



The 1st Thailand-Japan
International Academic Conference (TJIA2008)

"From Research to Sustainable Development"

Organized by
Thai Students' Association in Japan
under Royal Patronage (TSAJ)



Presented by





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Library Catalogue
ISBN 978-974-312-139-5

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Published in October 2008 by
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Printed by ET Publishing Co., Ltd.
Bangkok, THAILAND
Tel : +66-2731-0587, +66-2731-1803

Sponsors



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Tokyo, Japan



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Welcome Message

The 1st Thailand-Japan International Academic Conference (TJIA2008) is one of the missions of Thai Students' Association in Japan (TSAJ) to modernize the academic activity promoting the co-evolution of research and technology internationally. It consists of an academic cooperation between Thailand and Japan, which creates network among multidisciplinary of researchers, national institutions for innovation, industries, and societies forward the sustainable development perspective – the core objective of the conference.

Recently, there are more than two thousands of Thai students and researchers studying in Japan and those numbers tend to increase progressively. The degree of utilization of their outcome knowledge into the community should be taken into account. For this reason, the TJIA2008 conference aims to gather and present the researches done by Thai students and researchers, who are studying in Japan and connect their academic research to the national institutions and industries. More significantly, the students and researchers from Thailand and around the world are also expected to participate in order to exchange and transfer knowledge and technology under the theme of “From Research to Sustainable Development”.

Indeed, the participants in the conference come from several fields, namely, Natural Sciences and Technology, Life and Health Sciences, and Humanities and Social Sciences discipline, so that it can generate an interdisciplinary community conducting the new integration of solution for sustainable development. Furthermore, the conference is able to consolidate the students and researchers who are studying forwards sustainable development and create those directories and knowledge databases, which can be applied as an important resource for further development perspectives.

Gratefully, we, as the Thai students, are deeply appreciated in the collaboration from honorable advisory committee those who come from Royal Thai Embassy, institutions and universities from both Thailand and Japan. In the mean time, we are very thankful to Dr. Tej Bunnag and Presidents from JTECS, Tokyo Tech (Bangkok office), TRF, NSTDA and NIA for coming and giving a special talk, which will be a great opportunity for the participant to have guideline for living up his/her research on the philosophy of sustainable development and realistic application.

Lastly, on behalf of the TJIA organization, we warmly welcome you to the TJIA2008 and hopefully the conference will underscore the importance of sustainable development into your research and illustrate the transformation of your research into the benefits of community and future generation.

Patima Sinthupinyo
Chairperson
Tokyo Institute of Technology

Message from Ambassador



I highly commend the Thai Students' Association in Japan (TSAJ) for the initiatives to organize the 1st Thailand Japan International Academic Conference 2008 at the Tokyo Institute of Technology (Tokodai). The Conference, at its inception in 2006, was meant to be an exercise for academic exchange among Thai and Japanese students / researchers in Japanese universities.

The Royal Thai Embassy was in full support of this initiative, believing that it would contribute to the enhancement of closer bilateral cooperation, notably among the young intellectuals of the two countries who are responsible for the future of Thailand-Japan partnership in the 21st century.

A second conference followed in 2007, again with brilliant success, and Mr. Tanyanuparb Anantana, the current President of TSAJ, has approached the Royal Thai Embassy for support for the third conference in 2008, but this time the participation has expanded from bilateral to international level. The initiative is supported by the Thailand Research Fund, the Thai National Science and Technology Development Agency and the Thai National Innovation Agency whose directors and presidents are among us today.

This year Conference is yet another testimony of the continuous usefulness and resourcefulness of the TSAJ which is one of the oldest Thai students' associations overseas. TSAJ has in fact lived up to expectations.

Today, we are honoured by the presence of distinguished speakers, namely Mr. Masafumi Sato, Executive Director of Japan-Thailand Economic Cooperation Society, Prof. Toyosaka Moriizumi, Director of Tokyo Institute of Technology (Thailand), Dr. Piyawat Boonlong, Director of the Thailand Research Fund, Dr. Sakarindr Bhumiratana, President of National Science and Technology Development Agency, and Dr. Supachai Lorlowhakarn, Director of National Innovation Agency in the plenary session. Along with these scholars, Dr. Tej Bunnag, former Minister of Foreign Affairs of the Kingdom of Thailand will share his thoughts, on the theme "His Majesty the King and the Development of Thailand".

I also wish to commend the President of Thai Students' Association in Japan and the organizing team for their commitment and hard work. Finally, I have great hope that the participants here today will gain knowledge and valuable insight that will enable you to go back and contribute meaningfully to the development of your countries. With this in mind, I wish all of you every success.

Suvidhya Simaskul
Ambassador of Thailand to Japan
Royal Thai Embassy, Tokyo

Honorable Keynote Speaker

Dr. Tej Bunnag

*Assistant Secretary-General for Administration The Thai Red Cross Society
former Minister of Foreign Affairs of Thailand*

Date of Birth: 25 November 1943

Marital Status Married Mrs. Phensri Bunnag (Amatayakul) - one daughter

Education:

- Royal Thai Government Scholar (outstanding former RTG scholar 2008)
- Minor Scholar, Malvern College, Worcestershire, UK
- 1965 - Exhibitioner, B.A.(Hons), King's College, Cambridge University, UK
- 1966 - M.A., Cambridge University, UK
- 1969 - D.Phil., St. Antony's College, Oxford University, UK

Career:

As of 1 October 2008

Assistant Secretary-General for Administration, the Thai Red Cross Society

26 July - 3 September 2008

Minister of Foreign Affairs

2004 Advisor, Office of His Majesty's Principal Private Secretary

2001 Permanent Secretary for Foreign Affairs, Bangkok

2000 Ambassador Extraordinary and Plenipotentiary of Thailand
to the United States of America

1996 Ambassador Extraordinary and Plenipotentiary of Thailand
to France and Permanent Representative of Thailand to UNESCO

1990 Ambassador Extraordinary and Plenipotentiary, Permanent Representative of Thailand
to the United Nations Office and to the GATT, Geneva, the Swiss Confederation

1986 Ambassador Extraordinary and Plenipotentiary of Thailand
to the People's Republic of China and to the Democratic People's Republic of Korea

1984 Deputy Permanent Secretary, Office of the Permanent Secretary

1983 Ambassador Attached to the Ministry, Office of the Permanent Secretary

1980 Deputy Director-General, Office of the Director-General, ASEAN – THAILAND

1979 Director of Economic and Financial Policy Division,
Office of the Director-General, ASEAN - THAILAND

1976 First Secretary, Royal Thai Embassy, Jakarta, Republic of Indonesia

1973 Chief, East Asia Division, Department of Political Affairs

1972 Second Secretary, East Asia Division, Department of Political Affairs

1969 Joined the Ministry of Foreign Affairs as Second Secretary, Department of Information

Decorations:

2004 Knight Grand Commander (Second Class, higher grade)
of the Most Illustrious Order of Chula Chom Klao
The Red Cross Awards Medal (First Class)

2003 Knight Commander (Second Class) of the Most Admirable Order of the Direkgunabhorn
1994 Chakrabarti Mala Medal

1992 Knight Grand Cordon (Special Class) of the Most Exalted Order of the White Elephant

1987 Knight Grand Cordon (Special Class) of the Most Noble Order of the Crown of Thailand

Foreign Decorations:

- 2004 Grand Cross of the Order of Orange -Nassau, Netherlands
- 2003 The Most Honourable Order of Seri Paduka Mahkota Brunei S.M.B., Brunei Darussalam
- 2002 Commander Grand Cross of the Royal Order of the Polar Star, Sweden
- 2000 Grand Officier de l'Ordre Nationale du Merite, France
- 1991 Gran Croce dell' Ordine al Merito Melitense, Sovereign Military Order of Malta
- 1989 Gran Officiel de la Orden del Condor de Los Andes, Bolivia
- 1972 M.V.O. (5th Class), UK

Other Positions Held:

- Chairman of the Board of Trustees, Asian Institute of Technology
- Co - Chairman of Thailand – Cambodia Commission on Promotion of Cultural Cooperation
- Chairman of Thailand – Cambodia Cultural Association Committee
- Honorary Advisor of Mekong Institute Council
- Chairman of Mekong Institute Foundation
- Chairman of Bangkok Patana School Foundation Board
- Honorary Chairman of the Advisory Board, Mekong Organization for Mankind
- Secretary - General, Thai – Lao Association for Friendship
- Member of the University Council, Khon Kaen University
- Advisor, the Social Science Association of Thailand
- Advisor of Southeast Asian Studies Programs, Faculty of Arts, Thammasat University
- Member of the Executive Committee of Princess Maha Chakri Sirindhorn Anthropology Centre
- Member of the Policy Board of the Thailand Research Fund
- Chairman of the Eisenhower Fellowships' Nominating Committee in Thailand
- Member of the Governing Board of the Pridi Bhanomyong International College, Thammasat University

Publications

- The Provincial Administration of Siam 1892 –1915
(Oxford University Press, East Asian Historical Monographs, Kuala Lumpur, 1977)
- Thai language translation of the above
(Thammasat University Press, Bangkok 1989; reprinted 2005)
- Collection of articles on Unrests in Siam in 1902
(Social Science and Humanities Textbooks Project, Bangkok, 1981; third reprint 1990; fourth reprint forthcoming)

Honorary Distinction

- 1999 Outstanding Executive Civil Servant
- 2007 Honorary Doctorate of Education for Locality Development,
Bansomdejchaopraya Rajabhat University
- 2007 Honorary Member of the Siam Society under Royal Patronage

Keynote Speech

“His Majesty the King and the Development of Thailand”

Dr. Tej Bunnag

*Assistant Secretary-General for Administration The Thai Red Cross Society
former Minister of Foreign Affairs of Thailand*

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Introduction: The Developer King

His Majesty King Bhumibol Adulyadej is the ninth King of the Chakri Dynasty, which has been ruling Thailand since 1782. His Majesty King Bhumibol Adulyadej ascended the throne on 9th June 1946 and he has been working for his people throughout his reign. He is surely the first Thai monarch to have visited every region of the country. Starting in 1952, His Majesty, accompanied by Her Majesty Queen Sirikit, visited the least developed areas in different parts of Thailand to see for Themselves how their people lived. His Majesty’s desire to visit the people in all places, regardless of terrain or personal inconvenience, was not just to follow the royal tradition or for his own pleasure he did so because he wanted to learn how the people lived, to share their experience, and to learn directly of their plights and needs, so that he may utilize all the resources available to answer their needs and improve their living condition.

His Majesty truly deserves to be called the Developer King, for He is truly dedicated to help relieve the people’s hardship, raise their living standard and enhance their quality of life. This can be seen in pictures of His Majesty walking through rough and dusty countryside or flooded areas, and the pictures of him kneeling down to talk to the people, or leaning with his back against a wooden wall or the wheel of a vehicle. Thai people and foreigners in Thailand would also be familiar with pictures of His Majesty’s carrying a camera, a map, a notebook and a pen or pencil to record every detail of each visit. All this information would be stored in his personal “data bank” for follow-up action.

After studying thoroughly the information collected, both from personal interviews with the people and from the data provided before consulting the concerned officials and academics for confirmation and support, His Majesty would integrate his refined and organized development philosophy, with pros and cons, to ensure that a strong foundation has been laid before proceeding further to other stages or higher levels of development. Then His Majesty would pass on the initiatives to be considered by the government. His Majesty once said that “A royal project is a royal opinion. If a royal opinion cannot be touched, it would mean that Thailand cannot progress.”¹ By saying so, His Majesty’s emphasized that his initiative is only a suggestion or idea to be examined, analyzed and tested by the government, if it so wishes.² His Majesty has no intention to compete with the government, but to help them work for the betterment of the country.

Background and Problems: Origination of the Royal Development Projects

It was during many royal visits to the rural areas, where the majority of the Thai people live and carry out their occupations, that His Majesty realized the need to initiate the Royal Development Projects to improve the general well-being and standard of living of the people. At the same time, His Majesty became aware of the problems concerning the misuse of natural resources in the country. As a result, His Majesty initiated development projects which integrate the utilization of resources for the benefits of the people with that of environmental protection, in order to achieve sustainability.

Procedures of the Implementation of the Royal Development Projects

1) Study of information: Before His Majesty the King visits a particular area, he will study the information from documents and maps in order to learn about the local conditions.

2) On-site information gathering: When His Majesty arrives at a site, he will collect more information for facts and the latest data by:

2.1 interviewing the local people with regards to occupations, conditions of the villages, as well as climatic conditions and water sources;

2.2 conducting a survey of the location of the project to identify potential development;

2.3 discussing the matters with concerned officials. After studying the documents and the survey, His Majesty meets with concerned officials to discuss the possibility of the project in terms of expected benefits and cost-effectiveness.

3) Study and drafting of project: From His Majesty's initiatives, the agencies concerned will seek more information to plan the operation or draft the master plan consistent with His Majesty's initiatives.

His Majesty always insists that his initiatives are only suggestions. After his initiatives have been stated, the concerned government agencies have the task of studying and analyzing them with consideration based on technical feasibility. If the proposed projects are regarded feasible in terms of benefits and cost-effectiveness, the government may implement the project. By contrast, if the projects do not seem suitable in whatever way, the government has the right to abandon them.

4) Implementation: If His Majesty's initiatives are feasible, the Office of the Royal Development Projects Board will coordinate with various agencies and assign them to draft the details of the plans and projects. Afterwards, the Office will study and analyze the proposed plan and budget for use in the operation in order to make sure that they will be implemented effectively and in line with the objectives of the plan according to His Majesty's initiatives. In some cases, a central organization which consists of officials from the concerned agencies is established to be in charge of the task.

5) Monitoring and evaluation: After a period of project implementation by the agency, the Office of the RDPB will monitor and evaluate the work. In addition, His Majesty the King will return to the project site every time he has a chance, in order to monitor and observe the progress. If he encounters any problems or obstacles, he will give suggestions for the solutions.

Basic Principles of His Majesty's Approach to Development

The basic principles of His Majesty's approach to development can be summarized as follows :

1) Development activities should stress on an "integrated approach" in two aspects: integration of production systems and institutional integration of agencies. Several government agencies work together in one project to have the work done, as can be seen in the Royal Development Study Centers.

2) Development activities should be suitable for the area concerning geographical and socio-cultural environment.

3) Development activities should use simple technology which suits the particular physical environment and can be taken care of by the local people themselves.

4) Development activities should emphasize people participation, group formation and encouraging the people to be self-supporting.

His Majesty's concepts on the development of the country are popularised through short catchy titles, for use as working guidelines. These titles carry deep meaning as well as hint sometimes at the mode of operation. Here are some examples.

"Good Water Chases Bad"

His Majesty designed this concept to solve water pollution which is based on a management method in harmony with nature. The concept suggests the use of water to flush out and dilute polluted water in Bangkok's canals. The water gates regulating structures are opened and closed to allow entry of water at high tide and to drain the water out at low tide.

¹"Helping People to Help Themselves," King Bhumibol: Strength of the Land. Bangkok: Amarin Printing and Publishing, 2000. p. 150.

²King Bhumibol: Strength of the Land. Bangkok: Amarin Printing and Publishing, 2000. p. 150.

“The Natural Kidneys”

This is another example of His Majesty’s waste water treatment concept which has proved to be a simple and economical method of water treatment. For His Majesty the King, “public parks are regarded as lungs while small lakes are comparable to kidneys, cleansing the city’s blood. If they work poorly, we die. This principle should be understood.” According to this address, His Majesty’s idea was that, as large cities need “lungs”, or parks, the greenery of which purifies the air, so will it need a body of water that, by purifying polluted water, can act as “natural kidneys.” For better results, His Majesty combines this concept with the application of water hyacinth, an aquatic weed, to absorb toxins and other pollutants in the water.

“3 Tastes”

This is a system His Majesty created to solve some water problems. Southern Thailand, in particular, suffers from flooding, acidic water, and salinization which reduce agricultural yields. Here His Majesty recommended setting up systems that separate water of ‘3 tastes’. One system prevents acidic swamp water (taste 1) from contaminating agricultural lands, one system forestalls the encroachment of salt water (taste 2) and another system provides fresh water (taste 3) for agriculture, drinking and household needs.

“Aggravating the Soil”

This is a remedy for the problem that Southern Thailand faces. In Southern Thailand, there is strong soil acidity arising from high sulphur content that often prevents cultivation. “Aggravating the Soil” is a remedy His Majesty devised for the problem. The method consists of drying out and wetting the land alternately to accelerate the soil’s chemical reaction and raise the acidity to the maximum. The soil is then de-acidified through various techniques such as controlling the ground-water level to prevent the release of sulphuric acid, applying liming materials and washing away acidity with water. Selected crops are then introduced. Consequently, His Majesty’s techniques have turned wastelands into productive areas.

“3 Forests, 4 Benefits”

This idea involves integrating the need to conserve and to rehabilitate forest resources with socio-economic imperatives. To prevent forest destruction by farmers in search of wood, His Majesty suggests that three types of forest be planted to create four benefits. One type gives wood for household use one produces fruits, and the other fuel. Besides, these forests also enhance soil and water conservation and maintain humidity, bringing the total benefits to four.

“Reforestation without Planting”

This is another example that reflects His Majesty’s deep understanding of nature. His Majesty observed that forests grow naturally if people do not interfere with the process or destroy them by unconscious actions. If left alone, forests are self-regenerating. This is more productive than well-meaning but ill-understood reforestation campaigns that inadvertently introduce counterproductive methods, such as peeling off valuable soil surface or planting tree species unsuitable to the locality and the local ecology. Trees planted under such condition could die, not only without yielding benefits but entailing environmental damage. This profound concept led to the phrase “Reforestation without Planting.”

“Monkey’s Cheeks”

His Majesty devised this flood management system for Bangkok which suffered from heavy flooding for many years and called it “Monkey’s Cheeks”. His Majesty explained this system as follows:

“A monkey will, if you throw one a banana, open its mouth and swallow the banana whole and keep it in his cheek. A monkey can keep almost an entire bunch of bananas inside its cheeks. Only later will the monkey take the bananas out, chew and swallow them.”

His Majesty applies this observation to flood management by :

1. Diverting water from the north of Bangkok to be stored in large canals near the sea. This canal will be filled with water like a monkey’s cheeks at times of high water.
2. Opening the watergates in the canals when the sea level drops below that of the water in the canals to let the water flow by gravity.
3. Pumping out the water to the sea from the monkey’s cheeks if it reaches the lowest points of those canals and reducing the level of flooding by allowing water to be flowing down the canals at all times.
4. Closing the watergates when the sea level rises above that of the water in the canals to prevent water from flowing back into them.

This project helped the country particularly in 1995 when a big flood inundated Bangkok and its metropolitan areas, and is still capable of preventing flooding to the present day.

“Vetiver: Miracle Grass”

This is His Majesty's concept for soil improvement. He once said, “The important point is to conserve the topsoil, which is rich in nutrients. It should not be “peeled” off. The existing perennial trees should be preserved to maintain the moisture in the soil.” Regarding this concept, His Majesty uses Vetiver grass to conserve and to improve the soil which His Majesty introduced and adapted from longstanding practices. His Majesty found ways to make the most effective use of the grass according to differing local topographical conditions. On steep slopes along gullies, hills, the edges of new ponds, and roadsides, vetiver should be planted in contour lines across the slopes or in a semi-circle around each tree facing uphill in order to reduce soil erosion. For a deeply eroded gully, resulting from gushing flow of water, the technique is to grow vetiver across the gully in a shape of an arrow head or inverted ‘V’ shape facing against the direction of the water flow to disperse water. On flat land, vetiver is also cultivated between the rows of crops to preserve soil moisture. The success of these initiatives has been recognized around the world and led the International Erosion Control Association to present His Majesty with its International Merit Award for excellent work as a soil and environment conservationist in 1993.

“The Chaipattana Aerator”

Beside being a great developer, His Majesty is also an inventor who helps to revitalize polluted water to become clear. It may be hard for some people to believe that a monarch can invent a machine which has become internationally accepted, namely the “Chaipattana Aerator,” a floating mechanical surface aerator, which His Majesty designed and commissioned the Royal Irrigation Department to build for waste water treatment. This device is equipped with propellers to drive and churn the water into a fine spray for thorough aeration, quickly oxygenating the water. Now there are nine mechanical aerator models being tested for water pollution treatment appropriate for different areas. Among these, the Chaipattana Aerator Model RX-2 was given a patent in His Majesty's name on February 2, 1993. It was the world's ninth mechanical aeration device to be patented. It was also the first patent ever, in Thailand and in the world, to be registered and granted to a monarch.

The potential of the Chaipattana Aerator is not only accepted in Thailand but also worldwide. Several prizes were granted to His Majesty the King at the 49th Brussels Eureka Exhibition held in the Kingdom of Belgium in the year 2000. The organizer, the Belgian Chamber of Inventors, announced the reasons that, “The various prizes awarded today were issued not without thorough consideration. Inventions in every field must be applicable to widespread use and beneficial to the development of the quality of life and environment worldwide. Therefore the Chaipattana Aerator undoubtedly deserves the praise as the outstanding invention in this Event.”³

At the 49th Brussels Eureka 2000, the Chairman of the Belgian Chamber of Inventors requested His Majesty's consideration, after having awarded five prizes to the Chaipattana Aerator, for an aerator to be installed at Woluwe Saint-Pierre Park in Brussels. The purpose was to honor His Majesty's ingenuity in creating an invention which functions by simple and cost-saving technology and which is applicable to broad use, and beneficial to the improvement of the quality of life and the environment worldwide.

“The Royal Rain”

The Royal Rain is an artificial rain-making project initiated by His Majesty in 1986. His Majesty said, “...In 1955, I went to the Northeast in the dry season, in November...When I looked up at the sky, it was full of clouds. So why couldn't we pull down these clouds? I had heard about rain-making, so I remarked ‘Rain can be made. There are books on it. I've read that it can be done.’”

His Majesty's strategy in developing Royal Rain was systematic and scientific. His Majesty emphasized:

1. The need to develop and improve rain-making techniques in terms of design, operation, monitoring and evaluation, including using computers to study cloud formations and help rain-making operations achieve the goals.
2. The role of weather modification as an important component in water resource management by increasing the water volume in reservoirs, alleviating pollution and increasing water availability for public consumption.
3. The full cooperation and coordination among the government services and the agencies concerned as a key to success.

³The Chaipattana Foundation Journal. August 2003, p.42.

Classification of the Royal Development Projects

The Royal Development Projects can be classified into 8 categories.

- Agriculture Development
- Environment Development
- Public Health Development
- Occupational Promotion
- Water Sources Development
- Communications Development
- Public Welfare Development
- Others

From 1982 to today, more than 3,000 projects have been undertaken. Among them, water resources development projects constitute the largest proportion, followed by environment development and agriculture development. Up to the present, 96% of the projects is completed.

Royal Development Study Centers

His Majesty's approach to development of the rural areas has been passed on to farmers through the establishment of the Royal Development Study Centers.

During his visits throughout the country, His Majesty found that each region has its own problems. Therefore, he came up with the idea of setting up the Royal Development Study Centers in each region to conduct study and experiments to solve the problems of each area. Each Center would serve as "the Model of Success" to transfer the findings of the Centers for the farmers in the areas to follow in the form of a "living natural museum" because people can go to see demonstrations of development methods and techniques in various fields in order to acquire knowledge, adopt new and appropriate development methods concerning all aspects (water sources, land, forest, livestock, fishery) and receive occupational training in order to improve their livelihood. The objective is for the people to become self-reliant and self-confident. Each center serves as a "one-stop service."

With regards to operation, each center involves coordination within the government sector on project planning and management among different agencies and departments in order to render optimum benefits. Therefore, each center serves as the model of 'innovative administration and management.

At present, there are six Royal Development Study Centers situated in all regions of Thailand which carry out development activities according to local conditions.

1) Khao Hin Sorn Royal Development Study Center, in Chachoengsao Province in the Central Region. Earlier, the forest in this region was destroyed for settlement. The soil became sandy because of repeated cultivation of field crops. His Majesty saw the need to rehabilitate the soil and thus established the Center in 1979. Therefore the main activities of this Center focus on restoring soil fertility by promoting the use of green manure and legume crops.

2) Kung Krabaen Bay Royal Development Study Center in Chanthaburi Province in the eastern part of the Central Region. This area used to face the problem of mangrove forest destruction and seawater intrusion resulting in saline soil. His Majesty initiated the setting up of the Center in 1981 and suggested the studies and experiments to improve the coastal environment and to promote suitable methods of fishery.

3) Pikun Thong Royal Development Study Center in Narathiwat Province in the South. When His Majesty visited the people in the South, he found that a large area in this region was made up of swampland which contained poor quality acidic soil that could not be used for agriculture. Therefore, His Majesty initiated the establishment of this Center in 1982 to conduct studies and experiments to look for methods to improve soil quality.

4) Puparn Royal Development Study Center in Sakon Nakhon Province in the Northeast. The land in the Northeast was formerly sandy and saline and suffered from water shortage. The Center was established in 1982 as a place to conduct study and experimentation on appropriate development methods on various areas of agricultural development to provide models for the villagers to apply on their own land.

5) Huai Hong Khrai Royal Development Study Center in Chiang Mai Province in the North. There had been forest destruction which caused drought and forest fires in this region. The Center was therefore set up in 1982 for the development of watershed areas.

6) Huai Sai Royal Development Study Center in Phetchaburi Province in the southwestern part of the Central Region. The trees in this area had been cut down for sale and the land was cleared for cultivation. This led to irregular rainfall patterns causing the soil to become hard, easy to erode and no longer productive. In 1983, His Majesty advised that "If these conditions are allowed to continue, the place will become a desert" and initiated this Center to restore the balance of nature.

Sufficiency Economy and the New Theory

“Sufficiency Economy” is a philosophy that His Majesty the King had expressed in his speech as a guideline for the Thai people for more than 20 years before the economic crisis in the late 1990s. Until the year 1997, Thailand had set its development plans principally towards economic development aiming for material growth and wealth, the economic infrastructure was emphasized, but not the human infrastructure.

Sufficiency Economy stresses appropriate conduct and way of life while incorporating moderation, due consideration in all modes of conduct, and the need for sufficient protection from internal and external shocks. It requires the application of accurate knowledge, care and giving, mutual assistance, and collaboration. The aim is to create bonds which closely link people from all sectors and boost positive creative forces in order to lead to unity, balanced and sustainable development as well as readiness to cope appropriately with critical challenges occurring as a result of globalization. His Majesty’s philosophy stresses the middle path, as reflected in his speech given on December 4, 1997.

“To be a tiger is not important. The important thing for us is to have a self-supporting economy. A self-supporting economy means to have enough to survive.”

He pointed out the importance of step-by-step development of the nation because once a firm foundation has been laid, the people could have their basic necessities and then could enjoy higher levels of economic growth, as reflected in an excerpt from His speech given on July 18, 1974,

“...Development of the nation must be carried out in stages, starting with the laying of the foundation by ensuring the majority of the people have their basic necessities through the use of economical means and equipment in accordance with theoretical principles. Once a reasonably firm foundation has been laid and in effect, higher levels of economic growth and development should be promoted...”

Later, His Majesty the King added in the royal speech given on the occasion of His Birthday Anniversary on December 4, 1974 that it is not important whether Thailand would be accused of being old-fashioned what is important is the fact that we have enough to live and to eat.

“...no matter what others say – whether they will accuse Thailand of being old-fashioned or obscurantist. So long as we have enough to live on and to live for – and this should be the wish and determination of all of us – without aiming for the apex of prosperity, we shall already be considered as the top in comparison with other countries in the present world...”

The philosophy of Sufficiency Economy was the main principle in the Ninth National Economic and Social Development Plan which covers the period from 2002 to 2006. And the tool of demonstrating the concept of “Sufficiency Economy” is the “New Theory” integrated farming practice.

The New Theory is a set of systematic guidelines for proper management of land and water resources which ensures sufficiency economy for the farmers in order to enable them to become self-reliant, to have security in their occupations and to strengthen their families and communities by means of step-by-step development.

The complete New Theory agriculture has three stages.

First stage is sufficiency at the farm level which concerns the management of land by dividing a small piece of land into four parts of a ratio of 30: 30: 30:10 which can be adjusted to suit the condition of each area.

Part one, about 30% is designated for a pond for storing water and raising aquatic animals and plants. This pond will ensure water supply all year round.

Part two, about 30% is set aside for rice cultivation to ensure sufficient yields for daily consumption all year round, which will enable each family to cut down expenses and become self-reliant.

Part three, about 30% is used to grow fruit and perennial trees, field crops, vegetables and others which provide for daily consumption and the surplus can be sold.

And part four, about 10% is allocated for housing, raising animals and for other activities.

This stage will build a good basis for the people at the family level to become self-reliant to a certain level without taking advantages of others.

Second stage is sufficiency at the community level (cooperation among farmers) which suggests that farmers get together in groups or cooperatives and think together about what and how to produce crops, how to do marketing, and how to improve their own well-being and welfare. The aim is to enhance creative force among themselves which in turn helps strengthen the community, reduce the risk of impact from external factors and build connection with large-scale businesses, government agencies, as well as organizations.

Third stage is sufficiency at the national level (cooperation among cooperatives and investors) to assist the farmers in the investment for activities to improve the quality of their lives.

International Recognition

His Majesty's willful devotion to the needs of his people has been duly recognised by any international organizations and institutions, which have bestowed upon him numerous awards, including:

1. The Golden Medal of Outstanding Leadership in Rural Development by the Asian Institute of Technology on July 21, 1987
2. The Award of Honour for His Majesty's outstanding development work by the Rotary International on August 17, 1991
3. The Philae Medal for His Majesty's excellent work in rural development by the United Nations Educational, Scientific and Cultural Organization (UNESCO) on December 2, 1991
4. The Gold Medal of Distinction for His Majesty's outstanding work in the conservation of nature and environment by the United Nations Environment Programme (UNEP) on November 4, 1992
5. The Health-for-All Goal Medal for His Majesty's dedication towards the good health and well-being of Thai population by the World Health Organization (WHO) on November 24, 1992
6. The International Merit Award for His Majesty on the utilization of vetiver for soil conservation and environmental improvement by the International Erosion Control Association on February 25, 1993
7. The Specially-Commissioned Bronze Vetiver Sculpture as Award of Recognition of His Majesty's leadership in soil and water conservation by the World Vetiver Network on October 30, 1993
8. The Award of Appreciation in Recognition of Outstanding Contributions in the Field of International Drug Control by the United Nations International Drug Control Programme on December 12, 1994
9. The Agricola Medal in recognition of His Majesty's work in agricultural organization on December 6, 1995
10. The International Rice Awards by the International Rice Research Institute (IRRI) on June 5, 1996
11. The Partnering for World Health Award by the American College of Chest Physicians on November 13, 1996
12. The Presidential Award for Humanitarian Service by the Rotary International on October 24, 1996
13. The International Humanitarian Award by the Lions Clubs International on March 3, 1999
14. Telefood Medal by the Food and Agriculture Organization (FAO) on December 8, 1999
15. UN-HABITAT Scroll of Honour Award (Special Citation) by United Nations Human Settlement Programme (UN-HABITAT) on February 25, 2004

And many more.

At the 49th Brussels Eureka Exhibition in 2000, His Majesty's Chaipattana Aerator Model RX-2 was awarded five prizes as follow.

1. Minister J. Chabert Trophy for outstanding invention
2. Grand Prix International by the International Council of the World Organization of Periodical Press
3. Prix OMPI Femme Inventeur Brussels Eureka 2000
4. Yugoslavia Cup to honour His Majesty's talent
- And 5. Gold Medal with Mention for His Majesty's effective use of technology by the Committee of Brussels Eureka 2000

Later, in the following year, at the 50th Brussels Eureka Exhibition in 2001, His Majesty was bestowed more awards as follow:

1. Gold Medal with Mention for His Majesty's Bio-diesel Project
2. Gold Medal with Mention for His Majesty's New Theory Project
- And 3. Gold Medal with Mention for His Majesty's Royal Rainmaking Project

The former Secretary-General of the United Nations Organization, Kofi Annan, presented His Majesty with the first United Nations Development Programme's Human Development Lifetime Achievement Award in May 2006, just before the Kingdom celebrated the 60th anniversary of His Majesty's accession to the Throne.

Conclusion

Throughout His glorious reign, the longest in recorded Thai history, His Majesty is the guiding light for the Thai people in every aspect of life. As the Kingdom celebrated His Majesty's 80th Birthday at the end of 2007, His Majesty remains the great Developer, whose development work has inspired the whole country and brought peace and stability to the Thai nation.

Message from President of Tokyo Institute of Technology

A president of Tokyo Institute of Technology, I am delighted to extend a warm welcome to all participants on the occasion of the first Thailand-Japan International Academic Conference which is held at Tokyo Institute of Technology (Tokodai). It is a great honor to have distinguished guests, scholars and students from various locations to join this assembly which has been developed from a series of the annual academic conference initiated by the Thai Students' Association in Japan under Royal Patronage.

With remarkable achievements, Tokodai has been actively collaborating with Thailand for many decades on both academic exchange and research co-operation. We are proud of having 52 Thai students (as of May, 2008) currently studying in our institute in various fields of science and technology. As being a world class university, Tokodai continues to strengthen an active role to promote high qualified human resource development in science and technology for the region. In close cooperation with National Science and Technology Development Agency (NSTDA), we have been a partner with a number of Thai universities on establishing the joint graduate program of Thailand Advanced Institute of Science and Technology (TAIST). Last year, the grand opening ceremony of TAIST - Tokyo Institute of Technology was celebrated, following by a launch of Master of Engineering program in Automotive Engineering (AE). Also, this year is our first year of co-operating the international graduate program in Information and Communication Technology for Embedded Systems (ICTES).

I am paying attention to sustainable development in Thailand which is the main theme of this conference. Science and technology, human resource development and empowerment of people are the keys to achieve this perspective. I sincerely believe that this conference will provide an excellent basis for all participants to share their research accomplishments and exchange their ideas and hope that the fruitful results will contribute to successful knowledge integration on ways to the objectives of the conference.

I would like to express my sincere congratulations to organizing committee members. I wish all the participants every success in deliberations and have pleasant time in this occasion.

Kenichi Iga
President
Tokyo Institute of Technology

Committee

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Prof. Kenichi Iga

Prof. Toyosaka Moriizumi

Prof. Takao Enkawa

Mr. Masafumi Sato

Prof. Piyawat Boonlong

Assoc. Prof. Sakarindr Bhumiratana

Dr. Supachai Lorlowhakarn

H.E. Ambassador, Royal Thai Embassy, Tokyo

President of Tokyo Institute of Technology

Director of Tokyo Tech Office (Thailand)

Chairman of the Japanese Society for Quality Control (JSQC) and
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Executive Director of Japan-Thailand Economic Cooperation Society
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General Information

Nowadays, more than 2,000 of Thai students have been studying in Japan. During their period of studies, lots of academic research have been produced which could contribute to Japan industry and Thailand society, as well. From this regard, in the year of 2006, the 1st Thai-Japanese Students' Academic Exchange Meeting (TJSE) conference was initiated by Osaka University and organized by Thai Students' Association in Japan under Royal Patronage (TSAJ). Then, the 2nd TJSE was set up in the following year of 2007 at Osaka University. For this year (2008), developing from the 1st and 2nd TJSE conference, The 1st Thailand-Japan International Academic Conference (TJIA2008) will be held at Tokyo Institute of Technology. The TJIA2008 is expected to be an official international conference which will link Thai and Japanese students, researchers as well as professionals to have an opportunity in exchanging knowledge, learning and practice together.

The theme "*From Research to Sustainable Development*" has been set up in the TJIA2008 in order to encourage researchers from multiple disciplines and professions to create and carry out their researches living up to the dynamism of co-evolution of multifaceted functions towards the national sustainable development strategy. Apart from academic conference and cooperation for both countries, the conference aims to link network among multidisciplinary of researchers, national and academic institutions and industries forward the sustainable development perspective. The conference would also expect to generate an interdisciplinary community, promoting new integrated solution for sustainable development. In addition, the conference would consolidate Thai students and professionals who are studying and working in Japan to create those directory and knowledge database which could be an important resource for research, resulting in the great contribution to develop Thailand in the future.

Objectives

In accordance with the theme of “From Research to Sustainable Development”, objectives of the conference are as followings:

1. To broaden viewpoint and establish academic research connections for sustainable development and real application which is needed by policy maker (national institutions) and user (industry sector) in Thailand.
2. To gather and present the researches (that make a contribution to Thailand) which are conducted by Thai-Japanese students, researchers, and professionals.
3. To create academic network collaboration among Thai – Japanese students and researchers.
4. To promote both the exchange and transfer of knowledge, learning, practice, and technology between Thailand and Japan.

Scope of the Conference

The conference will be carried out in both oral and poster presentations as following sessions:

1. Natural Sciences and Technology (Engineering, Science and Technology etc.)
2. Life and Health Sciences (Biology, Biotechnology, Agriculture, Food Science and Technology, Medicines, Pharmaceuticals, Dentistry, Nursing etc.)
3. Humanities and Social Sciences (History, Humanities, Linguistics, Culture, Art and Design, Economics, Business Administration, Laws, Political Science etc.)

Main Activities

Main activities of this conference include oral and poster presentations, keynote speech, plenary session, special seminar, and company profile introduction and job fair.

For the oral and poster presentations, participants from various field of studies will present their research output concerning the theme “*From Research to Sustainable Development*”. The works also comprise of applicable concept aimed to achieve national sustainable development in Thailand. The keynote speech given by Dr. Tej Bunnag, will outline on the title “*His Majesty the King and the Development of Thailand*”

In the plenary session, the distinguished guests from the recognized institutes both in Thailand and Japan, will address on the same theme of the conference. Furthermore, there will also be special seminar regarding the topic “*Role and Opportunity for Thai Students after Graduated from Japan*” which is bound to be interested by all attendant.

In addition, several companies will be attending the session of job fair in order to promote the organization and provide an opportunity for participants who are searching for job after graduation to submit their resume.

Official Language: English

Provisional Programs

November 21st (Friday), 2008Conference Venue: West 1 Building and West 9 Building,
Tokyo Institute of Technology (Ookayama Campus)

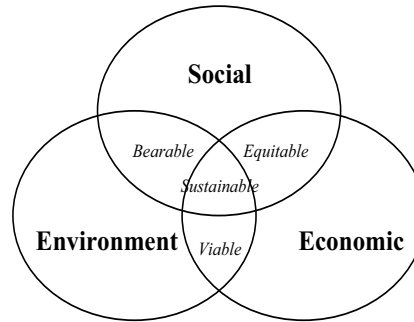
Time	Program	Venue
08:00 – 09:00	Registration	Entrance Hall
09:00 – 09:10	Opening Ceremony Welcome speech by Prof. Kenichi Iga President of Tokyo Institute of Technology	Conference Room 1
09:10 – 09:20	Opening speech by Mr. Suvidhya Simaskul H.E Ambassador, Royal Thai Embassy, Tokyo	
09:20 – 10:00	Keynote Speech “His Majesty the King and the Development of Thailand” by Dr. Tej Bunnag Assistant Secretary-General for Administration The Thai Red Cross Society former Minister of Foreign Affairs of Thailand	
10.00 – 12.00	Plenary Session “From Research to Sustainable Development” Mr. Masafumi Sato Executive Director of JTECS Prof. Toyosaka Moriizumi Director of Tokyo Tech Office (Thailand) Prof. Piyawat Boonlong Director of TRF Assoc. Prof. Sakarindr Bhumiratana President of NSTDA Dr. Supachai Lorlowhakarn Director of NIA	Conference Room 1
12:00 – 12:45	Lunch Break	Sakura tree rows in front of the Main Building (In case of rain, Conference Room 2 and W1 Building’s rooms will be used)
12:45 – 14:00	Company Profile Introduction and Job Fair Siam Cement Group, NDR, JAC Recruitment Thailand, Pasona Global, C.S.I. Group, Adecco, Singha Corporation Co., Ltd., Mitsui & Co. (Thailand) Ltd.	Conference Room 1
14:00 – 15:30	Oral and Poster Presentation Session Oral Presentations #1 Including invited talk by Prof. Hiroaki Kunieda Tokyo Institute of Technology Prof. Akinori Nishihara Tokyo Institute of Technology	Conference Room 1-4
15:30 – 16:15	Poster Presentations Coffee Break	Entrance Hall Conference Room 1-4
16.15 – 18.00	Oral Presentations #2 Including invited talk by Assoc. Prof. Siriporn Wajjwalku Thammasat University	
18:00 – 18.45	Special Seminar “Role and Opportunity for Thai Students after Graduated from Japan” Dr. Samran Chooduangngern Vice President of OJSAT Dr. Vichai Saechout President of ATPIJ Dr. Paritud Bhandhubanyong Former Director of MTEC	Conference Room 1
19:00 – 20:30	Banquet and Exchange Activities	Cafeteria in W12 Building, the 2nd floor

Theme Article: From Research to Sustainable Development

“Development that meets the needs of the present without compromising the ability of future generations to meet their own needs.”

Definition by Brundtland Commission, 1987

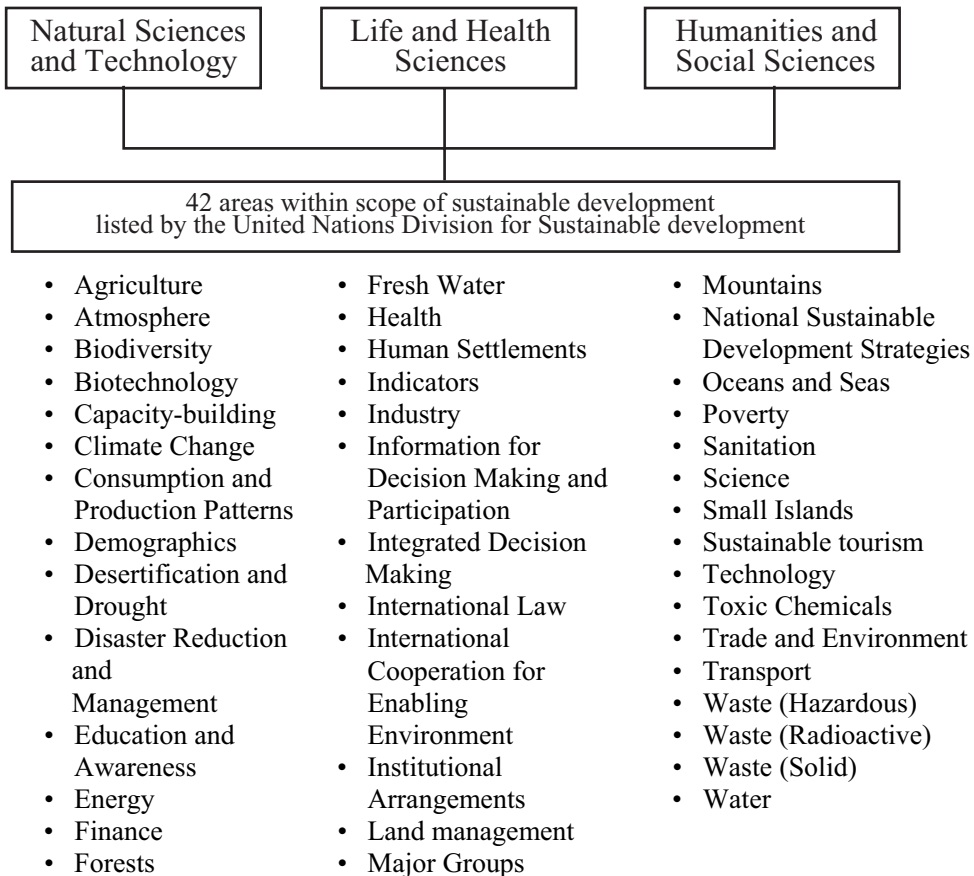
The 2005 World Summit Outcome Document refers to *"interdependent and mutually reinforcing pillars"* of sustainable development as economic development, social development, and environmental protection.



Scheme of sustainable development at the confluence of three preoccupations.

It motivated the concept of the 1st Thailand-Japan International Academic Conference as a multidisciplinary approach to sustainable development

“From Research to Sustainable Development”



Plenary Session and Special Seminar

Plenary Session

(10:00 – 12:00)

“From Research to Sustainable Development”

Mr. Masafumi Sato

Executive Director of Japan-Thailand Economic Cooperation Society (JTECS)

Prof. Toyosaka Moriizumi

Director of Tokyo Tech Office (Thailand)

Assoc. Prof. Sakarindr Bhumiratana

President of the National Science and Technology Development Agency, Thailand (NSTDA)

Dr. Supachai Lorlowhakarn

Director of National Innovation Agency, Thailand (NIA)

Prof. Piyawat Boonlong

Director of the Thailand Research Fund (TRF)

Special Seminar

(17.00 – 18.30)

“Role and Opportunity for Thai Students after Graduated from Japan”

Dr. Samran Chooduangngern

Old Japan Students' Association, Thailand (OJSAT)

Dr. Vichai Saechout

Institute of Technologists

Dr. Paritud Bhandhubanyong

National Metal and Materials Technology Center (MTEC)

Keynote Speaker



Mr. Masafumi Sato

Executive Director
Japan-Thailand Economic Cooperation Society (JTECS)

Education

<i>University</i>	The University of Tokyo, Japan (from April 1963 to March 1967) Bachelor of Mechanical Engineering
<i>Advanced Management Consultancy Course</i>	Research Institute for Management Science (RVB), Netherlands (from September to December 1980)

Work Experiences

- From April 1967 to January 1973:
Training Officer,
The Association for Overseas Technical Scholarship [AOTS]
- From February 1973 to August 1977:
Training Adviser to Secretary General,
Technology Promotion Association [Thailand-Japan], Bangkok, Thailand
- From September 1977 to August 1983:
Manager in charge of Management Training Programs,
The Association for Overseas Technical Scholarship [AOTS]
- From September 1983 to July 1987:
Industrial Development Officer,
The United Nations Industrial Development Organization [UNIDO],
Vienna, Austria
- From August 1987 to June 1998:
Manager, Overseas Affairs Division,
The Association for Overseas Technical Scholarship [AOTS]
- From July 1998 to October 1998:
Director and General Manager of Overseas Affairs Division,
The Association for Overseas Technical Scholarship [AOTS]
- From November 1998 to January 2005:
Executive Director,
The Association for Overseas Technical Scholarship [AOTS]
- From February 2005 to present:
Executive Director, Japan-Thailand Economic Cooperation Society [JTECS]
- From February 2007 to present:
Advisor, The Association for Overseas Technical Scholarship [AOTS]

36 Years of JTECS-TPA Cooperation
- Learn Together, Think Together, and Proceed Together -

Masafumi Sato

Japan-Thailand Economic Cooperation Society (JTECS)

Tel: 03-3946-0841, Fax: 03-3946-0896, E-mail address: m-sato@jtecs.or.jp

1. Start of JTECS and TPA

JTECS was established in July 1972 with the idea of Japanese government that worried about the anti-Japanese movement in Thailand in order to cooperate with TPA to be established by Japanese alumni in Thailand, i.e., ABK & AOTS Alumni Association of Thailand to “work really for Thailand”.

Before starting TPA, Thai representative and Japanese parties concerned agreed on the followings:

- (1) The independence of TPA operation should be respected to achieve the objective to “work really for Thailand”,
- (2) Japan will build a TPA office building in Thailand,
- (3) Japan will build a technical training school in Thailand in future,
- (4) Japan will communicate with TPA through JTECS,
- (5) Japan will help to setup an independent financial foundation for TPA to be free from Japanese subsidy and develop fully independent administration.

Human Ties as the Foundation

Since JTECS was established under the above background, those Japanese who serve for the work should never forget to humbly question “whether or not they were spoiling the independence of TPA”, and if “they were introducing benefits for Japan rather than prosperity for Thailand”.

This work will keep life and develop only if it is promoted for the independence and prosperity of Thailand, based on the initial agreements founded on the profound human ties between Thailand and Japan.

Goichi Hozumi (Founding President of JTECS, 1972)

2. Outline of JTECS and TPA activities

3. Supporting organization for JTECS, TPA & TNI

4. Financing of JTECS-TPA cooperation programs

5. Success factors for JTECS-TPA cooperation

- (1) Visible grass-level cooperation through old students and trainees who are familiar with both societies,
- (2) Strong human network among TPA directors, members, staffs, and JTECS members with equal partnership spirit,
- (3) Strategic selection of competitive activity areas, such as (i) Practical language lessons, (ii) Publication in industrial, managerial and cultural fields, (iii) Calibration and inspection of measuring equipments, (iv) Technical and management training for SMEs, (v) Promotion of IT, etc.,
- (4) Respect of autonomy in planning and management,
- (5) ODA funding for private organization with ownership,
- (6) Accountability and transparency to be supported by governments and public organizations

6. Reviewing JTECS-TPA cooperation in 36 years - An example of sustainable development

7. Further expectations to TPA & TNI

- (1) Response to immediate needs, and HRD for the future
- (2) Strategic identification of competitive areas for future industrial development
- (3) Strengthening of partnership with Japan in the intellectual and knowledge field
- (4) Further development of human network
- (5) Support to less developed countries and regional cooperation by applying TPA model.

Keynote Speaker



Toyosaka Moriizumi
Director
Tokyo Tech Office (Thailand)

Education

- 1969 Doctor of Engineering, Tokyo Institute of Technology
- 1966 Master of Engineering, Tokyo Institute of Technology
- 1964 Bachelor of Engineering, Tokyo Institute of Technology

Work Experiences

- 1969-1973 Research Associate, Faculty of Engineering
- 1973-1985 Associate Professor, Faculty of Engineering, Tokyo Institute of Technology
- 1985-1988 Professor, International Cooperation Center for Science and Technology, Tokyo Institute of Technology
- 1988-2005 Professor, Faculty of Engineering, Tokyo Institute of Technology.
- 1994-1996 Director of International Cooperation Center for Science and Technology.
- 1996-1997 Director of Research Center for Quantum Effect Electronics.
- 1997-1999 Senator, Tokyo Institute of Technology
- 1999-2001 Vice President (Provost), Tokyo Institute of Technology
- 2005 Professor Emeritus, Tokyo Institute of Technology
Director of Tokyo Tech Office (Thailand)

***From Research to Sustainable Development
-Aim of TAIST Tokyo Tech-***

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There is a clear difference between Thailand and Japan concerning student behaviors. Thai students hope to study abroad, while Japanese students study domestically. I think from an educational point of view that the trends, which are extremely different from each other, might offer a good trade-off between them. Frankly speaking, if more excellent Thai students study in Thai graduate schools (especially in the PhD programs), better research works could be output from Thai universities, enhancing the academic potentials. If more Japanese students study in foreign countries, Japanese academic societies would become more international, giving deep and wide impacts to globalize their society.

TAIST Tokyo Tech (Thailand Advanced Institute of Science and Technology Tokyo Institute of Technology) is an international joint graduate school (for master programs so far) and is built by the collaboration of NSTDA, Thai universities and Tokyo Tech. The purpose of it is to realize sustainable development of Thai industry by leveling up the research potential of Thailand. Since NSTDA and Tokyo Tech cannot have educational organizations, all the students are registered in the Thai universities, which confer the degrees on them. NSTDA and Tokyo Tech award them certificates. NSTDA provides the classrooms, research laboratories and scholarships to the students. Tokyo Tech sends the professors for lectures. Hence, TAIST Tokyo Tech is a virtual graduate school, but is now being authorized by the new law “Act on National Science, Technology and Innovation.”

TAIST Tokyo Tech plans to launch the following four Programs; i.e., Automotive Engineering (AE), Information and Communication Engineering for Embedded System (ICT-ES), Environmental Engineering (EnvE) and Bio Science and Technology (BIO) Programs. Each Program has not more than 30 students. Firstly, AE Program started last June, in which KMITL is the cooperative university and KMUTT will participate next June. ICTES Program is the second one (launched this June), in which SIIT and KU are the cooperative universities. EnvE Program will be founded next June, while the process for founding BIO Program has been suspended until the new administrative system is established according to the new law. Environmental consideration is essential for all of the advanced technological fields of AE, ICT and BIO Programs in conducting researches and developing human resources for sustainable development. Hence, all the Programs have the environmental courses in their curriculum so that EnvE and other three programs can form the structure of synergy.

Those master programs consist of the course study in the first year (lectured by Tokyo Tech professors and co-lectured by Thai professors) and the research study in NSTDA laboratories (supervised by Thai professors and co-advised by both NSTDA staff and Tokyo Tech professors). Since the research topics are selected from the NSTDA R&D projects, the students are trained in NSTDA laboratories, contributing to the research and are given wages as research assistants. Since NSTDA and Tokyo Tech are positive to make the collaboration with Thai industries (including Japanese companies in Thailand), TAIST Tokyo Tech could create a new type model of academic-industrial collaboration. The PhD programs would be launched after all the master programs are built.

May I conclude my talk, introducing our motto; “Born small, and grow big. Let’s work together to realize our win-win relation.”

Keynote Speaker

**Assoc. Prof. Sakarindr Bhumiratana**

President

The National Science and Technology Development Agency,
Thailand (NSTDA)***Education***

Postdoctoral Project Associate at University of Wisconsin under the Supervision of Prof. R.B. Bird (1975-1976). Research area: Dynamic of Polymeric Fluid.

Ph.D., University of Wisconsin-Madison, under the supervision of Prof. C.G. Hill, Jr. (Sept. 1975).

Research topic: Enzymatic Solubilization of Insoluble Fish Protein Concentrate :

A Kinetic and Membrane Reactor Study.

B.S. (Highest honor), Chemical Engineering, University of California, Davis (1971).

B.S. (Highest honor), Chemistry, University of California, Davis (1971).

Work Experiences

2004-present: President, National Science and Technology Development Agency (NSTDA)

2000-2004: Senior Specialist, National Center for Genetic Engineering and Biotechnology (BIOTEC), National Science and Technology Development Agency (NSTDA), Thailand.

2000-2004: Senior Vice President (Administrative Affairs), King Mongkut's University of Technology Thonburi (KMUTT).

1997-2004: Director, Chemical Engineering Practice School, KMUTT

2001-2004: Director, Rural Development Technology Services Unit, BIOTEC, NSTDA, Thailand.

1996-2007: Chairman, Board of Directors, Shrimp Culture Research and Development Co., Ltd.

1991-2000: Director, BIOTEC, NSTDA, Thailand.

1984-1994: Managing Director, Food Processing Plants, Royal Project and Royally Recommended Project.

1983-1996: Associate Professor Department of Chemical Engineering and Department of Food Engineering, King Mongkut's Institute of Technology Thonburi (KMUTT).

1986-1991: Deputy Director, National Center for Genetic Engineering and Biotechnology, Ministry of Science, Technology and Energy.

1987-1990: Associate Dean (Academic Affairs), Faculty of Engineering, KMITT.

1982-1986: Associate Dean (Academic Affairs), School of Energy and Materials, KMITT.

1979-1986: Chairman, Department of Chemical Engineering, KMITT.

1981-1988: Chairman, Division of Energy Technology, School of Energy and Materials, KMITT.

1979-1983: Assistant Professor, Department of Chemical Engineering, KMITT.

1976-1979: Lecturer, Assistant Professor, Department of Chemical Technology, Chulalongkorn University.

1975-1976: Post Doctoral Project Associate, University of Wisconsin (Chemical Engineering).

1971-1975: Research Fellow, Teaching Assistant, University of Wisconsin (Chemical Engineering).

1970-1971: Engineering Aide, University of California, Davis.

Research and Development for Sustainable Development in Thailand

Sakarindr Bhumiratana

National Science and Technology Development Agency

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In Thailand, research and development is required to meet many needs. These needs include basic research for human resource development; research directed towards the specific needs of the country and more advanced research to keep pace with key technologies. The major problem Thailand is facing is that currently the proportion of researchers per head of population is quite low when compared to countries like Korea and Taiwan. Also, there is the common problem of not enough funding for R&D.

Like most countries, Thailand has to adapt her R&D strategy in line with the changing global situation and the economic realities. There is pressure on industry to diversify and reduce production costs. There is also a need to add more value to agricultural produce, while contributing to the sustainability and self sufficiency of rural life. In addition, there is a need to make both industry and agriculture friendly to our environment.

Another element, not unique to Thailand, is the widening economic gap between a growing middle class and the poor. There is concurrently a widening gap between the urban and the rural population. Thus R&D needs to recognize these realities and be directed towards addressing the imbalance. One focus of R&D needs to be on helping to raise incomes and quality of life, particularly for the rural poor.

This paper will briefly describe the work of the National Science and Technology Development Agency (NSTDA) and how it is directed towards alleviating these issues. NSTDA has formed a number of research clusters in several key areas to achieve the aforementioned purpose.

Keynote Speaker

**Dr. Supachai Lorlowhakarn**

Director
National Innovation Agency, Thailand (NIA)

Education

- Ph.D. in Agricultural Technology (International Programme), Chulalongkorn University
- M.Sc. in Biological Science, Chulalongkorn University (1984)
- Certificate, The National Defense College of Thailand (2007)
- Certificate, The Capital Market Academy (2006)

Work Experiences

- Scholarly Member, Rajamangala University of Technology Bangkok Council
- Executive Board Member, College of Management, Suan Sunandha Rajabhat University
- Executive Committee, Stang Holding Company Ltd.
- Vice Chairman, Committee for MBA Innovation Management, Ramkhamhaeng University
- Executive Committee, Business Incubation Unit Programme, Commission on Higher Education
- Executive Member, Board of Intellectual Property Management, Ministry of Public Health
- Executive Member, Board of Research and Development for Industries, The Federation of Thai Industries
- Advisor, Board of Trade of Thailand
- Lecturer, Innovation Management and Human Resource Development for Innovation, MBA Innovation Management Programme, Ramkhamhaeng University
- Lecturer, Strategic Management, Suranaree University of Technology
- Former Director, Office of the Board of the Innovation Development Fund (IDF)
- Former Senior Director, Public Information Department, National Science and Technology Development Agency (NSTDA)
- Former Vice President, The Science Society of Thailand under the Royal Patronage
- Former Executive Committee, Foundation for the Promotion of Science and Technology under the Royal Patronage
- Former Managing Director, “ScienceAsia” Journal
- Former Researcher, Senior Technical and Product Stewardship Manager, ICI Asiatic Company

Nurturing Thailand's Competitiveness and Sustainable Development

Supachai Lorlowhakarn

National Innovation Agency, Thailand

Tel: +66-2-644 6000, Fax: +66-2-644 8444, E-mail address: supachai@nia.or.th

The National Innovation Agency (NIA) is an autonomous organization under the Ministry of Science and Technology, Thailand. Since its inception, NIA undertakes a broad-based and systematic approach to building up the national innovation ecosystem, by fostering strategic innovation which enhances national productivity, encourages economic restructuring and social development as well as promoting national competitiveness.

Innovative capability encompasses competitiveness at the entrepreneurial and the national levels. In addition to the intrinsic potentials of individual business enterprises, innovative strengths also cover the management skills to utilize the advantages and expertise of every single unit in the business network in such cooperative and competitive manners in order to strengthen and build up the new and realistic approaches for tangible benefits to the economy and the society at large. To achieve this, NIA adopted three strategic platforms, namely, Upgrading Innovation Capability, Promoting Innovation Culture, and Building up Innovation Ecosystems.

In order to upgrade innovation capability, especially in the private sector, NIA initiated the strategic innovation development in two new wave industries, namely, the bioplastics industry and the organic agriculture business. At the same time, NIA concentrates on three core areas of business, namely Bio-Business, Eco-Industry, and Design and Solutions. To this end, NIA employs various support mechanisms specially designed to help to spread the risks of investing in innovative businesses and expedite the emergence of new knowledge-based companies. These schemes, including the "Good Innovation...Zero Interest", "Technology Capitalization", "Innovation Cluster Grant" and "Venture Capital", have proven highly effective to stimulate investments in innovative and knowledge-driven businesses, thereby creating value-added for the Thai economy.

Aside from enterprise-level support programs, NIA works at the macro level to foster awareness and recognition of the importance of innovation to the national economy. NIA has placed a great emphasis on promoting innovation culture and creating an environment conducive to innovation and learning at all levels of the society, through various seminars and conferences, courses, and awards, such as the "Innovation Management Course for Executives" (IMEs), the "Innovation Management School" (IMS), the "National Innovation Awards", "Top Ten Innovative Business" and "Thailand Top Innovative Companies". Additionally, in 2006 the Cabinet approved NIA's proposal to honor His Majesty the King as the "Father of Thai Innovation" and designate the 5th of October of every year as the "National Innovation Day".

NIA also developed a series of initiatives and offers various services to enhance the capacity of public and private entities to innovate as well as to exploit innovation commercially, including the "Intellectual Property Management Unit" or IPM and the "Innovation Ambassador Programme". NIA's highly experienced staff work closely with industries, venture capital sources, and entrepreneurs to find the best way to exploit and commercialize new technology and innovation. NIA's own resources, networks, and collaboration with existing innovation clusters are utilized to facilitate knowledge-based businesses, further enhance innovative capability at institutional level and foster a national innovation ecosystems for sustainable economic and social development.

Keynote Speaker



Prof. Piyawat Boonlong
Director
Thailand Research Fund (TRF)

Education

- Ph.D. (Nuclear Engineering), Kansas State University, 1978
- M. Eng. (Mechanical), Cornell University, 1974
- B.S. (Mechanical Engineering), Cornell University, 1973

Work Experiences

Previous Positions:

- Executive Director, The Thailand Research Fund, 1998-2001
- Program Director, Science and Technology for Production and Services, The Thailand Research Fund, 1993-98
- Professor Emeritus in Mechanical Engineering, Chiang Mai University, Thailand

Research Experience:

- Visiting Researcher, University of Reading, U.K., 1984-85
- Visiting Scientist, University of Karlsruhe, Germany, 1991
- Project Coordinator (Thai counterpart), Thai-German Biogas Program, Phases 1,2,3, 1988-94, support by GTZ
- Project Leader, Energy Conservation in Tobacco Curing ASEAN-Australia Economic Cooperation Program, Phases 1 and 2, 1984-1986 and 1990-1993
- Project Leader, Natural Ventilation in Buildings, ASEAN-Australia Economic Cooperation Program, 1988-90
- Project Leader, Passive Cooling for Agricultural Products, Phases 1 and 2, IDRC, 1981-1984 and 1986-1988
- Co-researcher in 3 other projects on post-harvest technology of tropical fruits, supported by ACIAR and the European Commission

Invited Speaker



Dr. Samran Chooduangngern

Vice President

Old Japan Students' Association, Thailand (OJSAT)

Education

- Master Degree and Doctorate in Economics (Development Economics), Hitotsubashi University, Japan, 1975-1980 (Japanese Government Scholarship Programme)
- B.A. in Economics (Public Finance) Oita University, Kyushu, Japan, 1971-1975 (Japanese Government Scholarship Programme)
- Certificate (Japanese), Tokyo University of Foreign Studies, Japan, 1970-1971 (Japanese Government Scholarship Programme)
- Certificate (Science Section), Triam Udom Suksa School, Bangkok, Thailand, 1967-1970
- Diploma, Shawnee Mission West High School, USA., 1968-1969 (AFS Scholarship Programme)

Work Experiences

Dr. Samran started his professional career as an invited lecturer on the development of agriculture and agricultural co-operatives in Japan, at the Institute for Development of Agricultural Co-operatives in Asia (IDACA), Tokyo, during 1976-1979. During this period of over 30 years, as an economist by training, he has been serving in the various positions and functions basically at two organizations, i.e., the Secretariat of an U.N. affiliated Interim Mekong Committee, subsequently renamed as the Mekong River Commission (MRC), and the Bangkok-based TEAM Consulting Engineering and Management Co., Ltd. (TEAM). He was a former Senior Advisor to the Chief Executive Officer of the MRC at which he has worked for more than 20 years. Currently, he is an Assistant Executive Director of TEAM, responsible for International Business Development. By the nature of his work, he is therefore well familiar with development projects related to the Mekong River and MRC member countries: Cambodia, Lao PDR, Thailand and Viet Nam, assisted by donor countries (including Japan) and such international funding agencies as ADB and the World Bank.

As a part of his civic activities, he has also been serving as an Executive Committee Member of OJSAT for nearly 20 years, since 1989. Currently, he is a Vice President of this Moto-Nippon Ryugakkusei Kyokai in Thailand, responsible particularly for external affairs.

Invited Speaker



Dr. Vichai Saechout

Associate Professor
Institute of Technologists

Education

- DEng (Control Engineering), Tokyo Institute of Technology (Mar.1991)
- ME (Control Engineering), Tokyo Institute of Technology (Mar.1988)
- Researcher (Control Engineering), Tokyo Institute of Technology (Mar.1985)
- Japanese Basic Course at Osaka University of Foreign Studies (Oct.1984)
- BE (Electrical Engineering), King Mongkut's Institute of Technology North Bangkok (Mar.1984)

Work Experiences

- 1991-1992: Toshiba Corporation, Plant Systems Development Section. Designed and developed the control systems of rolling mill in the steel plant.
- 1992-2001: Tokyo Institute of Technology, Department of Control and Systems Engineering. Associate Researcher.
- 2001-Present: Institute of Technologists, Department of Manufacturing. Associate Professor.

Invited Speaker



Dr. Paritud Bhandhubanyong

Associate Professor

National Metal and Materials Technology Center (MTEC)

Education

2007	Honorary Doctorate, Nagaoka University of Technology
1992	Certificate in ISO 9000 for Lead Assessor, QMI QUEST
1991	Certificate in TQC for Manager (KCC), Japan
1990	Certificate in Arc Furnace and Continuous Casting Control, (JICA), Japan
1984	Certificate in TQC Training (APO), Japan
1983	D. Eng. (Metallurgy), The University of Tokyo
1979	M.B.A., Thammasat University
1979	M. Eng. (IE), Chulalongkorn University
1975	B. Eng. (IE), Chulalongkorn University

Work Experiences

1975	Junior Assistant Engineer, State Railway of Thailand, April-June
1999-2007	Director, National Metal and Materials Technology Center

Department of Industrial Engineering, Chulalongkorn University

1975 – 1976	Part-time Instructor
1976 – 1985	Full-time Instructor
1985 – 1986	Assistant Professor

Department of Metallurgical Engineering, Chulalongkorn University

1986 – 1989	Assistant Professor, Head of Department
1989 – 1994	Associate Professor, Head of Department
1995 – Present	Associate Professor

List of Presentations

List of Presentations

Oral Presentations, November 21st, 2008 (14.00-15.30)

Session A: Natural Sciences and Technology (Room 1)				
Time	ID	Name	Affiliation	Title
14:00 14:15	Invited Speaker	Prof. Hiroaki Kunieda	Graduate School of Science and Engineering / Communications and Integrated Systems	Introduction to TAIST Tokyo Tech
14:15 14:30	NS-A01	Anawat Suppasri	Tohoku University	Comparison among the Proposed Source Models for the 2004 Indian Ocean Tsunami
14:30 14:45	NS-A02	Tanuspong Pokavanich	Tokyo Institute of Technology	Intensive Study in Circulation and Water Quality Characteristics of Tokyo Bay
14:45 15:00	NS-A03	Chadin Chutachindakate	Kyoto University	A Study on Sediment Yield and Transportation Analysis at Managawa River Basin
15:00 15:15	NS-A04	Dedi Apriadi	Chulalongkorn University	Two Dimensional Finite Element Simulation of Natural Clay Deposit Response due to Earthquake
15:15 15:30	NS-A05	Nithiwatthn Choosakul	Kyoto University	Ground-based GPS Detecting of Atmospheric Water Vapor for Meteorological Purpose in Thailand

Session B: Natural Sciences and Technology (Room 2)				
Time	ID	Name	Affiliation	Title
14:00 14:15	Invited Speaker	Prof. Akinori Nishihara	Center for Research and Development of Educational Technology	International Distance Education between Tokyo Tech and Thailand
14:15 14:30	NS-B01	Athakorn Kengpol	King Mongkut's University of Technology North Bangkok	The Government Evaluation of Information Technology Using Group Technology Selection
14:30 14:45	NS-B02	Teera Siriteerakul	King Mongkut's Institute of Technology Ladkrabang	A Real Time Delphi System for Foresight Study of Sustainable Universal Health Coverage in Thailand
14:45 15:00	NS-B03	Komsit Prakobphol	Carnegie Mellon University	Alleviating Identity Theft in Social Network
15:00 15:15	NS-B04	Markpong Jongtaveesataporn	Tokyo Institute of Technology	Development of Thai Broadcast News Transcription System
15:15 15:30	NS-B05	Nuttida Suwanno	Prince of Songkla University	Thai Named Entity Based on SVM

Session C: Life and Health Sciences				
Time	ID	Name	Affiliation	Title
14:00 14:15	Invited Speaker	Phairote Teeranaipong	The University of Tokyo	A Functional SNP in CR1 Promoter Region Contributes to Protection Against Cerebral Malaria
14:15 14:30	LS-C01	Sarunporn Techasurungkul	Tokyo Medical and Dental University	Vitamin D Status and Falls, Frailty, and Fractures among Postmenopausal Japanese Women Living in Hawaii
14:30 14:45	LS-C02	Pattara Khamrin	Aino University	Evaluation of the Newly Developed Immunochromatography Test Kit For Rapid Detection of Norovirus Antigen in Stool Samples
14:45 15:00	LS-C03	Supatida Sirisawat	University of Tsukuba	Expression Analysis of Class B-MADS Genes During Flower and Ovary Development of Dendrobium Orchid
15:00 15:15	LS-C04	Arthit Makarasen	Nagoya University	Synthesis of Cereulide Analogs for Use in an Immunoassay
15:15 15:30	LS-C05	Supaporn Naknukool	Kagawa University	The Novel Basic Proteins from Duck Egg White: Structures and Functions

Session D: Humanities and Social Sciences				
Time	ID	Name	Affiliation	Title
14:00 14:15	HS-D01	Ataya Aoki	Tohoku University	Thai and Japanese Speech Behaviors in Group Discussions
14:15 14:30	HS-D02	Siriporn Peters	RMIT University	Participatory Communication Design for Sustainable Livelihoods for the Communities of People with Physical Disabilities in Thailand
14:30 14:45	HS-D03	Nuttawut Laksanapanyakul	Thailand Development Research Institute	Benefits to Thai Businesses from Japan-Thailand Economic Partnership Agreement (JTEPA)
14:45 15:00	HS-D04	Pitch Sutheerawatthana	The University of Tokyo	Influence of an Infrastructure on Subsequent Development Decisions
15:00 15:15	HS-D05	Thirapong Pipatpongsa	Tokyo Institute of Technology	New Discipline of Collaborative Research Crossing Borders thru Supercomputing Cyber-infrastructure
15:15 15:30	HS-D06	Jessada Salathong	Waseda University	Media and Education for Sustainable Development: Thailand's Newspapers Coverage of Climate Change

Oral Presentations, November 21st, 2008 (16:15-18:00)

Session E: Natural Sciences and Technology (Room 1)				
Time	ID	Name	Affiliation	Title
16:15 16:30	NS-E01	Pathomkorn Kunopast	Chulalongkorn University	Thermophysical Properties of Arylamine-based Benzoxazine Resins Alloyed with Epoxy Resin
16:30 16:45	NS-E02	Wanchat Bangsen	Chulalongkorn University	Characterization of Benzoxazine-Urethane Polymer Networks
16:45 17:00	NS-E03	Chanchira Jubsilp	Chulalongkorn University	High Thermomechanical Performance Hybrids of Dianhydride Containing Polybenzoxazine
17:00 17:15	NS-E04	Supaphorn Thumsorn	Kyoto Institute of Technology	Mechanical and Physical Properties of HDPE/Corn Starch Composite
17:15 17:30	NS-E05	Yuwa Chompoobutrgool	Kyoto University	Development of Single Chamber Solid Oxide Fuel Cell using BaLaIn ₂ O _{5.5} (BLI) Solid Electrolyte: Introduction of Sublimation Materials as Pore Former in Electrode Preparation
17:30 17:45	NS-E06	Chan Anyapo	Nagaoka University of Technology	Development of an Electric Wheelchair Using PEM Fuel Cell
17:45 18:00	NS-E07	Surawut Chuangchote	Kyoto University	High Efficient Dye-Sensitized Solar Cells Using TiO ₂ Nanoparticles / Nanofibers as Photoelectrode

Session F: Natural Sciences and Technology (Room 2)				
Time	ID	Name	Affiliation	Title
16:15 16:30	NS-F01	Kiraphat Paenduang	Thammasat University and Nagaoka University of Technology	Fatigue Crack Growth Characteristics of Friction Stir Welded AA 6063 T-5
16:30 16:45	NS-F02	Vorapong Suppakitpaisarn	The University of Tokyo	Robust Pattern Detection Using Quantum-Inspired Evolutionary Algorithms
16:45 17:00	NS-F03	Chutisant Kerdvibulvech	Keio University	Computer Vision for Thailand's Future
17:00 17:15	NS-F04	Ukrit Watchareeruetai	Nagoya University	Research on Weed Detection Methods for Precision Spraying in Lawns
17:15 17:30	NS-F05	Thamrongsak Suwanishwong	Kyoto University	An Optimal Renewal Timing Markov Model for Water Supply Pipelines System
17:30 17:45	NS-F06	Le Thanh Nam	Kyoto University	Sustainable Management of Ground Anchor Maintenance using Markov Process
17:45 18:00	NS-F07	Pongsak Suttinon	Kochi University of Technology	Sustainable Water Demand Management for Economic and Social Development in Thailand: Case of Lower Chao Phraya River Basin

Session G: Humanities and Social Sciences				
Time	ID	Name	Affiliation	Title
16:15 16:45	Invited Speaker	Assoc.Prof. Siriporn Wajjwalku	Thammasat University	The Social Science Research in Thailand: Current State and Future Prospects
16:45 18:00	--Panel Discussion --			

Poster Presentations, November 21st, 2008 (15:30-16:15)

Poster Session: Natural Sciences and Technology			
ID	Name	Affiliation	Title
NS-P01	Weerawut Chaiwat	Kyoto University	Analysis of Biomass Pyrolysis Mechanism for Development in Reactor Design
NS-P02	Thachanan Samanmulya	Chulalongkorn University	Gasification of Cotton and Jatropha Residue Using Supercritical Water
NS-P03	Thitima Rattavoravipa	Kyoto University	Liquid Phase Deposition of Anatase Titanium Dioxide Nanotubes Arrays and Their Performance of Hybrid Solar Cells
NS-P04	Surawut Chuangchote	Kyoto University	Electrospun Conductive Polymer Nanofibers for Organic Photovoltaic Cells
NS-P05	Pramote Puengjinda	Kyoto University	Experimental Study on the Performance of a Single-cell SOFC Prepared by Screen Printing and Co-firing process
NS-P06	Chantamane Poonjarearnsilp	Chulalongkorn University	Synthesis of Carbon Nanoparticles by Arc Discharge under Reduced Pressure Air
NS-P07	Thornchaya Satitpitakun	Chulalongkorn University	Improvement of Thermo-mechanical and UV Absorption of PMMA with ZnO Nanoparticles
NS-P08	Wasana Khongwong	Tokyo Institute of Technology	Synthesis and Characterization of SiC/SiO ₂ Core-Shell Nanowires
NS-P09	Apiluck Eiad-ua	Nagoya Institute of Technology	Production of Non-firing Ceramic from Paper Sludge Ash
NS-P10	Nattapon Samakrut	Chulalongkorn University	Characterization of Short Glass Fiber-Reinforced PC/ABS Blends
NS-P11	Teerapat Matchimapiro	Chulalongkorn University	Thermomechanical Properties of TPP-filled Polycarbonate/Acrylonitrile-Butadiene-Styrene Blends
NS-P12	Naruekamon Janjirawuttikul	Nagoya University	Acid Sulfate Soil-landform Relationships in the Lower Central Plain, Thailand
NS-P13	Wanwarang Ratananikom	Chulalongkorn University	Effect of Intermediate Principal Stress on Bangkok Clay Behavior under Quasi Simple Shear Condition
NS-P14	Sokbil Heng	Tokyo Institute of Technology	Stress Analysis of Granular Media Confined in Long Vertical Column
NS-P15	Mohammad Hossein Khosravi	Tokyo Institute of Technology	Interpretation of Ko-consolidation Processes Illustrated by Randomized Inhomogeneous Strains
NS-P16	Pakpoom Sakkamchorn	www.pimthai.com	Program "PimThai" (Typing Thai by Romanized Input)

Poster Session: Life and Health Sciences			
ID	Name	Affiliation	Title
LS-P01	Thitiworn Choosong	Kanazawa University	Workplace Environment and Personal Exposure of PM and PAHs to Workers in Natural Rubber Sheet Factories Contaminated by Wood Burning Smoke
LS-P02	Unyanee Poolsap	Kyoto University	An Integer Programming-Based Method of Predicting RNA Secondary Structure with Pseudoknots and Its Relation to Simple Linear Tree Adjoining Grammar
LS-P03	Chatchai Yachantha	University of the Ryukyus	Inhibitory Effect of Lime Powder as Natural Source of Potassium Citrate on In Vitro Calcium Oxalate Crystallization
LS-P04	Kwanchnok Sattasul	Ehime University	Characterization of the Amino Acid Transporter in Plant Plastids
LS-P05	Soracom Chardwiriya-preecha	Ehime University	Identification of the Vacuolar Amino Acid Transporter Genes in Fission Yeast
LS-P06	Arthit Makarasen	Kasetsart University	Bioactive Aporphine Alkaloids from Aerial Part of <i>Stephania venosa</i> (Blume) Spreng
LS-P07	Siriporn Pota	University of Tsukuba	Phylogenetic Relationship between Two Rust Fungi on <i>Allium</i> Species in Japan
LS-P08	Sonthaya Numthuam	University of Tsukuba	Rapid Determination of Bacterial Contamination in Shredded Cabbage using Dissolved Oxygen Sensor
LS-P09	Saowaluk Rungchang	Tokyo Japanese Language Education Center and Tamagawa University	Solid Extraction Study of Antioxidants from Tamarind Seed Coat

Poster Session: Humanities and Social Sciences			
ID	Name	Affiliation	Title
HS-P01	Thirapong Pipatpongsa	Tokyo Institute of Technology	Educational Drive of Tokyo Tech toward Human Resource Development in Thailand
HS-P02	Thirapong Pipatpongsa	Tokyo Institute of Technology	Outlooks of Tokyo Tech Educational Field Trip in Thailand

Natural Sciences and Technology

Oral Presentations

(14.00-15.30)

(16.15-18.00)

Poster Presentations

(15.30-16.15)

Life and Health Sciences

Oral Presentations

(14.00-15.30)

(16.15-18.00)

Poster Presentations

(15.30-16.15)

Humanities and Social Sciences

Oral Presentations

(14.00-15.30)

(16.15-18.00)

Poster Presentations

(15.30-16.15)



Invited Speaker



Akinori Nishihara

Professor

Center for Research and Development of Educational
Technology, Tokyo Institute of Technology

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Education

- Dr. of Eng. in electronics from Tokyo Institute of Technology in 1978
- M.E. from Tokyo Institute of Technology in 1975
- B.E. from Tokyo Institute of Technology in 1973

Work Experiences

- Research Associate at Department of Physical Electronics, Tokyo Institute of Technology
 - from April 1978 to July 1985.
 - Associate Professor at International Cooperation Center for Science and Technology
 - from August 1985 to December 1990.
 - Associate Professor at Department of Physical Electronics, Tokyo Institute of Technology
 - from January 1991 to December 1996.
 - Professor at the Center for Research and Development of Educational Technology
 - since January 1997.
- He is Assistant Director of the International Office since April 2007, and a Deputy
- Director of Global Scientific Information and Computing Center since October 2007.

International Distance Education between Tokyo Tech and Thailand

Akinori Nishihara

*Center for Research and Development of Educational Technology, Tokyo Institute of Technology
Tel: +81-3-5734-3232, Fax: +81-3-5734-2560, E-mail address: aki@cradle.titech.ac.jp*

Tokyo Institute of Technology (Tokyo Tech) conducts international distance education since 2002. TAIST (Thailand Advanced Institute of Science and Technology) Tokyo Tech was inaugurated in 2006, and some of its lectures are transmitted from Tokyo Tech's Ookayama campus to Thailand Science Park. Distance education with careful support of learners enhances educational effects, if not substitutes face-to-face courses. E-learning materials are also offered to students for review.

Information and communication technology can suitably be used to overcome not only physical distance but also mental distance between learners and teachers as well as among learners. Tokyo Tech started international distance education first using satellite communication in 2002 in conjunction with the opening of our Bangkok Office. Courses taught in English in Tokyo Tech international graduate program started in 1993 have been transmitted to Asian Institute of Technology and King Mongkut's Institute of Technology Ladkrabang using a geostationary satellite. Since 2006 we use internet to reduce the transmission cost. Although reliability is not high as satellite communications, international internet environment is now at a level to be used for regular lectures.

Lecture materials are placed on a learning management system in advance. For some courses, lecture videos are also uploaded for students to review (Fig. 1). Local co-lecturers and/or teaching assistants help students learn better. We believe this care is absolutely necessary for remote students to learn from a screen.

Based on the above experience, we intensively use international distance education in the Information and Communication Technology for Embedded Systems course at TAIST-Tokyo Tech inaugurated this year (Figs. 2, 3). Distance education is not completely equivalent to face-to-face lectures, but the communication is bidirectional and students can ask questions any time. In addition, after a lecture given from Tokyo, a local co-lecturer conducts supplementary lessons and exercises, which we believe improve the educational effects very much. From the lecturer side, it is necessary to well prepare in advance for a distance education such as character sizes used on blackboard or screen, voice loudness and speaking speed, large motion, and time schedule in the course. Lecturers should also pay much attention to the students during the course. Even with such cares taken, dropout rate may be very high in distance education. Thus we use so-called blending; blending with other methods like exercises, supplementary lessons, etc. Even a single face-to-face meeting with the lecturer improves the sense of affinity for the students. So we encourage the Tokyo Tech lecturers to visit Bangkok at least once during the term.

Since 2007 we receive a course on Technical Writing from the Philippines. Tokyo Tech students learn a lot in that course.

ICT is advanced to be used for distance education. To implement successful distance education, however, a lot more should be taken into account other than technology.



Fig.1 E-learning site



Fig.2 TAIST-ICTES classroom

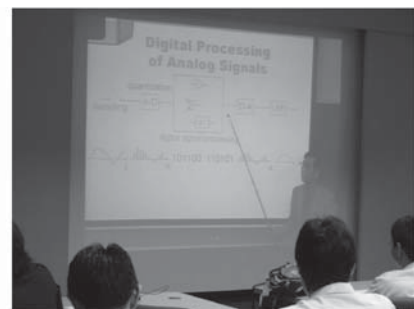


Fig. 3 Lecture from Tokyo

Invited Speaker

**Hiroaki Kunieda**

Professor
School of Science and Engineering,
Tokyo Institute of Technology

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Education

Ph.D. (1978)	Tokyo Institute of Technology Ph.D. Thesis, “Lumped Element Equivalent Representation of Distributed Networks and its Applications”
S.M. (1975)	Tokyo Institute of Technology
B.S. (1973)	Tokyo Institute of Technology

Work Experiences

1978-1984	Assistant Professor at Department of Electrical Engineering, Tokyo Institute of Technology
1985-1994	Associate Professor, Department of Electrical and Electronic Engineering, Tokyo Institute of Technology
1995-present	Professor, Department of Communications and Integrated Systems, School of Science and Technology, Tokyo Institute of Technology

Introduction to TAIST Tokyo Tech

Hiroaki Kunieda

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TAIST Tokyo Tech has been established at NSTDA in Thailand to establish an institution for human resource development to foster and support world-class researchers and high-level engineers through a combination of advising from many Tokyo Tech professors, excellent facilities and research staff in NSTDA, and established resources of Thai universities such as KMITL, SIIT, and KU, since June in 2007.

It is expected that TAIST Tokyo Tech will initiate the start of a positive spiral of human resource development system in Asian region. TAIST Tokyo Tech aims to harmonize advanced technology with the environment and to realize research and human resource development for global sustainable development.

At present, the Master's Programs for AE (Automobile Engineering) and ICTES (Information and Communication Technology for Embedded Systems) have started with about 30 students for each program in a year. In this presentation, the details of its programs and its prospective future will be introduced to stimulate cooperation between Thailand and Japan through TAIST program.

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Education

2004	Degree awarded (Rombun Hagasei) School of Law, Nagoya University
1989-1992	Ph.D. - Law (International Relations) School of Law, Nagoya University
1987-1989	M.A. - Law (International Relations) School of Law, Nagoya University
1986-1987	Certificate on Japanese Language, Nagoya University
1981-1985	B.A. - Political Science (International Relations) (Honor) Faculty of Political Science, Thammasat University

Work Experiences

2008 – Present	Director of Division of National Policy and Transnational Issues at Thailand Research Fund - Tentative
2006 – Present	Chair of Japanese Studies Network, Thailand
2005 – 2006	Director of Master Degree Program in International Relations (English Program), Faculty of Political Science, Thammasat University
2003 – Present	Project Coordinator, Japan Watch Project, Thailand Research Fund
2002 – 2005	Chair of Japanese Studies Program, Institute of East Asian Studies, Thammasat University
2000 – 2002	Associate Dean in charge of Academic Affairs, Faculty of Political Science, Thammasat University
1997 – 2002	Director of Southeast Asian Studies Program (Minor Program) Faculty of Political Science, Thammasat University
1995 – 1997	Assistant Dean in charge of Academic Affairs, Faculty of Political Science, Thammasat University

A Functional SNP in CR1 Promoter Region Contributes to Protection against Cerebral Malaria

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Introduction Complement receptor type 1 (CR1) has been shown to be a ligand for rosette formation in human *Plasmodium falciparum* (PF) malarial infection. Although the association of erythrocyte CR1 (E-CR1) expression level and severity of malaria has been reported in several populations, some studies have noted inconsistent findings. To elucidate these issues, I investigated for the association of CR1 polymorphisms with malaria severity in a Thai population and searched for genetic factor(s) which control E-CR1 expression.

Methods Based on WHO classification, 203 mild, 165 (non-cerebral) severe and 109 cerebral PF malaria patients were recruited. Seventeen SNPs located in promoter and gene region were analyzed by PCR-direct sequencing and PCR-RFLP. Flow cytometry was used to evaluate E-CR1 protein expression level in healthy controls.

Results rs9429942C>T in CR1 promoter region showed strongly association with protection against complicated malaria, especially cerebral malaria ($p=0.0009$, OR=0.25, 95%CI=0.11-0.56). Analysis of E-CR1 protein expression level revealed that individuals who carried TT genotype contributed to significantly higher E-CR1 expression ($p=0.028$).

Conclusion This study provides crucial evidence indicates that higher E-CR1 expression correlates with protection against cerebral malaria based on plausible explanation from previous evidences which suggested that level of E-CR1 corresponded to increasing in immune complex clearance rate.

Comparison among the Proposed Source Models for the 2004 Indian Ocean Tsunami

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The 2004 Indian Ocean tsunami source models were discussed to reproduce/estimate the damage to Thailand's perspective focused in the coastal area of Andaman by using the tidal records and runup data. The existing tsunami source models were reviewed as an input for a tsunami numerical simulation. The far-field tsunami numerical simulation was performed to obtain the required parameters from the numerical model results namely, maximum wave height and arrival time. Then parameters such as the root mean square error (RMSE) and Aida "K" were calculated as a tool for the model comparison. The most suitable existing tsunami source model for the tsunami damage assessment and mitigation in Thailand was justified based on the tsunami characteristic which is corresponded to an interest of study's topic. The source model proposed by DCRC is the most suitable when the wave height is considered and will be used in the study of tsunami casualty and building damage in Thailand.

1. Introduction

Although it passed almost 4 years since the 2004 Indian Ocean tsunami generated by the earthquake with more than M_w 9.2 (see [1] and [2]) caused devastating damage and a large number of researches and studies have been carried out to explain the tsunami source mechanisms, there are so many proposals of its source model by using several available data; seismic observation, crustal movement, tsunami runup and tidal records at the stations, which is still under discussion. There is the difficulty to determine the best among all from all aspects. Thus, this study proposes the reasonable selection of the source model with a specific purpose in a targeting area.

2. Methodology

The 8 tsunami source models were selected to perform the 2004 Indian Ocean far-field tsunami to Thailand (Fig. 1). The number of fault varies from 2 up to 22. The initial condition is calculated by the model proposed by Mansinha and Smylie [3]. Far-field tsunami numerical model is performed using the TUNAMI Code which was developed by the Disaster Control Research Center (DCRC). Dynamic effect from the rupture velocity is also taken into account as to reproduce the tsunami propagation to be more realistic. The model is based on the linear-long wave theory in a spherical coordinates with neglecting the bottom friction term. Three-second temporal grid size is used to satisfy with the numerical stability condition. Model results namely, maximum wave height and arrival time were used to justify the most suitable existing

tsunami source model when compared to the observed data in Thailand.

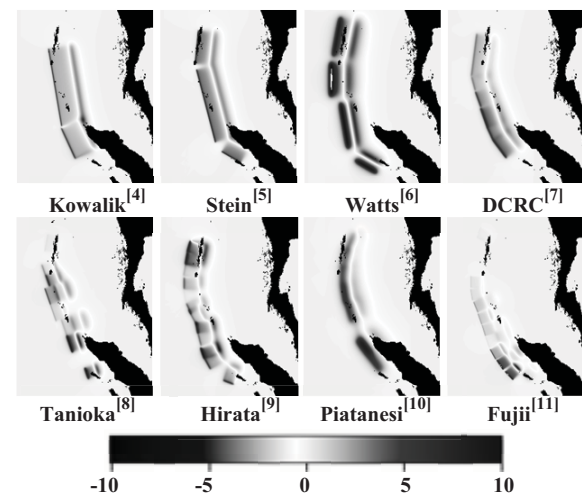


Fig.1 Tsunami source model

3. Results and Discussion

Error computation and Root Mean Square Error (RMSE) regarding to the maximum wave height was calculated. Arrival time was compared to the record by tidal gauge.

The parameter 'K' proposed by Aida [12] was used and described in equation (1) to (3). The amplitudes of the first and the second half cycles, a_1 and a_2 , of the computed waves are compared with the observed records.

Given

$$K_i = x_i / y_i \quad (1)$$

$$\log K = \frac{1}{n} \sum_{i=1}^n \log K_i \quad (2)$$

where, x_i and y_i are the observed and computed amplitudes of a_1 and a_2 respectively, K is regarded as a correction factor to adjust the

amplitudes of a_1 and a_2 computed for the model so as to fit the actual tsunami averaged over several stations. Finally, κ is defined as a measure of the fluctuation in K_i as follow.

$$\log \kappa = \sqrt{\frac{1}{n} \sum_{i=1}^n (\log K_i)^2 - (\log K)^2} \quad (3)$$

Results are shown in Table 1 and 2. While, model comparison is summarized in Table 3.

Table 1 Comparison of maximum wave height

Source model	PhangNga, Thailand		Phuket, Thailand	
	RMSE (m)	Error (%)	RMSE (m)	Error (%)
Kowalik	2.70	26.80	5.12	83.74
NOAA	2.57	30.90	3.46	68.06
Watts	8.39	107.47	5.01	96.34
DCRC	1.17	12.54	0.93	14.22
Tanioka	3.76	38.22	2.16	32.97
Hirata	3.34	32.19	1.82	32.74
Piatanesi	2.79	30.70	4.83	70.18
Fujii	5.01	58.28	3.23	61.93

Table 2 Comparison of K and arrival time (t, min)

Calculated parameters	a_1		a_2	
	K	t_{0-c}	K	t_{0-c}
Kowalik	0.392	23.08	0.447	21.50
NOAA	0.500	23.50	0.337	22.17
Watts	0.256	15.33	0.476	22.67
DCRC	0.489	18.58	0.558	23.58
Tanioka	1.046	21.17	1.169	22.50
Hirata	0.461	13.00	0.556	27.33
Piatanesi	0.456	24.08	0.407	22.83
Fujii	1.612	18.50	2.521	21.67

DCRC's model has the outstanding maximum wave height results with the lowest RMSE and percent error. Tanioka's model was the most fit with the K values (the most nearly to 1). Watts's model has the most minimum time different from the observed tide gauge.

Table 3 The best four model comparison

No.	Wave height	Aida "k"	Arrival time
1	DCRC	Tanioka	Watts
2	Hirata	Stein	Fujii
3	Kowalik	DCRC	Hirata
4	Tanioka	Hirata	DCRC

4. Conclusions and Recommendations for Thailand

Further tsunami study in Thailand can be conducted after considering the source model comparison. For example, by a consideration of the dynamic effect from the rupture velocity which will cause a change in tsunami arrival

time will be benefited for those who are going to study about the tsunami warning system. In other words, in the casualty and building damage point of view, wave height is the most considered parameter. Thus, DCRC model is selected to perform the Near-field tsunami numerical model in order to obtain inundation area, depth and velocity. This model results will be used together with the population data for the tsunami casualty study and with satellite imagery for the building damage study at DCRC in the nearly future.

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level, wave, flow velocity, water temperature, salinity, turbidity) and biochemical properties data (i.e. DO, phytoplankton chlorophyll-a nutrient concentration). Fig.2 exemplifies the survey methodology. The meteorological data (i.e. wind, solar radiation, humidity, air temperature), river discharges and offshore water properties were gathered from variety of the governmental agencies as well as research institutes. The data were used to setup, calibrate and validate the computer simulating model. Results from the model benefit in extending the availability of information from fragmented and short-term observations which help the research to investigate the large scale study area with less manpower and efforts.

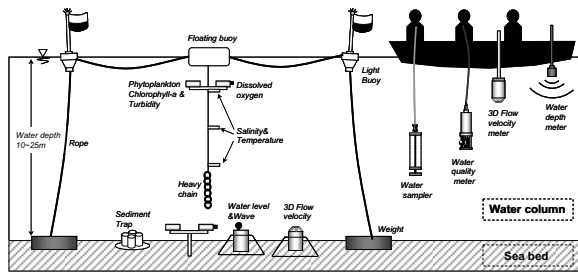


Fig. 2 Moorage system and measurement methodology

3. Results and Discussion

Results suggested Tokyo Bay circulation is mainly governed by wind (Fig.3). General circulation of the bay have distinguish difference between summer and winter which generally induced by seasonally variation of solar radiation. It was found that the bay water contain excessive nutrients that derived from immense wastewater discharge from Tokyo megacity. This promoted the immoderate growth of phytoplankton in the water column resulting in the frequent occurrence of red tide in summer. High concentration of plant detritus in the water at the end of the blooms were decomposed and consumed DO. More usage of DO than supply resulted in hypoxia. Hypoxia was observed during field observation in 2007 in the middle and lower layer of the water column (Fig4). This characteristic suggested that the water column stratification in summer (mainly from water temperature) restrict the mixing between warmer upper layer water (high DO) and lower colder water (less DO).

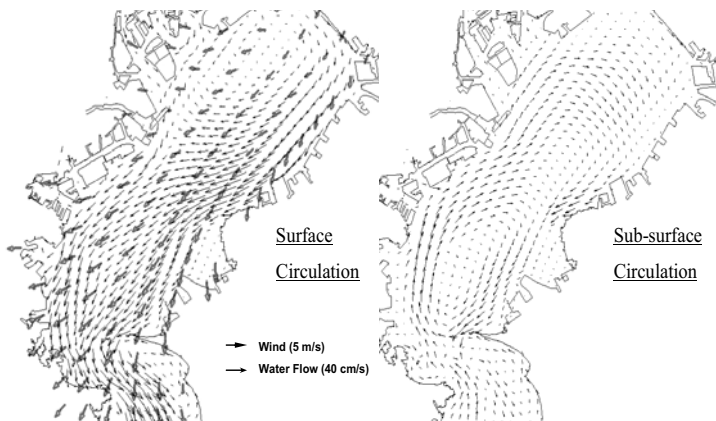


Fig. 3 Computer simulated surface and bottom water circulation pattern during north wind in summer 2007.

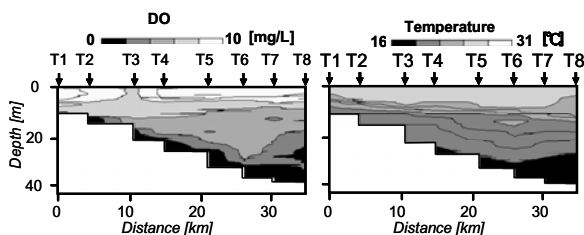


Fig.4 Observed results of DO concentration and water temperature in summer 2007

4. Conclusions and Recommendations for Thailand

Upper Gulf of Thailand (UGT) has been frequently reported in the degradation of water quality and natural ecosystems. Existing problems include siltation and excessive nutrient discharge from four major rivers in the country which resulted to nuisance red tides, harmful algal blooms, massive fish kills and low DO water [3,4]. These problems in turn lead to adverse effects on public health, tourism and country economy. Lack of basic understanding on UGT circulation and its water quality characteristics are among the major constraints to relieve and work out the problems. Approaches in the present research can immediately be implemented to UGT (as well as other water resources) to extract the essential basic information to properly tackle the problems as well as to promote sustainable utilizations of the water body. However, the nature of this type of research restricts it to be an interesting subject only to major organizations or governmental bodies. Shortfall in interest from the public sector in Thailand cut down the availability of research grants which in turn make this type of study to be less attractive to young researchers. Other major hindrances concern about the availability, accessibility as well as quality of long-term supportive data.

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A Study on Sediment Yield and Transportation Analysis at Managawa River Basin

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Sediment system in watershed includes not only sediment yield but also sediment transportation along the rivers. In this study, the Geographic Information System (GIS) incorporated with sediment yield model can be assisted to enhance the evaluation estimation of soil erosion. Surface erosion on Managawa river basin is then computed with the Modified Universal Soil Loss Equation (MUSLE) and it is verified to reflect the hydrological processes to which it will be able to estimate soil losses. In the sediment transport routing module, total load equation is applied to carry sediment from soil surface erosion to deposit in Managawa dam. According to annual accumulation sediment volume data in Managawa reservoir during 1981 – 2003, the establish model and simulation results are satisfied. The efficiency of the Modified Universal Equation with sediment routing in rivers is more than the simple Modified Universal Equation.

1. Introduction

Managawa Dam is located on the high rainfall density and steep slope area that previously caused sediment problems. Every year the bottom levels of reservoir are observed so that annual sediment depositing volume is well recognized. Many soil erosion models and useful numerical formulas to predict annual sediment yield have been published. The most popular soil erosion equation is Universal Soil Loss Equation (USLE). Simple empirical methods such as Universal Soil Loss Equation (USLE), Revised Universal Soil Loss Equation (RUSLE) or Modified Universal Soil Loss Equation (MUSLE) are frequently used for the estimation of surface erosion and sediment yield from catchment areas. In Modified Universal Soil Loss Equation (MUSLE), the rainfall energy factor is replaced with a runoff factor. Hydrologic process of sediment yield was optimized, thus these help to improve the sediment yield prediction, [1]. The main objective of this study is to compute annual volume of sediment deposition in Managawa dam by using soil erosion and sediment transportation models. Erosion on sub-basin caused by rainfall and surface runoff is computed with Modified Universal Soil Loss Equation (MUSLE), which time interval is a day continuously from 1981 to 2004. After outlets of each sub-basin, sediment will be transported by main channel. This study shows the results of these combined systems.

2. Methodology

In this study, the computing the annual sediment volume deposit in dam by mathematical model is necessary to input the models; soil erosion model, hydraulic model

and sediment transport model, with hydrology data, hydrodynamic data, sediment data, geographic data and topographic data.

Hourly rainfall data from 1981-2004 were collected by 8 rain gauges located on Managawa river basin and the results from plotting double mass curve of each rainfall stations are reliable. Distribution of rainfall could be affected by topographical data such as elevation. Thiessen method was used to estimate rainfall within the entire catchment.

Discharge and water level data are available in hourly to input as boundary condition in hydraulic model which outflows from Kumokawa Dam and Sasougawa Dam are the upper boundaries and water level at Managawa Dam is the lower boundary.

Geographic Information System (GIS) data used for finding out parameters in soil erosion model are Digital Elevation Model (DEM) 50m x 50m, land use and soil type. For land use information, there are available in 1976, 1987, 1991 and 1997 however the most of land use of the study area is forest and it shows a little change through time as shown in Fig.1.

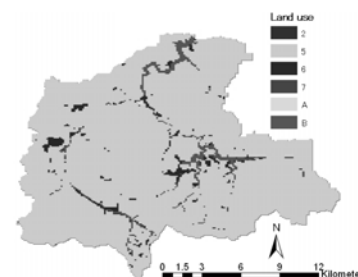


Fig.1 Land use 1997, 2 = Agricultures, 5= Forest, 6=Waste Land, 7=Building, A= Small Building, B=Water Body

Calculating soil erosion in this study following the Soil and Water Assessment Tool (SWAT) shows that the watershed modeling framework is able to delineate from the digital description of the landscape as Digital Elevation Map (DEM), land use and soil data sets. ArcView interface, Spatial Analyst, with geomorphologic assessment procedures to obtain soil erosion from each sub-basin were applied. Managawa river basin was divided in to 9 sub-basins. In this study, one sub-basin on upper Sasougawa Dam is neglected because that upstream dam captures all sediments from the upper part. After that the calculated daily sediment supply from each sub-basin will be taken to input as lateral sediment inflow to Managawa River model. Hydrodynamic (HD) and sediment transport (ST) models are calculated by MIKE 11 developed by DHI Water and Environment. Flow chart of this study is shown in Fig. 2.

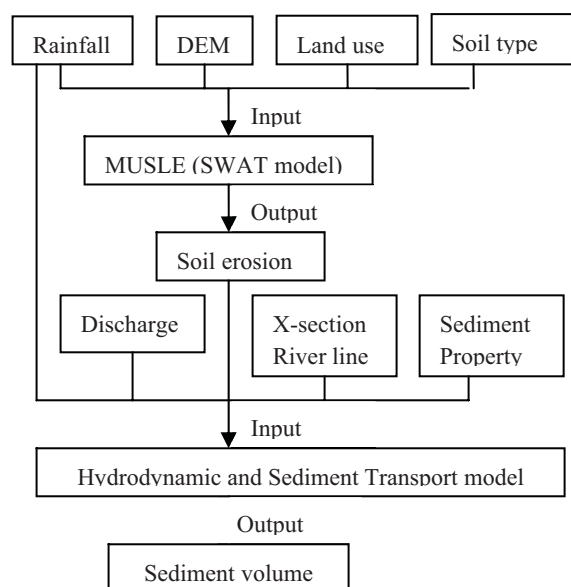


Fig.2 Scope of this study

3. Results and Discussion

The computed sediment volumes in this study show large differences with the observed data. Therefore, total accumulated sediment volumes were compared among them. Observed and computed total sediment volumes until the year 2003 were 1,747,197 m³ and 1,560,381 m³ respectively, which error is about 10%. In some years, the accumulative data are not much difference as shown in Fig.3. Therefore, the sediment yield and sediment transport model in this study can then be used to estimate the sediment accumulation volume in Managawa Dam.

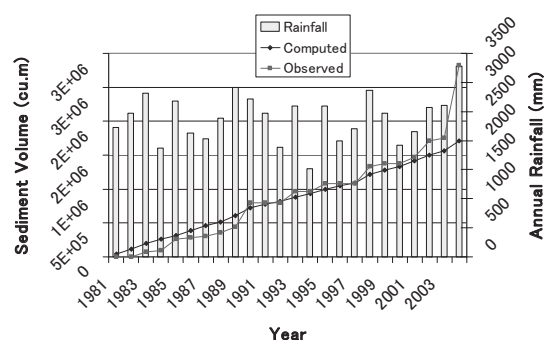


Fig.3 Annual rainfall, observed and computed accumulation sediment volume.

4. Conclusions and Recommendations for Thailand

The MUSLE was developed for simulating the impact of land management practices on eco-hydrologic system. The results of annual sediment accumulating volume for this study area show large differences with the observed data but total volumes almost coincided very well. In order to improve the model, other modifications may be needed to compute sediment yield and transport process in high flood periods. However, this model can be used to estimate reservoir sedimentation volumes and its tendency if catchment's conditions vary. This model can be applied to Thai cases for investigating sediment volume in Thai reservoirs.

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Two Dimensional Finite Element Simulation of Natural Soft Clay Deposit Response due to Earthquake

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This paper presents effect of natural soft clay deposit to the earthquake seismic response by performing dynamic finite element simulation. The time domain simulation was performed by using PLAXIS Dynamic computer program considering variations in dynamic soil properties. Properties of the local ground are obtained from collected geological and soil investigation report covering target area. The shear wave velocity for the simulation was obtained from seismic down-hole test. Furthermore, to analyze effect of local ground condition as well as anticipated earthquake motion characteristics, five strong motion records were used and scaled to 0.2g peak base-rock acceleration (PBA). Result of the simulation is presented in the form of peak ground surface acceleration and amplification factor values at ground surface. Finally, some conclusions and recommendations of the possibility of the study for applying in Thailand will be presented.

1. Introduction

Many damage patterns in past earthquakes show that the significant effects of local soil conditions on seismic response of the ground. For examples, in Mexico City during 1985 Michoacan earthquake, peak accelerations of incoming motions in rock were generally less than 0.4g, but due to resonant response from clay deposited in the original site the incoming motions were amplified about five times. In the 1989 Loma Prieta earthquake, the spectral accelerations were amplified 2 to 4 times over adjacent rock sites specifically for soft soil sites region.

This study shows effect of natural soft clay deposited in the specific area to the seismic response of the ground surface by using dynamic finite element simulation [1]. The advantages of this simulation are that we can learn behavior and mechanism of the ground surface response with different earthquake motion characteristics and geometrical of the adjacent base-rock. Another issue that it is possible to incorporate an advanced soil constitutive model into the simulation compared with the conventional 1-D wave propagation analysis.

2. Methodology

Principally, there is one important stage that has to be conducted before performing the dynamic finite element simulation or site response analysis that is seismic hazard analysis but it is beyond on this paper.

In this study, considering probability exceeding of the different levels of the earthquake return period, sources and

mechanism of the earthquakes incorporated to design life-time of the specific structure, we employed peak base-rock acceleration (PBA) is about 0.2g. Totally, five strong motion records, i.e.: Chi-Chi earthquake, Mexico, El Centro, Salvador, and Kobe earthquake were used as input motion and scaled to 0.2g. One of them is shown in Figure 1.

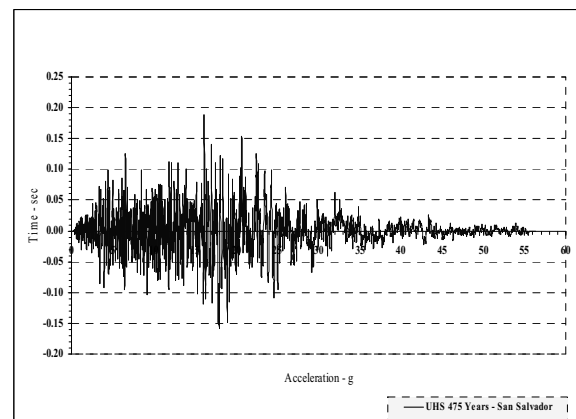


Fig. 1 Time histories input motion

Based on the geological survey and geotechnical investigation data the subsurface conditions of the target area located at 5 km from edge of basin is shown in Figure 2 [2]. Soil condition at the target area is dominated by sandy clay to organic clay, with consistency soft to stiff. The depth of base-rock is approximately 200 m from the ground surface. Further, the dynamic soil properties such as shear wave velocity can be obtained by conducting geophysical surveys.

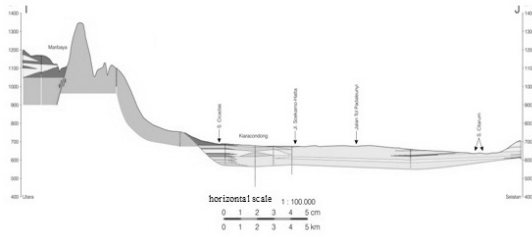


Fig. 2 Geological profile along target area

In the next stage, site response analysis was conducted by 2-D finite element simulation using PLAXIS dynamic computer program from PLAXIS B.V. This simulation was performed to estimate peak ground acceleration (PGA), amplification factor, and response spectra of ground response. Figure 3 shows the finite element modeling of the analysis. In this modeling, boundary condition at the left and right side of the soil profile was modeled by absorbent boundary and earthquake loading at the base-rock was represented by prescribed displacement.

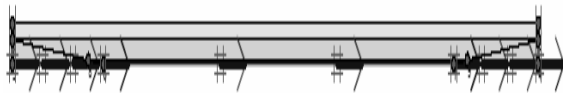


Fig. 3 Finite element modeling

Finally, ground motion of response spectra was generated by SeismoSignal computer program from Seismosoft Ltd.

3. Results and Discussion

Result of dynamic finite element simulation considering various input motions indicate that peak base-rock acceleration is amplified as shown in Figure 4. Due to the effect of soft clay deposit, amplification factor of around 1.6 – 2.0 was predicted for target area that located 5 km from the edge of basin. Similar analysis result also reported from Kocaeli earthquake in the Adapazari Basin [3]. Ground response spectra based on 500 years return period of earthquake was developed and shown in Figure 5.

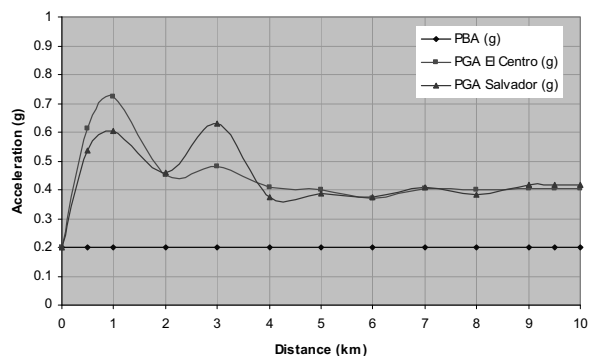


Fig. 4 Comparison between acceleration at base-rock and ground surface

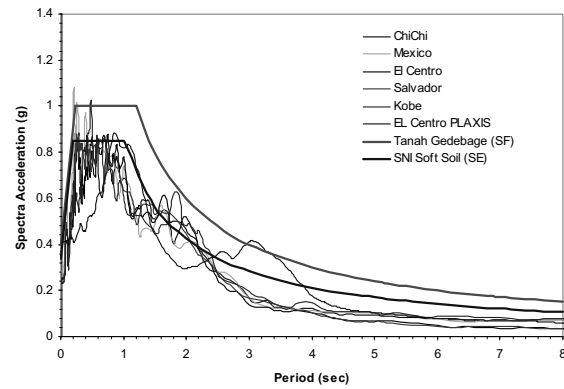


Fig. 5 Envelope of ground response spectra for 500 years return period

4. Conclusions and Recommendations for Thailand

Effect of the local soil condition into site response analysis by using dynamic finite element simulation has been presented. Since Thailand is also located at soft soil sites and earthquake region, it is possible similar procedures in this study are applied. Moreover, it can be used as an input for damage estimates of buildings and lifelines for earthquake disaster mitigation of the city.

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Ground-Based GPS Detecting of Atmospheric Water Vapor for Meteorological Purpose in Thailand

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The signal propagations from GPS satellites to ground-based GPS receivers are delayed by atmospheric water vapor. This signal delay can isolate in term of zenith wet delay (ZWD) and extract into the Integrated Water Vapor (IWV) above the GPS receiver. The IWV data can be used for meteorological purposes. Two case studies were considered. The southwest monsoon period is showed by the strong correlation of the variation of IWV, wind direction change and rainfall. The increasing and decreasing of IWV could be indicated the onset and the withdrawal of the southwest monsoon period. The other is the confluence wind from the Gulf of Thailand. It may cause the increasing of the shot-term-rapid of IWV, which is detected at BNKK station, and the propagation to the north of Thailand, which is detected at CHMI station.

1. Introduction

GPS is the navigation satellite system developed by the U.S. Department of Defense. GPS is not only used for the navigation as follow the original purpose, but also it can be widely applied to the geodetic positioning, time transfer, and surveying by geodesists, geophysicists, and surveyors. Recently, base on the fact that the GPS signals are delayed when the signals pass through the earth's atmosphere and the water vapor in the troposphere, they play an important role the delay. So, the used of GPS for meteorological purpose has been conduced. The signal delay, which causes by the water vapor along the path from GPS satellites to GPS receivers as called as zenith wet delay (ZWD), can be derived vertically integrated water vapor (IWV) of the atmosphere [1].

2. Methodology (or Experimental)

All of the GPS receivers provides the data of pseudorange and carrier phase in two frequencies ($f_1 = 1575.42$ MHz, $f_2 = 1227.60$ MHz) with the 30 seconds sampling interval. The GPS signals, which propagate from GPS satellites to ground-based GPS receivers, are delayed by atmospheric water vapor. This delay is parameterized in terms of a ZWD, which is retrieved by filtering of the GPS data. Given surface temperature and pressure readings at the GPS receiver, the retrieved ZWD can be transformed into an estimate of the IWV overlying that receiver [2].

Two case experiments, the identification of the southwest monsoon period of Thailand and the consideration of the confluence wind

from the Gulf of Thailand into the land, were set up to study the possibility to use the derived-GPS IWV together with the other meteorological data. The IWV data from 2001 to 2003 were used to investigate the onset and the withdrawal of southwest monsoon period. The day-to-day relationship between the IWV data and the wind directions were used for consideration of the effect of confluence wind flow from the Gulf of Thailand into the land area.

3. Results and Discussion

Rainy season of Thailand dominates by Southwest Monsoon period that bring the moist air and rainfall from the Pacific Ocean into the land. According to the 30 years history of mean monthly rainfall of Thailand, the period of highly rainfall from May to October is as same time as the Southwest monsoon that dominates in Thailand. In order to identify the monsoon onset and withdrawal, IWV is utilized in this study. With the investigation of the transition period of IWV related to the wind direction and rainfall, we could identify the onset and withdrawal of the monsoon over Thailand. For the onset time, the result showed that the IWV slightly increases from around Day of Year (DOY) 100 to around DOY 130 at the same time as wind direction changes from Northeast to Southwest direction and rainfall started. The slope of the IWV increasing is 0.55. For the withdrawal time, the IWV slightly decrease from around DOY 290 to 320 with slope -1.32 at the same time as wind direction changes from Southwest to Northeast direction and rainfall decreased.

The wind passes the Gulf of Thailand into the land, generally called as confluence wind, the moist air from the Gulf of Thailand is transferred. On the day that the condition of confluence wind dominates, the high density of water vapor in the atmosphere is detected. The wind directions and speeds are responsible and dependent on how far the moist air from the ocean can transfer into the land. Although, the wind data are not enough to consider the moist-air-transferring because they are no moist air information show in the wind data. In this case, it might be possible for the IWV data to provide the connection between the wind and the moist air information. In this study, the IWV and wind data of two stations, Bangkok (BNKK) and Chiang Mai (CHMI), were used. It could be noted that the vicinity maximum effect of confluence wind from Gulf of Thailand should be found on the BNKK station because of the location, however if the confluence wind strong enough, CHMI station also will be affected. The day-to-day relationship between the IWV data and the wind directions were used for consider the effect of confluence wind flow from the Gulf of Thailand into the land area. The result showed that a spike of IWV data was appeared on the day of moist air which was transferred by the confluence wind. It clearly obtains from the phenomena of the confluence wind that the moist air is transported into the deep land. For example, DOY 052 of year 2002, the observational result showed that the spikes of IWV data were detected in both of BNKK and CHMI stations as the time of confluence wind was dominated. At BNKK station, the observational data showed that the wind direction was around 100 degrees. It was the direction of confluence wind flow from Gulf of Thailand. The spike of IWV found at this station with the maximum value of 36.42 mm. At CHMI station, we observed the IWV with the maximum spike of 24.12 mm and around 200 degrees of wind direction. It was the direction of confluence wind from Bangkok to Chiang Mai.

4. Conclusions and Recommendations for Thailand

For GPS-meteorology in Thailand, it is clearly from the case studies that the results introduce the good possibility to use in Thailand. The first case illustrates the next step on southwest monsoon period of Thailand by using remote sensing technique. The second case can develop as the monitoring system of

the moist air propagation which is useful for rain-making activity.

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The Government Evaluation of Information Technology Using Group Technology Selection

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Government decisions on investment in new information technology projects have become particularly crucial in highly competitive projects in which designs, users and distribution strategies change rapidly. The contribution of this research is to propose a framework to enable Decision Makers (DMs) achieve an overall consensus in the technology selection of Information Technology (IT). The framework consists of a series of steps beginning from individual rankings of criteria, through to a consensus ranking applying Delphi and Maximise Agreement Heuristic (MAH) methods. For the individual decision maker, the approach applies the Discounted Cash Flow (DCF) to quantify the quantitative impact of the value of IT projects. Then the model is enhanced to accommodate the consensus ranking which can handle both quantitative and qualitative based upon applying Delphi and MAH. The advantage of DCF - Delphi with MAH is that in a group setting, status differences can reduce the willingness of group members to participate, and it is possible a few individuals can dominate the decision process, particularly in Government decisions on IT investment levels in which this research has been done in Thailand.

1. Introduction

The objective of this research is to present a framework to enable Decision Makers (DMs) to work as a group and achieve an overall consensus. An explanation was given to each DM as to precisely what is meant by each Government IT alternative proposed. The DMs usually indicated that the explanation of the problem, and the DCF were helpful in enabling them to articulate their decision criteria. They were not sure, however, how to manage different individual ratings of the relationships between all IT alternatives, to reach a reasonable consensus.

2. The Enhancement of Group Decision Making

The first response to the awareness from DMs is to apply the principle of the review of the individual judgments by an anonymous group based upon the criteria. Whilst there are several techniques in practice, the Delphi method developed by the Rand Corporation is amongst the most practical (Tavana *et al* [1]). Its objective is to obtain the most reliable consensus of opinion of a group of experts without direct confrontation. The Delphi method is composed of three essential processes. Firstly, to achieve judgments from individual DMs. Secondly, to collate and statistically summarize the individual judgments. Finally, to feed the collated information back to individual DMs without revealing their identity and seek for a revision in their judgments, if any. Theoretically, the sequence of collating, feedback and revision is

repeated over several rounds until no further change is achieved. At this stage, the ranking information of Benefits/Costs/Risks on making Government IT decision from the individual DMs, come from interviews with five Government Project Leaders in Thailand, and this is the first process in the Delphi method.

3. Results and Discussion

The individual ranking preference weights and Mean of the Element Relationships are shown in Table 1 which come from five collaborating Government Project Leaders based upon Benefits, Costs and Risks criteria of investing in IT (given priority is the comparison converted from DCF).

Table 1 illustrates the mean rankings from which indicates that Benefits (0.34) is the most important criteria over Costs and Risks. However, the Benefits achieves nearly the same amount of others preference, which means the DMs have given all criteria nearly equal weight to the costs and risks of IT. The next process is to submit the results from Table 1 to all the DMs who are encouraged to reconsider their earlier pairwise comparisons of the criteria. These revisions constitute the second round.

Table 1 Preference Weights (Round 1)

Gov.	Ben.	Costs	Risks
1	0.35	0.35	0.30
2	0.33	0.33	0.33
3	0.30	0.30	0.40
4	0.40	0.30	0.30
5	0.33	0.33	0.33
Mean	0.34	0.32	0.33
Rank	1	3	2

Table 2 Preference Weights (Round 2)

Gov.	Ben.	Costs	Risks
1	0.35	0.35	0.30
2	0.33	0.33	0.33
3	0.30	0.30	0.40
4	0.38	0.34	0.28
5	0.35	0.35	0.30
Mean	0.34	0.33	0.32
Rank	1	2	3

Based upon the ranking of the preference weights in Table 2, Benefits is still be the most important, with the calculation of overall mean score = 0.34. The second most important is Costs and then Risks respectively. This can happen only because, in Round 2, the DMs improved their earlier pairwise comparisons of the criteria without introducing potential bias from interpersonal interaction.

The Delphi processes are stopped after only Round 2, due to the time availability from the DMs. One suggestion from the DMs was that DCF with Delphi and overall mean scores cannot provide a reasonable consensus ranking because it should accommodate the consensus logic rather than only the average of preference weights. There is a need to provide a method with more insight than overall mean scores to closely represent their consensus view.

Group decision making processes and optimal aggregation techniques for ordinal individual ranking have been studied by a number of researchers. Amongst them Beck and Lin [2] develop MAH and "Minimising Regret Heuristic" or MRH which is simple and more practical than those complex approaches. Therefore, the MAH is chosen to apply in this research based upon the ranking in Delphi Round 2 (at Table 2). The MAH algorithm can be seen in Beck and Lin [2].

Table 3 Comparison Between Ranking

Rank	Preference Ranking from Delphi Round 2	Preference Ranking from MAH
1	Benefits	Benefits
2	Costs	Costs
3	Risks	Risks

Table 3 illustrates the comparison between the Delphi ranking (Round 2) of overall mean scores (From Table 2) and the MAH ranking. There is no preference changed in ranking from MAH result. This time the DMs can feel more comfortable with the criteria and weights given by the agreement processes.

4. Conclusions and Recommendations for Thailand

The objective of this research is to present a framework to enable DMs to work as a group and achieve reasonable consensus. Integration of DCF - Delphi with MAH can increase in-depth analysis and contribute to providing a higher quality decision, particularly investment in several government projects that encounter a number of effects e.g. cost of project, environment issues etc. In DCF-Delphi with MAH, DMs are questioned systematically and feedback is provided anonymously. The logical structure of the approach and the impersonal feedback of Delphi reduce the inhibitory effects of status differences and the potential domination of the group by a few individuals. In addition, with MAH, a Government IT Project Leader can be satisfied with the explicit way of deriving the rankings that can make a decision more clearly and effectively.

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A Real Time Delphi System¹ for Foresight Study of Sustainable Universal Health Coverage in Thailand

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Real Time Delphi system offers a way to transfer intangible expert opinions into a physical media. It allows group discussion to reach a sound consensus. Base on anonymity, iteration, and controlled feedback, experts can give their opinion, revise, and provide their supporting arguments to motivate the group rather than any individual in it. In the Foresight Study of Sustainable Universal Health Coverage in Thailand, the system helped gathering expert opinions and formulating tangible data, which later makes a scenario building workshop smooth, cooperative, and informative

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1. Introduction

In typical discussion in a meeting, there are some people tend to use opinions, rather than facts, to validate their points. Now, is it really true? Would the others support that argument? It is rather hard to prove due to the intangible nature of the opinions. Is there any way we can transfer the intangible opinion into some physical media?

A method called Delphi technique [1], developed by RAND Corporation, can be a solution to this problem. It can effectively collect and synthesize expert judgments. It has been used for planning, decision making, and policy research. An output from the method would be the group's opinion. By 2003, the formerly paper-based Delphi technique has been implemented as Real Time Delphi [2] – utilizing computer and the Internet to process and feedback responses in real time.

The conventional Delphi technique is based on “rounds”. In each round, panel experts are asked to provide their opinion on a set of wicked problems [3] – problems with ‘good or bad’ answers rather than ‘right or wrong’ ones. Experts are not required to state their supporting argument in the first round. For the later rounds, the experts are given the group response from the previous round, and then they have to state their opinions again. Participating experts can reevaluate their previous opinion against group response. This time, if the opinion from an individual expert is in a significant disagreement with the group, he or she would be strongly encouraged to provide the supporting argument.

A Real Time Delphi (RT Delphi) is a new approach to a Delphi study. It provides computer based communication where the group responses information is made available at (almost) real time. This approach would eliminate necessary of “round” since information can be processed automatically. Gordon and Pease [2] claim that this “round-less” approach is efficient and applicable to any Delphi topics.

Adopting the technology and the technique, RT Delphi system was developed for Health Insurance System Research Office (HISRO) in order to help capturing and processing experts opinion on sustainable universal health coverage in Thailand. The information captured in this process will be a vital foundation to the scenario building workshop. The workshop participants can refer to the concrete information rather than opinions.

2. Methodology

As mentioned, the system was developed for real investigation, a foresight study of universal health coverage. There are three sections in the questionnaire: 1) Value – questions focus on asking about important values in healthcare system, 2) Key System Driver – questions about what would happen to those values if some foreseeable event which acted as driver happened, and 3) Uncertainty – questions about what would happen to the values in an event which some unfortunate incident has occurred. In practicing Delphi technique, steps involved were:

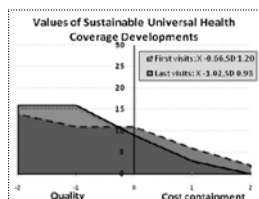
¹ The system was built as a joint work between Health Insurance System Research Office (HISRO) and APEC Center of Technology Foresight (APEC CTF).

- Panelists reviewed set of Values, Key System Drivers, and Uncertainty Factors, formulate a set of questions along with papers on the topics.
- The RT Delphi system was built with selected questions integrated.
- First round were initiate in a workshop with 79 participants.
- Second and third round was informally formed by email invitation.
- Results were analyzed
- Experts were invited to join scenario building workshop, using analyzed result from the system.

The final results of the scenario building workshop, interesting and important as they were, are beyond scope of this paper.

3. Results and Discussion

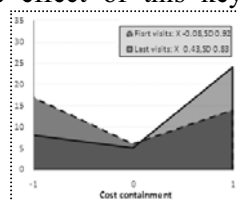
First set of questions are designed to extract experts' opinions on values of healthcare system. For example, experts were asked to value the following two objectives of a healthcare system: quality and cost containment. The answers are rank from -2(quality) to 2(cost containment). The average from the first round result is -0.66 with standard deviation of 1.20. At the end, the average was shift to -1.02, a little more to quality side, while the standard deviation is reduced to 0.93. The reduction in standard deviation can be very well interpreted as expert agreement.



This set of questions follow Thurstone's Law of Comparative Judgment[4]. Two values were positioned against each other when asking experts to select their responses. As such, one cannot value one side without compromise the other.

Second and third set of questions are linked back to values questions. For example, the experts were asked if the government budget were reduced (key system driver), how would it influent the values asked in the first question (quality/cost containment).

The responses to the effect of this key system driver to the value cost containment are interesting. At first the average was -0.08, which can be read as reducing government budget would have a slightly negative effect on healthcare cost containment. Toward the end,



after they have seen the group result and reasons, the group was moved to positive 0.43.

It is important to note that the result of the system is not the final output of the study. It would merely be an input in a policy building workshop. With this in mind, experts can concentrate on expressing their opinions rather than trying to control group responses.

4. Conclusions and Recommendations for Thailand

In the kick-off meeting, experts were impressed by the system. They were excited that they can observe the group responses in real time. They were keen to confirm or revise their opinion base upon the group result and gave supporting argument without fear of peer judgment.

There were considerable amount of important information made available by RT Delphi system in the workshop. This information would be rather hard, if at all possible, to be formulated by other means.

The RT Delphi system can be as useful in any other foresight researches. Evidently, this system can help promote sustainable development when many experts are involved, no matter where they are.

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Alleviating Identity Theft in Social Network

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Identity theft in social networks is becoming a hot issue. The fraudster can forge any online identity in social networks using the image saved from a user's profile. He can use this online identity to gain access to secrets, stalk, or trick users into doing something the fraudster wants which is the fundamental step in social engineering. I propose the design and prototype implementation of an image verification server that uses digital watermarking to prevent fraudsters from forging a legitimate user's profile in social networks. The server also gives users better control over their privacy.

1. Introduction

As social networking web sites such as MySpace, LinkedIn and facebook have become popular, they also raise many privacy concerns. Only a small number of members change the default privacy preferences, which are set to maximize the visibility of users' profiles. Based on the information they provide online, users expose themselves to various physical and cyber risks, and make it extremely easy for others to create a digital dossier of their behavior.

Even if the users are careful and do not disclose their profile to public, it is still very easy for fraudsters to trick the users into accepting his friend request and gain access to the information. The fraudster can forge the profile of someone the target knows or someone famous using the image saved from their profiles. He, then, send out the friend request. The user would be tricked into thinking that this is his acquaintance and accept the friend request. This problem occurs because the fraudster can freely use the profile image of whoever he met in the social network as his own profile image.

I propose the design and the prototype implementation of an image verification server which can be used to alleviate the above problems in social networking web sites. The principle behind an image verification server is to verify the authenticity of the image and find the original owner of the image. After that, the site that uses image verification services can take an appropriate action. In social networks, like facebook, the site can notify the original owner about the uploading of his/her image and ask for the consent before allowing the uploading user to use it in his/her profile. The concept of an image verification server is general and can be applied to any web site.

2. Image Verification Server

The goal of the image verification server is to offer a service to verify whether the

uploaded image is genuinely from the user or belongs to another user. The server uses digital watermarking to achieve that.

Digital watermarking is a technique which can be used to embed information into images. When the image is first uploaded by the original owner to the social networking web site, the server embeds the ID of the user into the image using a digital watermarking technique. After the uploaded image is re-uploaded by other users, the server tracks the original owner of the image by extracting the ID from the watermark.

I implemented the prototype of the image verification server as a proof of concept. The other goal is to observe performance and usability of the server. I used Xie's algorithm [1] for digital watermarking in the prototype due to that it satisfies the purpose of the server according to the analysis in Meerworld [2]. The prototype is a simple social network implemented in php 4.3.10 with a MySQL database. In the prototype, the user can display some basic information in his/her profile and upload a profile image. In addition, the user can see who is uploading his/her image and approve or disapprove the uploads.

3. Evaluation

Under the normal operation (browsing, upload and approve image), the prototype works as expected. It is transparent to user. The latency of 100 KB image uploads increase 10 times (from 0.11 seconds to 1.13 seconds on average). The newly uploaded image can be embedded with a watermark. When the profile visitor saved the uploaded image, the system can detect the presence of the watermark and send approval request to the original owner of the image.

The fraudster can attack the watermark by applying transformation to the image. This transformation can distort the watermark and make the detector fail to detect it. I tested the robustness of the system with basic

transformations from Adobe Photoshop. I applied transformations to the image and tried to upload and observe if the system can still identify the owner of the image. The results show that the server can withstand blur, sharpen, and noise filters. The server can also withstand level adjustment. However, the server fails to detect cropping of the image. This is due to the fact that Xie's watermarking algorithm is weak against cropping. The detailed analysis and evaluation of the algorithm can be found in Meerworld [2].

4. Discussion and Recommendations for Thailand

Image verification server relies on the robustness of the digital watermarking algorithm used. The verification is secured as long as the watermark is secured. Note that the image verification server does not prevent a fraudster from saving the image and use it locally on his computer. The fraudster can also upload the profile image saved from other sources that are not verified by the server.

In the future, a more robust algorithm for digital watermarking can be used. The combination of digital watermarking and image similarity can also potentially improve the performance of detection. Moreover, different watermarking algorithms are strong against different kinds of attacks. Thus, random algorithms can be used to make it more difficult to formulate the attack. For example, other algorithms might be strong against cropping attack but weak against level adjustment. The server can randomly select between these two algorithms. The attacker will have to find the correct transformation for the image in order to destroy the watermark.

I believed that a new application area of digital watermarking in combating identity theft in social network will bring more effort into this field of research and a robust algorithm can be achieved.

Identity theft in social networks is a worldwide problem. Thai users face the same problem. Some popular social networks among Thai people are hi5, multiply, and facebook. Many Thai users openly disclose their private information on these websites. This leads to the problem of impostors who impersonate legitimate users' profile. They use images and information found on users' profile to create a fake profile. The consequences from these incidents are similar to what I have discussed in the introduction. This is essentially the problem that this paper trying to solve.

However, the most efficient counter-measure to this problem lies on the users themselves. First, users need to carefully select their privacy level settings. Public access to their profile should be prohibited. Second, users should also be cautious when accepting their friend requests. Finally, users should be aware that some messages or images posted on these websites are available to others as well.

4. Conclusion

Image verification server can mitigate these identity theft problems in social networks by preventing the fraudster from freely saving a user's profile image and use it on his own. The level of privacy is also increased by letting users control their image usage. The prototype implementation shows a good performance. It can detect most basic image transformations.

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Development of Thai Broadcast News Transcription System

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Broadcast news transcription system is one of the applications that can shift the paradigm of text indexing to multimedia indexing. In case of English, research activities have been continuing for more than ten years. Tokyo Institute of Technology has initiated the development of the first Thai broadcast news transcription system since 2007. We started by developing speech and text corpora which are crucial to the development of a state-of-the-art speech recognition system. This paper shows overview information of our corpora and attempts to improve the performance of the system.

1. Introduction

Multimedia information has been getting more and more important especially on the internet in the past few years. Many broadcasting companies have started making their archives in digital format. Various services, such as search engine, are expected to be ready for processing multimedia information the same as what have been performed on written text data. Broadcast news transcription system is one of the applications to fulfill this desire. Research on broadcast news transcription system has become attractive to many research groups since the initiation by DARPA in 1995. Tokyo Institute of Technology has started the development of the first Thai broadcast news transcription system since 2007. The time lag of this research theme for Thai drives motivating challenges to speed up our research activities to catch up with others.

2. Corpora construction

As the development of a state-of-the-art speech recognition system depends on large speech and text corpora, a collection of Thai broadcast news corpus was developed. It consists of three main corpora: a broadcast news speech corpus, a broadcast news transcript text corpus, and a newspaper text corpus.

The speech corpus is the collection of broadcast news recordings including structural descriptions, text transcriptions, and additional information such as speaker information (name and gender), speaking style, and background noise. This corpus was transcribed from around 17 hours of TV broadcast news.

The transcript text corpus is the collection of text transcribed from broadcast news recordings. It was transcribed exactly the same as the text associated with the speech corpus except that no structural information is annotated. Our broadcast news transcript text was derived from 35 hours of TV broadcast news.

The newspaper text corpus was collected from newspaper text covering about five years of news (2003-2007).

3. Language modeling

3.1 Lexical units

Traditional language models (LM) rely on lexical units that are defined as entities separated from each other by word boundary markers. Since there are no such boundaries in Thai, alternative definitions of lexical units have to be pursued. The problem is thus to find the optimal set of lexical units that constitutes the vocabulary of the LM and yields the best final result. The word is a traditional lexical unit recognized by Thai people and is used by a typical Thai large vocabulary continuous speech recognition (LVCSR) system. Novel lexical units for Thai LVCSR, pseudo-morpheme (PM) and compound pseudo-morpheme (CPM) were proposed in [1].

3.2 LM interpolation

The transcript text corpus is much smaller than the newspaper text corpus. An n -gram LM trained from the newspaper text corpus should be reliable to predict general news text; however, the newspaper LM cannot predict spoken style text well because there is not much spoken style text in the newspaper corpus. Interpolating the newspaper LM with the transcript LM should help improve the performance of the newspaper LM. The combined LM can be thought of as the newspaper LM that was integrated with better n -gram estimation on spoken style text. The overall likelihood $P(w|h)$ of a word w occurring after the history h is computed as linear interpolation of $P(w|h)$ for each of the models as,

$$P(w|h) = \lambda P_1(w|h) + (1-\lambda)P_2(w|h) \quad (1),$$

where λ is the weight of the newspaper LM, $P_1(w|h)$ and $P_2(w|h)$ are n -gram probabilities of the newspaper LM and the transcript LM, respectively.

4. Results and Discussion

4.1 Test set

Audio in the speech corpus was segmented according to the annotated data. It was categorized into four groups of speech data: clean-planned speech, clean-spontaneous speech, speech with background music, and speech with other background noise. 3000 speech segments were randomly selected to compose a test set.

4.2 Overall recognition result

Table 1 shows the recognition result for all groups in the test set. We used PM error rate (PER) as a measure of recognition accuracy. The LM was trained from the broadcast news transcript text corpus. The word, defined by humans, was used as a lexical unit in the LM and the pronunciation dictionary used in the LVCSR engine was manually made by humans. As expected the recognition result of clean-planned speech yielded the best result.

4.3 Comparison among various lexical units

Table 2 shows the recognition result of systems using different lexical units. Only the newspaper text corpus was used to train LMs. All pronunciation dictionaries used in the LVCSR engine were generated automatically by a tool. SWATH [2] was used as a word segmentation tool for generating tradition word units. Here, only clean-planned speech data in the test set was used for evaluation. From the result, the proposed CPM system clearly outperforms the Word system.

4.4 Transcript and Newspaper LMs

Two LMs were trained from the transcript and newspaper text corpora. Various LMs were then created by the interpolations of these models, varying the weight λ . The dictionary size was fixed to around 64k and pronunciation entries were generated by a tool. Only clean-planned speech data was used for evaluation. PER is showed as a function of the newspaper LM weight in Figure 1. The best result was obtained from the interpolated model when the newspaper LM weight was 0.5. The improvement over the newspaper model came from the enhanced estimation on spoken style speech. Conversely, the improvement over the transcript model was resulted from better n-gram estimation on general text.

5. Conclusions and recommendations for Thailand

Research activities on Thai broadcast news transcription system at Tokyo Institute of Technology were reported in the paper. This research directly benefits technologies for Thai language. At present, the size of our corpora is still extremely small, compared to other languages' corpora. We are now collaborating with NECTEC to develop additional corpora.

Table 1 Recognition result of various speech condition

Speech condition	Time proportion	PER (%)
Clean-planned	35.3%	18.1
Clean-spontaneous	1.0%	37.8
Background music	14.0%	51.0
Other background	49.7%	33.5
Overall	100%	30.7

Table 2 Recognition result of various lexical units

Lexical type	PER (%)
Word	24.9
PM	28.5
CPM	23.5

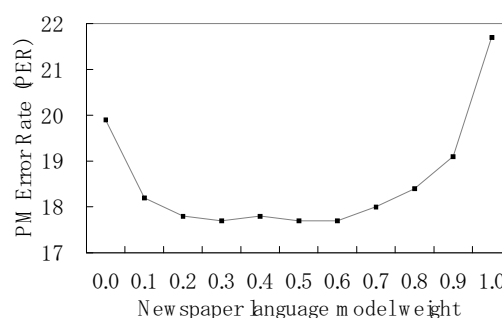


Fig. 1 PER based on interpolated models

The construction of corpora will move forward more quickly if the cooperation with TV stations can be established. Then, the large-scale corpora can be achieved to support research on broadcast news speech recognition.

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Thai Named Entity Extraction based on SVM

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The method for Thai Named Entity extraction using SVM was proposed. Thai Named Entity characteristics were grouped into three categories: Person, Organization and Location. The method was proposed using the combination between rule based method and learning method. Rule based method was used in the preprocessing step to detect the Thai Named Entity. We employed some of clue words as the named identifier to identify Named Entity. Each category contains 500 sentences. All selected sentences included target word and the neighbor words with ± 2 window size. Fifteen feature sets were extracted to investigate the optimal feature set. The standard evaluation measures which are widely used in IR research fields such as Precision, Recall and F-measure were used. The result of 4-fold cross validation using Thai news corpus showed that the optimal feature set is the combination of Word, SM (Semantic Concept Information) and Orthographic which more than 93 in Location category, 89 in Person and 76 in Organization category.

1. Introduction

NE (Named Entity) is often seen as important clue in topic of the text. NE recognition is a task in which proper name and numerical information are extracted from the documents and classified into categories such as person, organization, place and date. NE recognition has been successfully applied to English due to the interest generated by evaluation conferences such as Message Understanding Conference (MUC). There were many approaches attempted to solve this kind of problem such as dictionaries and rule based approach, and some supervised learning techniques. For Thai NE, there are some features of Thai NE such as Thai NE do not use capital letter which uses for recognizing NE in English, there are some special characters or some orthographical information which can be used only for Thai NE, there is a large portion of Thai NE that has no specific construction rule, many Thai NE begin with common noun or group of common nouns, Thai NE can be a noun phrase or compose of preposition phrase and the abbreviation can use for Thai NE but some abbreviation words are not. Since the Thai language limitation, the Thai NE extraction tasks were very few. According to the work of [1], they proposed the feature based approach and employed Winnow algorithm for Thai proper name identification. The features they used are context and collocations as well as POS (Part Of Speech) tag. [2] presented the Thai NE identification task using two learning algorithms: Winnow and RIPPER. Their experimental result showed the effectiveness of Winnow and RIPPER, and demonstrated that Winnow is superior to RIPPER. [3] used statistical and heuristic rule based model to

locate and categorize Thai NE. The result is remarkable in magazine genre but not in newspaper genre. In contrast to previous similar works, this research uses the combination of features such as Word, POS, SM and Orthographic to improve performance for Thai NE extraction. We focused on identifying name belonging to Person, Location and Organization.

SVM has emerged as one of the leading trainable models for many classification tasks that involve discriminative learning from positive and negative examples. In our research, we used the SVM_light which is an implementation of Joachims [4] to train our data. We use default values for all parameters.

2. Experimental

There are two main modules; preprocessing and NE recognition. The preprocessing module composes of collecting sentences, and segmenting and tagging POS. We collected 500 articles of Thai business news from The Krungthep turakij news site. In order to carry out the training corpus, the sentences which contained NE target words were then selected automatically by rule based tagger containing pattern match rules and clue word list. We separated sentences into three groups; person, organization and location. Each group had 500 sentences, 2500 words. All sentences were then send to segment and tag POS by SWATH program [5]. Since we defined our window size as ± 2 from the target word, therefore each sentence contained 5 segmented words. All target words were determined POS as proper noun while all neighbor words were assigned POS by SWATH program. In NE recognition process, they compose of preparing training data and

testing data and then training and classifying data based on SVM_light. In our method, the main features compose of Word which is the numbering of each word in the corpus, POS which derived from SWATH, SM which is a group of lexical entries classified and ordered in the hierarchical level of meanings, and Orthographic feature such as space, parenthesis etc. The experiments of 15 feature set's combinations were investigated. Due to the use of a context window, the SVM input vector is the combination of the feature vector of the current word and those of the neighboring words. The feature vector derived from a word is a long sparse vector. First, the algorithm collects all possible features from the training documents. Each feature corresponds to one dimension in the feature vector. Therefore the vectors tend to have thousands of dimensions, but only with a small number of nonzero components which correspond to the features of the words. We set the value of nonzero components to "1". We used the standard evaluation measures which are widely used in IR research fields such as Precision, Recall and F-measure.

3. Results and Discussion

Results for comparing the accuracy from all combinations belonging to each category; person, organization and location are shown in Table 1, Table 2 and Table 3 respectively.

Table 1 The comparison of accuracy between Base1(Word and Orthographic) and other features within Person category

evaluation	Base1 (Word+Ort.)	Base1+ POS	Base1+ SM	Base1+ POS+SM
Precision	83.34	85.58	88.71	89.73
Recall	95.8	93	90.4	87.6
F-measure	88.74	88.49	89.12	88.18

Table 2 The comparison of accuracy between Base2 (Word and SM) and other within Organization category

evaluation	Base2 (Word+SM)	Base2+ POS	Base2+ Ort.	Base2+ POS+SM
Precision	76.29	75.71	79.88	79.68
Recall	74.8	74.2	73.2	73.4
F-measure	75.51	74.9	76.26	76.26

Table 3 The comparison of accuracy between Base3 (Word and Orthographic) and other features within Location category

evaluation	Base3 (Word+Ort.)	Base3+ POS	Base3+ SM	Base3+ POS+SM
Precision	90.17	91.47	92.39	92.18
Recall	94.8	94.5	94.8	94.6
F-measure	92.39	92.94	93.56	93.36

4. Conclusions and Recommendations for Thailand

Due to the rapid growth of the internet, the number of online documents is exploding in our daily life. This situation makes it difficult to find and gather all information we really needed. Name Entity can apply to many Natural Language Processing (NLP) tasks such as Information Retrieval, Information Extraction, Machine Language understanding, Machine translation, Thai thesaurus construction and Text summarization. We recommend that it is necessary to improve NLP tools for Thai language to support the numerous documents that we consume everyday. Since the lack of researches in this area for Thai language, it can be the opportunity for Thai researcher to research and develop new innovation for Thai NLP tasks.

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Vitamin D Status and Falls, Frailty, and Fractures among Postmenopausal Japanese Women Living in Hawaii

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In this study we investigated vitamin D status and its relationship to physical performance, muscle strength, falls, and fractures in postmenopausal Japanese females living in Hawaii. Of 510 community-dwelling postmenopausal women participated in the 8th examination of the Hawaii Osteoporosis Study, 495 were included in these analyses. Multivariate regression models were used to evaluate the relationship of 25-OHD (D_3 and total) to 8 performance-based measurements, 12 activities of daily living (ADLs), and muscle strength (grip, triceps, quadriceps). Logistic regression analyses were performed to evaluate the relationship of 25-OHD to falls, vertebral fractures and non-vertebral fractures. The mean total 25-OHD was 31.94 ± 9.46 ng/mL; 44% of subjects had values <30 ng/mL, while none had values <10 -12 ng/mL. There was little evidence of seasonal variation. Among performance-based measures, ADLs, and strength tests, only quadriceps strength was significantly associated with total 25-OHD ($p=0.0063$) and 25-OHD $_3$ ($p=0.0001$). No significant association of 25-OHD was found with vertebral or non-vertebral fractures, or incidence of one or more falls. The lack of serum 25-OHD relationship with falls and fractures or most physical performance measures in this study may be related to the low prevalence of very low 25-OHD levels in this population.

1. Introduction

Fall and hip fracture rates in native Japanese in Japan and Japanese-American females in Hawaii were reported to be half of those of Caucasians living in Hawaii and other parts of the United States. This population group also has one of the longest life spans in the world. High fish consumption and abundant sunlight throughout the year are known to be characteristics in this population. Differences in vitamin D status and seasonal variation of vitamin D levels among these populations may contribute to these findings.

We hypothesized that 1) vitamin D deficiency (<10 -12 ng/mL)^[1] is less prevalent in this population, and 2) that higher serum 25-OHD levels would be associated with better measures of physical performance, muscle strength, and a lower incidence of falls and fractures.

2. Method

The subjects of this study were the 495 women (mean age 74 ± 5 years) who participated at the 8th examination of the Hawaii Osteoporosis Study (HOS)^[2] conducted from January, 1992 through September, 1994. Their serum specimens were collected and preserved -70 degrees. Serum 25(OH)D assays were performed at Nichols Institute using liquid chromatography tandem mass spectrometry in 2006.

Multivariate regression models were used to evaluate the relationship of 25-OHD (D_3 and

total) to 8 performance-based measurements, 12 activities of daily living (ADLs), and muscle strength (grip, triceps, quadriceps). Logistic regression analyses were performed to evaluate the relationship of 25-OHD to falls, vertebral fractures and non-vertebral fractures. Each of above data was collected at the 8th HOS exam.

3. Results and Discussion

Subjects mean age was 74 ± 5 year, and mean BMI was 23.5 ± 4.4 kg/m². Mean serum 25-OHD levels was 31.94 ± 9.46 ng/mL (79.85 ± 23.65 nmol/L)(Figure 1), ~ 28 ng/mL (70 nmol/L) during January and February, and 31-34 ng/mL (77.5-85 nmol/L) during most other months.

Among 8 performance-based measures and 3 strength tests, only quadriceps strength had a significant association with serum 25-OHD ($p=0.0063$) and 25-OHD $_3$ ($p=0.0001$) after adjustment for age, height, and weight. No significant associations were found between 25-OHD levels and difficulty with any of the 12 ADLs.

During a mean follow-up of 2.7 years, there were 31 subjects who had vertebral fractures, 24 subjects who had non-vertebral fractures, 147 subjects who had a first fall and 64 subjects who had a second fall. No significant association of 25-OHD was found with vertebral or non-vertebral fractures, or incidence of one or more falls.

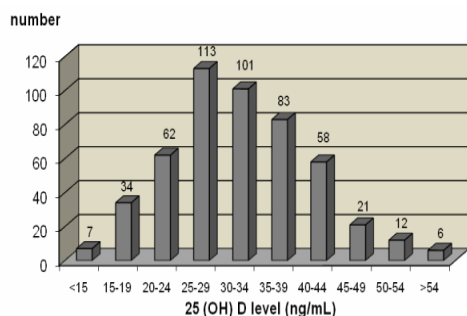


Fig.1 25-OHD levels

None of the subjects in this study would be considered vitamin D deficient (with 25-OHD level <10-12 ng/ml^[1]). These findings are consistent with our first hypothesis, and may be attributable to more consistent UV-B exposure, active lifestyle, and high dietary fish content in Hawaii. The diet of Japanese-American women in Hawaii appears to be a combination of foods typically eaten in Japan and North America. Fish consumption in Japan is much higher than in Europe or the United States, and constitutes 91% of daily vitamin D intake in Japan. However, diet supplements other than fish may also constitute a large part of dietary vitamin D intake in these subjects.

Multiple studies ^[3,4] have suggested that low vitamin D status may occur despite adequate sun exposure. This is confirmed in our study, in which the lowest 25-OHD level that was observed was 10 ng/mL. Despite the relatively high mean serum 25-OHD in our cohort, a substantial proportion of subjects (44%) still had serum 25-OHD values less than 30 ng/mL and would be considered by some to have “suboptimal” vitamin D status. This finding suggests that in order to achieve optimal 25-OHD levels, wider use of vitamin D supplementation may be appropriate, even in a population with abundant sun exposure.

No association was observed between serum 25-OHD levels and most of the outcome measures in this study. This might be explained by a low prevalence of very low 25-OHD levels, resulting in low statistical power because there are too few outcome events in the range of 25-OHD levels where an association would be expected to be most noticeable.

Lack of data regarding amount of sun exposure, dietary and supplemental vitamin D intake is one of limitations in this study. Also the interpretation of tests for statistical significance is less straightforward due to the large number of endpoints studied, the post-

hoc nature of the analyses, and multiple models with different covariates.

4. Conclusions and Recommendations for Thailand

In conclusion, relatively high serum 25-OHD levels were observed in community-dwelling, postmenopausal women of Japanese ancestry living in Hawaii, with very low prevalence of vitamin D deficiency and little evidence of seasonal variation. No strong association with physical performance, falls, and fractures could be demonstrated, perhaps due to the relatively low prevalence of very low vitamin D status observed in this population. Stronger relationships between 25-OHD levels and health outcomes may be demonstrated in populations with a higher prevalence of very low vitamin D levels.

This study suggests the necessity of supplement vitamin D intakes even in population with abundant sun exposure to achieve optimal vitamin D status in order to prevent fall, frailty and fractures in elderly. This may greatly contribute to Thailand, since, falls and subsequent fractures occur frequently among elderly, leading to increase in morbidity, mortality and substantial health care burden in our society. Increasing proportion of Thai older individuals would further cause rise in annual medical expenses from all falls and fractures related injuries. Therefore it is significant to prevent fall in Thai elderly. Apart from its roles in calcium metabolism, improving neuromuscular function and fall prevention, vitamin D also benefits in other non-skeletal outcomes, including lower prevalence of periodontal disease and colorectal cancer, which requires further research. Furthermore, it is also important to understand present state of dietary intake and levels of vitamin D status in Thai people.

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Evaluation of the Newly Developed Immunochromatography Test Kit for Rapid Detection of Norovirus Antigen in Stool Samples

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The efficacy of the newly developed immunochromatography (IC) assay was evaluated for the rapid detection of norovirus (NoV) in stool specimens. A total of 503 stool specimens collected from children who suffered from acute gastroenteritis in Japan and 303 stool specimens from Thailand were tested for NoV antigen by this IC kit (IP-Noro) and by a gold standard RT-monoplex PCR method. The IP-Noro kit revealed 78.9 and 75.0% of sensitivity, 96.4 and 99.2% of specificity, and 92.4 and 95.7% of agreement for Japanese and Thai samples, respectively. The findings indicate that IP-NoV kits could be used as the alternative method for screening of NoV in stool samples. The advantages of IP-Noro kit are less time consuming and simplicity of performing the test.

1. Introduction

Viral gastroenteritis is one of the most common illnesses in humans worldwide, and different agents such as rotavirus, astrovirus, adenovirus, sapovirus, and norovirus have been associated with the disease [1]. Norovirus (NoV) belongs to the family *Caliciviridae*, which is a positive-sense, single-stranded RNA virus. NoV is a leading cause of viral gastroenteritis and responsible for outbreaks in various epidemiological settings, including restaurants, schools, day-care centers, hospitals, nursing homes, and cruise ships. Currently, NoVs are grouped into five genogroups (G). Human NoV genogroups are subdivided further into several genotypes. Previous epidemiological studies clearly indicated that NoV GII/4 genotype is the main causative agent among NoV that cause acute diarrhea [2]. Because no cell culture system exists for NoV, characterization and classification is based on RT-PCR and genomic sequencing analysis [3]. Recently, broad reactive monoclonal antibody against several NoV genotypes had been produced in our laboratory [4]. This antibody was further applied to use as a capture antibody for the IC test (collaborate with Immuno-Probe Co. Ltd.). In this current research, we have evaluated the efficacy of this newly developed NoV IC kit (IP-Noro) to access their usefulness in detecting of NoV in stool samples.

2. Methodology

A total of 503 stool samples were collected from children with acute gastroenteritis symptom during 2004-05 in Japan. In addition, 303 stool specimens were

also collected during 2005-06 in Thailand. The presence of NoV in fecal specimens was detected by RT-PCR [3]. All of the NoV positive samples were characterized further for their genotypes by capsid gene sequencing.

To evaluate sensitivity and specificity of this IP-Noro kit, all of the 503 Japanese and 303 Thai samples were tested for NoV antigen by using the newly developed IP-Noro kit. The test was performed according to the manufacturer's directions. Briefly, 10% of stool samples were prepared by using buffer supplied by the kit, and then 80 μ l of stool supernatant was mixed with 20 μ l of reaction buffer. This was followed by dropping the mixture onto the strip test. The IP-Noro strip used a membrane coded with gold colloid-conjugated with mouse monoclonal antibody, which showed a broad reactivity with several types of NoVs [4]. The test line was coded with polyclonal antibodies against NoV GII/3 and GII/4, while the control line was coded with anti-mouse immunoglobulin (Fig. 1).



Fig. 1 Detection of NoV in a stool sample by using the IP-Noro kit. The test is negative when only one line appears in the control area (A). The test is positive if two lines appear in the membrane (B).

3. Results and Discussion

From a total of 503 fecal specimens collected from patients with diarrhea, 114 (22.7%) were positive for NoV by using the RT-PCR standard method. Of these, majority of the samples (98.2%) belonged to the NoV GII, while only 2 (1.8%) carried GI. Genotype identification by genome sequence analysis demonstrated that both of the GI strains belonged to the GI/1 genotype. Of the total 112 GII specimens, 95 (83.3%) were GII/4, 14 (12.3%) were GII/3, and 3 (2.6%) were GII/6 genotypes. For the 303 Thai samples, 44 (14.5%) were found positive for NoV by using the RT-PCR method. Of these, all of the positive samples were identified as NoV GII genogroup and majority was GII/4 genotype.

Table 1 Comparison of NoV detection in stool samples by IP-Noro kit and RT-monoplex PCR.

		RT-monoplex PCR	
		Positive	Negative
Japan			
IP-Noro	Positive	90	14
	Negative	24	375
Thailand			
IP-Noro	Positive	33	2
	Negative	11	257

To evaluate sensitivity, specificity, and agreement of the newly developed IP-Noro kit, the results of 503 Japanese and 303 Thai stool samples tested by IP-Noro were compared with those of the RT-PCR gold standard method (Table 1). The sensitivity, specificity, and agreement of this IP-Noro test kit were 78.9 and 75.0%, 96.4 and 99.2%, 92.4 and 95.7%, for Japanese and Thai samples, respectively (Table 2).

Recently, large outbreaks of NoV occurred in various epidemiological settings worldwide. When patients are diagnosed as severe diarrhea, rapid virus detection is essential for the intervention of appropriate treatment. For this reason, a new IP-Noro kit was developed to serve as a rapid method for identification of NoV directly from stool samples. In this study, our data demonstrated that the IP-Noro kit could be used as an alternative method for detecting of NoV in stool specimens and may be practical for screening of NoV during outbreaks of viral gastroenteritis. In addition, this kit has lots of advantages such as cost-effectiveness, easily handling at the bedside, and it takes only 20 min to get the result.

4. Conclusions and Recommendations for Thailand

Acute gastroenteritis diseases remain a leading cause of morbidity, mortality, and are still being a major public health problem

Table 2 Sensitivity, specificity, and agreement of NoV detection by IP-Noro kit between Japanese and Thai stool samples.

IP-Noro	Sensitivity (%)	Specificity (%)	Agreement (%)
Japanese samples	78.9	96.4	92.4
Thai samples	75.0	99.2	95.7

throughout the world, including Thailand. However, few molecular epidemiological studies of viral associated gastroenteritis have been conducted previously in Thailand. Accordingly, molecular epidemiological study and development of rapid detection of viruses in order to enable effective management and implementation of appropriate preventive control are needed.

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Expression Analysis of Class B-MADS Genes during Flower and Ovary Development of *Dendrobium* Orchid

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The development of petal and stamen of flower is known to be controlled by class B-MADS box genes. In orchid, petaloid organs have adapted its morphology resulting in nearly identical shape of floral organs in whorl 1 and whorl 2. To clarify the molecular mechanism underlying such particular shape formation of orchid, we isolated four class B-MADS box genes from *Dendrobium* orchid including three *AP3/DEF*- and one *PI/GLO*-like genes named *DMAP3A*, *DMAP3B*, *DMMADS4* and *DMPI*, respectively. RT-PCR analysis results showed that the expression of *DMAP3A* and *DMMADS4* and *DMPI* was detected in all four whorls of flower. However, the *DMAP3B* was strongly expressed only in whorl 2 and the signal was not detected in whorl 1. The expanded expression of *DMAP3A* and *DMMADS4* and *DMPI* to whorl 1 of flower might contribute to similarity of floral organ in whorl 1 and whorl 2 of orchid. Interestingly, the expression of *DMMADS4* and *DMPI* were also detected during the development of ovary. The results suggest that the expression pattern of class B-MADS box genes of *Dendrobium* orchid are broader than those of their counterparts in monocots.

1. Introduction

Development of flower is a major mechanism during a plant life cycle. Genetic and molecular studies on flower formation of *Arabidopsis* and *Antirrhinum* revealed that a series of MADS-box transcription factors named as A, B and C are required for the development of floral organ, which is sepals-petals-stamens-carpel from outer to inner whorl of the flower. The concerted action of the A, B and C genes could be explained by the ABC model (Coen and Meyerowitz, 1991). In particular, A gene alone plays a role in controlling sepal development, the combination of A and B genes is required to specify petal development, the B and C genes in combination controls the stamen identity, and C gene alone works to regulate carpel formation. In this study, to investigate molecular and genetic mechanism controlling floral organ development of *Dendrobium* orchid, we isolated four B class B-MADS box genes and analyze their expression pattern by RT-PCR.

2. Methodology

2.1 Plant Material

Two species of *Dendrobium* orchid i.e. *D. crumenatum* and *D. moniliforme* were used as plant material in this study. To induce flowering, the plants of *D. crumenatum* were dropped in temperature of about 10 °C for 2 days. The blooming flowers were pollinated and kept ovaries at 1, 3, 5 and 7 days after

pollination. Floral buds and the ovaries were collected and stored at -80 °C until use.

2.2 Isolation of B function genes from floral bud of *D. moniliforme*

To isolate the putative AP3/DEF and PI/GLO orthologs, degenerate primers designed from conserve sequences in the MADS-box region of orchids (Hsu et al., 2002 and Xu et al., 2006), were used as forward primers with anchor reverse primer to amplify cDNA fragments by 3'-RACE method. To get the full length genes, genes specific primer at the start codon of the genes were designed. In this study three DEF-like and one GLO-like genes were isolated named *DMAP3A*, *DMAP3B*, *DMMADS4* and *DMPI* respectively. Amino acid sequences of all four genes were analyzed as phylogenetic tree using PAUP version 4.0 software (Swofford, 1993) with the neighbor-joining method. Boot-strap values were derived from 100 replicate runs.

2.3 RT-PCR analysis

The gene specific primers corresponding for sequence of *DMAP3A*, *DMAP3B*, *DMMADS4* and *DMPI* genes were designed. Flowers at young bud stage were separated organ to be sepal, petal, lip column and ovule. Each organ was isolated for total RNA and synthesized the cDNA. To study genes expression during ovary development, ovaries of the pollinated flower at 1, 3, 5 and 7 days after pollination were used.

3. Results and Discussion

In this study, three genes from the *AP3/DEF*-subfamily and one gene from *PI/GLO*-subfamily were isolated from *D.moniliforme* i.e. *DMAP3A*, *DMAP3B*, *DMMADS4* and *DMPI* respectively. The results from phylogenetic analysis confirmed that all four genes belong to class B-MADS box genes.

For RT-PCR analysis, the expression of *DMAP3A* and *DMMADS4* and *DMPI* were detected in all four whorls of flower including sepal, petal, lip and column, however the expression of *DMAP3B* was strongly detected only in petal and lip (whorl 2) and column (whorls 3 and 4) of flower and the signal was not detected in whorl 1, sepal (Fig. 2). The results indicated that although the floral organ in whorl1 and whorl2 of *Dendrobium* orchid are identical, the molecular mechanisms control these two whorls are different. In particular, at least three of *AP3/DEF-like* genes (i.e. *DMAP3A*, *DMAP3B* and *DMMADS4*) are required for the development of organ in whorl 2. However, without *DMAP3B*, two *AP3/DEF-like* genes are necessary for the development of organ in whorl1. Interestingly, the expression of *DMMADS4* and *DMPI* were also detected in ovaries (Fig. 2). The result suggested that these two genes not only specifies floral organ identity but also has functions in ovary development of orchid. For further study, functional analysis of these two genes is necessary to confirm the genes functions.

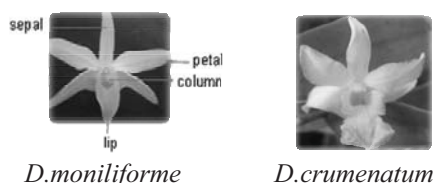


Fig. 1 Floral morphology of *D.moniliforme* and *D.crumenatum*

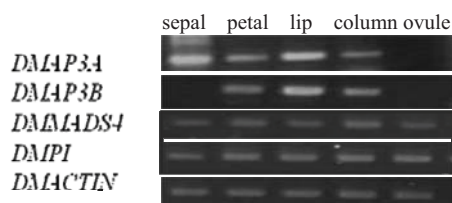


Fig. 2 RT-PCR analysis of class B genes, *DMAP3A*, *DMAP3B*, *DMMADS4* and *DMPI* in *D.moniliforme*

study will be valuable source for further study on the floral physiology of orchid. In addition, the knowledge about genes function can be used as genetic resource for breeding program of orchid.

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4. Conclusion and Recommendation for Thailand

Thailand is one famous orchid habitat in the world. Genetic and molecular study on genes controlling floral shape formation in this

Synthesis of Cereulide Analogs for Use in an Immunoassay

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LS-C04

Bacillus cereus causes two type foodborne illness, emetic and diarrheal. The emetic-type syndrome is caused by emetic toxin. Cereulide is an emetic toxin produced by *Bacillus cereus* through an unusual non-ribosomal peptide synthesis (NRPS). It is very important to prevent mold growth through good agricultural storage and manufacturing practices, with proper monitoring for possible contamination. Thus, we need to limit cereulide concentration in food and animal feeds. Currently standard methods for detection of cereulide are complicated and need an extensive clean up of the samples and require expensive instruments. An indirect competitive inhibition type enzyme-linked immunosorbent assay (ELISA) is a rapid method for diagnostic antigen or antibody. Modifications of cereulide by labeling with biotin or other biopolymer are a very powerful research tool in immunology. Linked lysine cereulide analogs is a very important rule for preparing protein conjugates to develop a quick and effective ELISA test for measuring cereulide.

1. Introduction

Bacillus cereus causes two type of food poisoning, emetic and diarrheal. The emetic-type syndrome is caused by emetic toxin and the diarrheal-type syndrome is caused by enterotoxins. The *Bacillus cereus* group consists of six members (*B. anthracis*, *B. cereus*, *B. mycoides*, *B. pseudomycoides*, *B. thuringiensis*, and *B. weihenstephanensis*). These species are closely related and should be placed within one species, except for *B. anthracis*, which causes anthrax. *Bacillus thuringiensis* is widely used for its insecticidal properties, but has also been related with foodborne disease. Cereulide **1** is toxic metabolites produced by *Bacillus cereus*. It was first isolated in 1994 by Isobe *et al.* and elucidated to have the structure as shown for compound **1**. The stereogenic centers of cereulide were confirmed by chemical degradation and the higher structure was assigned from NMR spectroscopy and molecular mechanical calculations. Cereulide **1** is 36-membered cyclic depsipeptides with 12 stereogenic centers having the sequence of cyclo [-D-O-Leu-D-Ala-L-O-Val-L-Val-]₃ (Figure 1). Cereulide **1**, produced through an unusual non-ribosomal peptide synthesis (NRPS) is known as an emetic toxin. As a food poison cereulide causes heavy nausea, vomiting, and periods with abdominal pain.

For these reasons, the presence of cereulide in food and animal feeds is potentially hazardous to the health of both humans and animals. Furthermore, cereulide contamination affects the economic values of

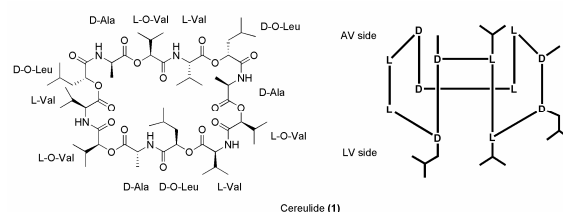


Fig. 1 2D and 3D Structure of cereulide **1**

the crops as well as reduced efficiency of animal production, resulting in higher costs incurred by all sectors from production to consumption. Cereulide contamination is most frequently found in milk, pasta, cooked rice. Thus, there is a need to limit their concentration in food and animal feeds. Therefore, suitable analytical method for detection and quantitation must be available for effective food and/or feed safety programmes. Currently standard method for detection of cereulide are oral challenge in mammals, microscopic assessment of vacuole formation in HEp-2 cells, high performance liquid chromatography (HPLC), nano-HPLC-ESI-Q-TOF-MS, Liquid chromatography-mass spectrometry (LC-MS) and PCR assays for the detection of emetic *Bacillus cereus*. However, these methods though sensitive are complicated and need an extensive clean up of the samples and require expensive instruments.

Enzyme-Linked Immuno Sorbent Assay (ELISA) is a biochemical technique used mainly in immunology to detect the presence of an antibody or an antigen in sample. Modification of proteins, DNA and other biopolymers by labeling them with reporter

molecules are needed for a very powerful research tool in immunology. The objective of this study was synthesized linked lysine cereulide analogs for preparing protein conjugates with biotin to develop a quick and effective ELISA test for measuring cereulide.

2. Methodology

Cereulide was chemically synthesized in 1995 by Isobe *et al.* by using commercially available components L-O-Val, L-Val, L-O-Leu and D-Ala, which established the same emetic toxin, ionophoric and pathogenic activities. An improved total synthesis of cereulide has now been completed. Linked lysine cereulide analogs were designed in 4 compounds which have lysine linked side-chain by replacement of original amino acid residue in cereulide with lysine.

3. Results and Discussion

In summary, linked lysine cereulide analogs have been synthesized in a high yield. L-O-Lysine residue are easily obtained from diazotization reaction of L-Lysine 1/2 H₂SO₄. All linked lysine cereulide analogs can be synthesized by using the key important rule which is use p-toluyyl chloride for peptide fragment coupling and m-nitrobenzoic acid anhydride (MNBA) for macrolactonization provided the efficient total synthesis of cereulide analogs.

Further progress of the current development for enzyme-linked immunosorbent assay (ELISA) is to be reported elsewhere.

4. Conclusions and Recommendations for Thailand

The contamination of cereulide can occur in the field, during harvest and transportation, and during storage, under the conditions where *Bacillus cereus* is allowed to grow. In Thailand, They have also been reported to contaminate especially in Milk, Chesses and Cooked rice. Thus a development of ELISA assay is need for a rapid detection of cereulide in feeds. Moreover, cereulide and lysine linked cereulide analogs were synthesized by using simple and inexpensive reagent. The procedure can be applied for use in Thailand for sustainable development.

Acknowledgement

We are grateful for financial support from the Ministry of Education, Culture, Sports, Science and Technology (MEXT) in Japan. Grateful acknowledgement is also extended to the Nagoya University for support and assistance during this work.

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The Novel Basic Proteins from Duck Egg White: Structures and Functions

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Many proteins in egg white (EW) are well-known for their food functional properties and biological functions. However, there still exist many unidentified proteins in EW. In this study, duck basic protein small 1 (dBPS₁) and 2 (dBPS₂), the novel basic proteins from duck EW, were purified using cation-exchange and gel filtration chromatography. The recovery from total EW protein was 0.1% and 0.16% (w/w) for dBPS₁ and dBPS₂. Peptides derived from hydrolyzation of dBPS₁ and dBPS₂ by pyroglutamate amino-peptidase, chymotrypsin, lysyl endopeptidase and protease V₈ were used to determined amino acid sequence of the proteins by Edman degradation method. It was found that these proteins contained 39-amino acid residues. Amino acid sequence of dBPS₁ was EKKGFCAGYCSYSCAKTDEWTFHQTCGKMYCCIPPPKKG that was 45% identical with that of dBPS₂. Amino acid sequence of dBPS₂ was completely same as cygnin from black swan. A pepsin-hydrolysate derived from dBPS₁ and dBPS₂ showed a potent ACE inhibition activity with IC₅₀ of 4.75 and 10.27 μM. The ACE inhibition peptides from dBPS₁ and dBPS₂ were isolated by RP-HPLC and gel filtration before analyzed by MALDI-TOF mass spectrometer and protein sequencer. The result indicated that Glu₁-Tyr₉ and Glu₁-Ser₁₁ derived from dBPS₁ and Glu₁-Tyr₁₁ and Lys₄-Tyr₁₁ derived from dBPS₂ were the most potent ACE inhibitory peptides. Even though the amount of dBPS₁ and dBPS₂ is not much in duck EW, the consumption of duck EW may provide those ACE inhibition peptides that may effect in lowing blood pressure.

1. Introduction

Eggs have been an important part of the human diet throughout the world. They have traditional been used for breakfast, home meal preparation, baking and as and ingredient of many foods. Hen and duck eggs are the most commonly eaten eggs. Egg is generally recognized as a perfect source of proteins. The protein in egg white (EW) performed an important role not only in food processing technology, but also in human health-promoting. Accordingly, continuing research in the identification of new components in EW may provide benefits for human daily life.

This current study, we isolated the two novel basic proteins from duck EW and investigated their structures and physicochemical properties. Moreover, the ACE inhibitory activity of the novel basic protein hydrolysate by pepsin and the amino acid sequence of the potent ACE inhibitory peptides from these proteins were determined.

2. Methodology

dBPS₁ and dBPS₂ were purified using ion exchange and gel filtration chromatography. Peptides hydrolyzed by pyroglutamate aminopeptidase, lysyl endopeptidase, chymotrypsin and V₈ protease were used to identified amino acid sequence by Edman degradation method. The molecular mass was measured by MALDI-TOF mass spectrophotometer. The pI was determined by

isoelectric focusing on polyacrylamide gel. The ACE inhibitory peptides were derived from incubation of reduced protein sample and pepsin for 24h, at 37°C. The potent ACE inhibitory peptides were isolate by using RP-HPLC and gel filtration chromatography. The ACE inhibitory activity was determined according to the method of Cushman [1].

3. Results and Discussion

Commonly, the basic proteins in avian EW include only lysozyme and avidin. In the current study, two novel basic proteins with small molecular weights in duck EW were isolated by ion-exchange and gel filtration chromatography. Their characteristics as basic and small proteins roused our curiosity about duck EW proteins. They were named dBPS₁ and dBPS₂, according to their physical characteristics and order of elution by ion-exchange chromatography. The elution order accounts for the different pIs of dBPS₁ (pI = 9.35) and dBPS₂ (pI = 9.44). The dissimilarity in basicity of dBPS₁ and dBPS₂ may be due to the difference in the number of positively charge amino acids in dBPS₁ (six lysine) and dBPS₂ (six lysine and one arginine). The amounts of dBPS₁ (0.1%) and dBPS₂ (0.16%) from total EW proteins that were obtained from purification suggest that these proteins were minor proteins of EW, since the major proteins are recognized to be ovalbumin (54%), ovotransferrin (12%), ovomucoid

(11%), ovoglobulin G2 and G3 (8%), lysozyme (3.4%), and ovomucin (1.5%).^{1, 2} Even though the amounts of both proteins in EW were sufficient to be detected, there is no report about the presence of dBPS₁ and dBPS₂. This may be due to the extremely low molecular masses of dBPS₁ and dBPS₂. These small basic proteins, dBPS₁ and dBPS₂, showed the similarity to cygnin from black swan EW and meleagrin from Turkey EW in their amino acid sequences.

It was previously shown that the hydrolysate of egg white had an ACE inhibitory activity [2]. This report addresses our study conducted to identify the ACE inhibitory activity of hydrolysate of dBPS₁ and dBPS₂ by pepsin. Moreover, we isolated the active peptide from these hydrolysates.

The experiment was performed with the hydrolysates that were derived from 24h incubation of intact proteins and pepsin for 24 h. In this experiment we used pepsin which is reported that it is the specific to produce the peptides plays a very important role. The hydrolysate of dBPS₁ and dBPS₂ by pepsin, IC₅₀ of 4.75μM (22.47 mg/L) and 10.27μM (49.65 mg/L), possessed strong ACE inhibitory activity that can be classified as significant in vitro inhibitor. The ACE inhibitory peptides from dBPS₁ and dBPS₂ were purified by using RP-HPLC and gel-filtration chromatography. The potent ACE inhibitory peptides derived from, dBPS₁ were EKKGFCAGYCS and EKKGFCAGY, corresponding to Glu₁-Ser₁₁ and Glu₁-Tyr₉ of dBPS₁. The effective ACE inhibitory peptides from dBPS₂ were KYCPKVG and EVRKYPKVG, which are Lys₄-Tyr₁₁ and Glu₁-Tyr₁₁ from the native sequence. According to the result, three of identified peptides possess Tyr, one of aromatic amino acid that favourable for COOH-terminal amino acid of ACE inhibitor, at the C-terminal position [3]. Lys₄-Tyr₁₁ showed a stronger ACE inhibitory activity than Glu₁-Tyr₁₁ as the peak of the Lys₄-Tyr₁₁ was much smaller than that of Glu₁-Tyr₁₁ but it performed almost same activity in ACE inhibition. This may be the result of Lys at the NH₂-terminal amino acid of Lys₄-Tyr₁₁ that is more preferable than Glu of Glu₁-Tyr₁₁ as it was indicated that the most favourable NH₂-terminal amino acid for ACE inhibitor is Lys>Arg>Tyr>Ala>Leu>Asp>Glu [4]. Moreover, the positive charge of Lys may contribute substantially to ACE inhibitory potency as in the case of guanidine group of C-terminal Arg of several peptides. Comparing

the efficiency of ACE inhibitory peptide derived from dBPS₁, Glu₁-Tyr₉ was more potential than Glu₁-Ser₁₁. This may be the result of not only the difference in C-terminal amino acid but also the length of peptide.

The results from the present study suggest that the peptide hydrolysate of dBPS₁ and dBPS₂, its fraction, or isolated peptides can be used in the prophylaxis and prevention of hypertension.

4. Conclusions and Recommendations for Thailand

Many researches about egg are done in Thailand. However, most of them are done in processing technology way, but not much in the biochemistry way which is the principle knowledge that should be understand before apply to the processing step.

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Thai and Japanese Speech Behaviors in Group Discussions

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HS-D01

This study examines some communicative aspects of Thai and Japanese in group discussions. It explores how cultural norms and social values are revealed differently in Thai and Japanese interaction. The methods were both quantitative and qualitative. Six Thai and Japanese group discussions were recorded and transcribed. The speech data was segmented into comparable units and classified according to their communicative functions in group process. Data distributions and frequent patterns were located. Representative structures of conversational units were chosen and analyzed by ethnographic conversation analysis approach. The study found three different aspects of Japanese and Thai interactions concerning group management. First, the roles of leader in task area and social emotional area were assumed by the same person in Thai groups but by different individuals in Japanese groups. Second, the membership participation was marked by a parallel style in Thai groups, but a reciprocal style in Japanese groups. Third, group discussions were more likely to be proceeded by recipient-targeted questions in Thai groups, but by questions targeted to non-specific recipients in Japanese groups. The differences in their speech behaviors prove that Thais and Japanese have different values in group interaction and different concept of relation between the 'self' and the 'group' as a whole.

1. Introduction

The purpose of group discussion is for participants to express different opinions in order to accomplish a certain goal. Discussants use language to strive for balance between getting the task done and maintaining social relationship. Although the fundamental concept is universal, the practice and the central concern may not be. Despite long established relation between Thailand and Japan, there have been few contrastive studies on communicative styles of the two cultures. The present study examines the characteristics of Thai and Japanese speech behaviors in group discussions and explores how social norms and values are revealed and how perceptions of the 'self' were differently realized in their interaction.

2. Methodology and Experiment

The conversation data were collected from 3 Thai and 3 Japanese group discussions, in each of which 5 acquaintances performed a discussion task in their native language. The discussions were audio/video taped and transcribed. Speech data were segmented into 'ideas units' [1]. All units were labeled and categorized into functions perceived to be the speaker's intention. Two focus areas of this paper are functional units in Social-Emotional (SE) and Group Management (GM). SE consists of acts that help to promote interpersonal relations and do not directly relate to task, e.g. phatic talk, laugh, and

backchannels. GM acts are those that prompt and orient the group to exchange views and proceed toward the solution, e.g. giving command, suggesting how to do the task, summarizing state of discussion, or asking for opinion. The frequencies and distributions were assessed to locate the features of recurrent patterns. Finally the sequential patterns were closely examined with a culturally contexted conversation analysis approach [2].

3. Results and Discussion

3.1 Communal interactional pattern of Japanese discussion

3.1.1 Role sharing between members: Since no leader was appointed prior to the discussion, the situation was open for anyone to take the leading roles. The calculation showed that in each group the member who commanded (GM) acts as leader and the member who contributed the most in the SE area were different individuals in all Japanese groups. GM act performers were likely to be male except under special conditions. SE acts were mostly carried out by female members playing supporting roles.

3.1.2 Reciprocal participatory style: In a typical adjacent turn, the first part acts as a stimulus which makes the second part conditionally relevant, e.g. a question or summon is expected to be followed by an answer. In discussions, it is mostly the leader

who performed the act of questioning and summoning. The study found that in Japanese groups, questions and summons were likely to be answered in close links, exhibiting followers' cooperation and submission to leaders' authority. Besides, although the first pair part was not directed at anyone in particular, the second pair part was likely to be fulfilled by at least one member who acted on behalf of the group. This shows that a reciprocal participatory style is a norm in Japanese group, and that members perceive themselves as a single hierarchical unit.

3.1.3 Preference on non-targeting questions: The primary role of question is to elicit answers. Questions and answers are crucial components in getting the discussion under way. This study found that Japanese questions were mostly directed to non-specified recipients in the public sphere rather than targeting at an individual member. The ratios of the questions addressed to a non-specific recipient to the targeted ones in 3 groups were 24:9, 38:26, and 12:6. This suggests that the activities in Japanese group are usually carried out on a communal base, where participants' selves do not play a central role in discussion.

3.2 Free standing interactional patterns of Thai discussion

3.2.1 All-inclusive leadership style: The most active person in SE and GM areas in all Thai groups was found to be the same person. The leaders took double duties: leading group and creating pleasurable group interaction. Thai leaders sought to alleviate the degree of the face threatening acts (FTA) resulted from group management by working out in SE area to a great extent. It suggests that interpersonal skill is regarded as more important quality than gender and age in casual context.

3.2.2 Parallel participatory style: There were occurrences in this data that the questions and summons directed to non-specific recipients in public sphere were not answered, nor regarded as needing an answer. These questions or summons were likely to be followed by dual statements or by some expansion of other activities. The answers, if they were to be made, arrived after some lapse of time. This implies that participants perceived their entitlements to manage the group event on equivalent footings. Statements that did not specify the recipient were not securing uptakes and did not impose response on the hearers.

3.2.3 Preference on specific-recipient-targeted questions: More Thai questions targeted at

recipients. These were done by naming, asking specific information of an individual, or probing a series of questions to the same person. The ratios of the questions addressed to a non specific recipient to specific recipient targeted ones were 5:19, 25:27 and 6:24 which suggest that when Thai groups carry out their tasks, each member's 'self' is emphasized.

4. Conclusions

Japanese speech behaviors in group management suggest that Japanese communication possesses communal emphasized characteristics. Working in group, members are fused together forming a single hierarchical unit in which the selves are not the central attention. Their rapport is built on the essence of *wakimae* [3], or the discernment of social context, and the attempt to be egoless. On the other hand, Thai speech behaviors indicate that Thai communication has free standing characteristics. Group members exhibited abundant features of self-reliance and non-submissive patterns. Each individual positions him/herself directly in undertaking the activity, rather than filtering through a collective network. Group rapport is built on the *kan-eng* basis, literally meaning 'together, each individual being one own casual self'. Due to these different interactional styles, it is predictable that when the two cultures encounter, problematic situation will occur. By casting light on these differences, this study has implications for Thai and Japanese language training, cross-cultural education and self-awareness promotion.

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Participatory Communication Design for Sustainable Livelihoods for the Communities of People with Physical Disabilities in Thailand

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HS-D02

The objective of this research was to investigate the potential role and contribution of participatory communication and participatory communication design in developing capabilities of people with physical disabilities to sustain their livelihoods and way of life. This research was done through a design intervention and a case study analysis of a particular community of people with physical disabilities in Thailand. The methodology was Participatory Action Research under the Sustainable Livelihoods Framework. The research procedures consisted of consultation, collecting data, taking actions and reflection, and monitoring and evaluation. The conclusion, participatory communication and participatory communication design plays the crucial part through out the research process to enable the disable community to reach their full potential to have sustainable livelihoods in the long-term.

1. Introduction

This research builds on my previous research, in which I worked with people with physical disabilities in Bangkok, Nontaburi, and Samutprakran province in Thailand. They have different physical disabilities, skills, and knowledge. Most of them have been trained to produce handicrafts in a vocational training program. After the training, most of them who live in the same area and have the same skills tend to set up groups to produce and sell handicraft products. Unfortunately, they face the same problems as many mainstream crafts people. Cheaper imported products from other countries threaten their products.

Considering the cheaper and imported competition in the markets, the disabled people found that it was very difficult for them to make a living. Most of them had to give up their only chance to make a living. My previous research focused on developing products with these communities to enhance opportunities for their products in their markets. As a result, there were various degrees of success. However, this was not the enabling solution in the long-term development for the disabled because the researcher played the role as a designer and provided all design solutions for them.

As Manzini [1] expresses the ancient wisdom, “if someone is hungry, do not give them fish. Give them a fishing rod and teach them how to fish. When they are hungry again, they will be able to get their own fish.” This wisdom is the inspiration for my PhD research. To create enabling solutions with/for the disabled community, both the researcher and the disabled people have to change their way

of thinking and behaving. This will require a transition whereby the designer researcher is no longer the one who provides solutions. The disabled are no longer the recipients of solutions. When the research ends, they must learn to develop their own products using their own skills, abilities, and local resources to match the changing demands in the markets.

According to the report of the Ministry of Social and Human Security in Thailand [2], most of the disabled has a little of formal education. Therefore, the objective of this research aimed to investigate the potential role and contribution of participatory communication and participatory communication design to develop capabilities of people with physical disabilities to sustain their livelihoods and way of life. This research was done through a design intervention and a case study analysis of a particular community of people with physical disabilities in Thailand.

2. Methodology

The methodology of this research was Participatory Action Research (PAR) using the Sustainable Livelihoods Framework. The participants of this research were the disabled people who are the members of the Samutprakran Disabled Persons Association (SDPA) in Phrapradaeng community in Samutprakran province, Thailand. The research procedures consisted of four phases as follows.

1) Consultation

A consultation meeting was conducted in the disabled community to clarify the research objectives, procedures and roles of the researcher and participants, get consent from

the potential participants, and consult them for potential plan and schedule for the next phase.

2) Collecting Data

The data was collected by individual interviews, participatory observation, and a group discussion. In the group discussion, the participants had active roles to analyze their current situation, identify problems, and set up goals and plan activities to develop their capabilities, which enable them to have sustainable livelihoods.

3) Taking action and Reflection

The participants undertook their own actions to develop their capabilities. In this phase, participatory communication and participatory communication design played the crucial part through out the process because they support the disabled understand complex problems and share their views. The participatory communication design also enabled the disabled to develop their capabilities, which enable them to reach full potential to have sustainable livelihoods. When the disabled took control the whole process, it was time that the researcher “handed over the stick” to the disabled community.

4) Monitoring and Evaluation

The researcher monitored the activities of the disabled community to sustain their livelihoods without intrusion and evaluated the effectiveness of the research procedures.

3. Results and Discussion

The roles of Participatory communication and participatory communication design were very crucial through out the whole process. They supported the disabled to share their view, and visualized their complex problems. The participatory communication design enabled the disabled community to develop their own capabilities for sustainable livelihoods in the long-term .

4. Conclusions and Recommendations for Thailand

The participatory communication and participatory communication design plays the crucial part through out the research process to enable the disable community to reach their full potential to have sustainable livelihoods in the long-term. The disabled also created intellectual properties, which can be protected by Thai Intellectual Property Laws. These properties have the capacity to produce sustainable solutions for the disabled community. This research is only the seed project for the long-term development of this community. In order

to accomplish the sustainable livelihoods of the disabled communities in this area, it needs both participatory and collaborative networks from government organizations and private sector to support self-sufficiency for this community.

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Benefits to Thai Businesses from Japan-Thailand Economic Partnership Agreement (JTEPA)*

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HS-D03

This study examines to what extent Thai exporters and importers benefit from JTEPA between November 2007 and March 2008 and identifies obstacles that prevent them from fully utilizing the preference. The level of tariff savings, which is calculated as the result of the interaction of the three key factors; product coverage, preferential tariff margin, and preference utilization rate, is used to measure the benefits granted under the agreement. It is found that Thai exporters enjoyed a considerable tariff savings; while a majority of Thai importers failed to benefit from JTEPA. According to the interviews with businesses, a number of obstacles were claimed, for instances, lacking of necessary information on preferential tariff treatment, insufficiently attractive margin of preference, and restrictive rules of origin. To promote the exploitation, the Thai government should aim at negotiating for further tariff reduction and relaxation of rules of origin for certain products, and in the meanwhile dedicate more resources to raise awareness and increase understanding of JTEPA among Thai companies. A JTEPA secretariat office is also strongly suggested to be established to follow up pending issues and to promote greater utilization of JTEPA privileges.

1. Introduction

Thailand adopted six free trade agreements (FTAs) with its trading partners; namely, ASEAN FTA (AFTA), ASEAN-China FTA (ACFTA), Thailand-Australia FTA (TAFTA), Thailand-New Zealand CEP (TNZCEP), the early harvest scheme between Thailand and India, and just recently Japan-Thailand EPA (JTEPA). Concerning trade in goods issue, these FTAs are expected to bring about benefits to Thai businesses by providing cost advantages to both Thai export and import products.

Previous studies by TDRI (2006) and TDRI (2008) elucidated that a number of Thai businesses do not fully utilize the existing preferential arrangements. The objectives of this study are to examine the benefits granted under JTEPA, identify obstacles that prevent them from being fully utilized, and provide some policy recommendations to improve the implementation of JTEPA. This is the first *ex-post* empirical study since the implementation of the agreement in November 2007

2. Methodology

Since JTEPA has just been implemented less than a year, it is impossible to measure the changes in social welfare brought about by tariff reduction. In this study, we argue that the level of tariff savings can be used to measure the benefits. As shown below, we also decompose the tariff saving rates into three

components: product coverage, preferential tariff margin, and preference utilization rate.

$$\begin{aligned} \frac{\text{tariff saving}}{\text{total trade value of all products}} &= \frac{X_{C/O} * \text{margin}}{X_{all}} \\ &= \left(\frac{X_{C/O} * \text{margin}}{X_{all}} \right) \left(\frac{X_{eligible}}{X_{eligible}} \right) \\ &= \left(\frac{X_{eligible}}{X_{all}} \right) \left(\text{margin} \right) \left(\frac{X_{C/O}}{X_{eligible}} \right) \\ &= \text{product coverage} * \text{margin} * \text{preference utilization rate} \end{aligned}$$

Where $X_{C/O}$ denotes trade value that businesses claim for preferential tariff treatment, $X_{eligible}$ denotes total trade value eligible for the preferential tariff, and X_{all} denotes total trade value of all products whether or not eligible for the preferential tariff.

3. Results and Discussion

By analyzing five months of utilization data (November 2007–March 2008) gathered by the Department of Foreign Trade, we found that JTEPA has so far brought about \$75 million of tariff savings for Thai export to Japan. The top three beneficiary sectors are processed food, textile and garment, and jewelry and ornament. The overall utilization rate is found to be 55.9%, with jewelry and ornament (96%), textile and garment (71%) and processed food (66%) as the top three beneficiaries.

Although Thai exporters appear to benefit significantly from the preferential treatment granted by JTEPA, our interviews with them reveal some problems related to the utilization of JTEPA privileges. Like the results reported by Ratananarumitsorn *et al.* (2008), apart from

* This study is a part of a research project 'Reaping benefits from JTEPA and AJCEP', which was commissioned by the Office of Industrial Economics, Thailand. We are grateful to Dr.Somkiat Tangkitvanich, the project leader, for his invaluable advices.

passiveness in making use of preference, some exporters claimed that they don't know whether their good is eligible under the FTA preference and how to make use of the FTA preference. Some small exporters complained that the procedure for applying for certificates of origin (C/Os) was still complicated. Others said that the preferential tariff margins were too low and that the rules of origins for some products were too restrictive to be useful.

According to a survey by the Japan External Trade Organization (JETRO), Japanese companies were interested in JTEPA than in the other FTAs that Japan has concluded. [4] However, their utilization rate of JTEPA has been only 6.5 percent, resulting in \$48 million of tariff savings. Three sectors that enjoyed most tariff savings are automobiles and auto parts, iron and steel and textile and garment. In terms of utilization rate, the top three beneficiary sectors are textile and garment (20%), automobiles and auto parts (14%) and iron and steel (12%).

Our interviews with Japanese trade associations, trade promotion authorities and trading firms also showed some problems in utilizing JTEPA privileges from the Japanese perspective. For some companies, a per-shipment fee for issuance of C/O was considered too costly for just-in-time production system. Some Japanese manufacturers were also concerned about revealing their production costs to Japan Chamber of Commerce and Industry (JCCI), the private trade association in charge of issuing C/Os for Japanese exporters. Finally, the issues of re-invoicing, and other aspects of intermediary trade were raised by some multinational companies that have production bases in many countries.

Table 1 Tariff Savings brought about by JTEPA
(November 07 – March 08)

	Thai Exports	Thai Imports
Total trade (\$ million)	7,938.93	13,189.84
Product coverage (%)	29.77	38.61
Preferential tariff margin (%)	7.82	4.84
Preference utilization rate (%)	55.85	6.57
Tariff savings (\$ million)	75.18	48.40
Tariff savings/total trade (%)	0.95	0.37

4. Conclusions and Recommendations for Thailand

This study examines to what extent Thai exporters and importers benefit from JTEPA between November 2007 and March 2008 and

fully utilizing the preference. It is found that Thai exporters enjoyed a considerable tariff savings; while a majority of Thai importers failed to benefit from JTEPA. To encourage Thai businesses to reap more benefits from JTEPA, we propose:

- The Cabinet should establish a JTEPA secretariat office to follow up pending issues and to promote greater utilization of JTEPA privileges by Thai companies.
- The Thai government should aim at negotiating for further tariff reduction and relaxation of rules of origin for certain products.
- The Customs Department and the Department of Foreign Trade should dedicate more resources to raise awareness and increase understanding of JTEPA among Thai companies.

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Influence of an Infrastructure on Subsequent Development Decisions

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HS-D04

The article presents a part of an on-going research on evaluation scheme of infrastructure development. The overall research framework is briefly described. The article, then, explains a component of research framework in more details with demonstration of a case study: the Nam Ngum Dam at Lao PDR. The main argument is that an infrastructure becomes pre-condition for next development decisions. Once completed or in use, infrastructure turns into our environment. Current and future decisions are thus unavoidably based on this current environment. There exists a hypothetical discussion that the inflow shortage at the Nam Ngum reservoir leads to a subsequent decision of constructing the Nam Song Diversion Dam. Based on a lesson observed from the case study, the article develops a discussion that the erosion and flooding at the Bang Pakong Diversion Dam might lead into construction of a new dam in the future.

1. Introduction

The extreme goal of research is to develop a decision-support framework for evaluating infrastructure development with consideration of secondary effects. The research argues that secondary effect is a missing element in project evaluation. The notion of “secondary effect” simply refers to any effect other than the primary objectives of a development project. It is expected that understanding the mechanisms of secondary effects will help in not only avoiding any severe consequences but also enhancing the full capacity of infrastructure in relation to sustainability.

To clarify the mechanism, a research framework is developed. The article explains a component of research framework in more details with demonstration of a case study.

2. Methodology

Research framework is developed through literature review of theories and reports of case studies. Related theories in social sciences are reviewed, particularly concepts in Science and Technology Studies (STS). Cases studies are preliminarily examined through reports of international development agencies and NGOs. Then, some case studies are selected for further observation through site visits and interviews.

3. Results and Discussion

Research framework is developed with a premise that secondary effect can occur either when social needs or problems are formulated, or when decisions regarding alternatives of development activities are being made, or when final goods and services (such as physical infrastructure) are being used. With a brief survey of case studies, the research framework is then elaborated into three stages :

making, utilizing, and framing [1].

The article focuses on framing stage. The main proposition here is that infrastructure and its impacts become pre-condition for subsequent development decisions. An example is seen at the Nam Ngum Dam, Lao PDR. It should be noted that the following discussions are hypothetical based on reports, previous research, interviews, facts, and logical arguments.

The Nam Ngum Dam, completed in 1971, has a capacity of about 7,000,000 m³ and covers around 370 km². The hydroelectric generating capacity is 150 MW. The majority of electricity (60-70%) is exported to Thailand [2]. From 1982 to 1992, the decline of generated electricity mirrored the decline of water inflow into the reservoir. However, data revealed that rainfall did not decline in the same manner. This suggests that the reasons for the inflow shortage was not rainfall but other water usage activities [3][4]. This situation led to a 1994 study of Nam Ngum watershed resource management that was implemented with the aim of proposing policies for better resource management in the watershed. Some have claimed, however, that the agency responsible for decision-making decided to construct two new dams instead of implementing the proposed watershed management policy [5]. Two new dams, the Nam Song Dam (completed in 1996) and the Nam Leuk Dam (completed in 2001), were constructed with the purpose of converting water from nearby rivers to the Nam Ngum reservoir. By doing so, the shortage of inflow was expected to be resolved.

It is difficult to strongly conclude that the inflow shortage at the Nam Ngum reservoir justified the construction of the Nam Leuk

Dam. With an installed power station, it is plausible that converting water from the Nam Leuk Dam to the Nam Ngum reservoir would constitute a clever use of the water for generating electricity twice [6].

The inflow shortage at the Nam Ngum Dam did lead to the subsequent decision of constructing the Nam Song Dam. This purpose was clearly written into a feasibility study that mentioned that the majority of the flow of the Nam Song would be diverted to the Nam Ngum reservoir for power generation at the Nam Ngum power station [7]. From 1998 to 2007, 12-24% of inflow at the Nam Ngum reservoir was supplied by the Nam Song [8]. Some have claimed that the cost of the Nam Song Dam was actually a part of the Nam Ngum Dam because the purpose of its construction was to fill up the decline of inflow at the Nam Ngum reservoir [4].

A subsequent decision on constructing a new infrastructure may not always be problematic, as the new decision might resolve previous problems and sustain its own benefits simultaneously. The key point, however, is that the actual driving force of such decision must be well recognized so that efforts at converting currently unsustainable utilization of an existing infrastructure into more sustainable utilization are seriously implemented.

4. Conclusions and Recommendations for Thailand

What is the lesson learnt from the case study for development in Thailand? The author sought for the same phenomenon in Thailand. It is found that the Bank Pakong Diversion Dam may follow a similar pattern.

The Bang Pakong Diversion Dam has imposed serious erosion and flooding problems downstream [9]. This was big news in 1999. These problems caused the dam's present suspension from operation. To resolve these problems, many engineering solutions have been proposed and implemented. One of them is to release 130,000,000 m³ of capital water from two upper dams, the Klong Sri Yad Dam and the Klong Tha Daan Dam. The amount of capital water accounts for approximately 23% of total capacity of stored water at the two dams. However, the two upper dams have their own consumption demand, in which the demand for water may soon increase due to population growth and associated activities. Therefore, the two upper dams are not expected to be able to supply sufficient capital water in a long run. Thus, the Bang Pakong

Dam will need to seek capital water from other sources, which may become a key factor justifying construction of a new upper dam. At present, the dam operation is being suspended. More works of hydrological analysis and monitoring are being studies. Hopefully, they will suggest a better recommendation of how to restart operating the dam without releasing water from upper dams.

Thailand plays roles of both recipient and donor country. As recipient country, the consideration in this article may help enhancing effectiveness and efficiency of government budgets and loans. As donor country, Thai government would make sure that unsustainable development projects are not offered through Thai's Official Development Assistance.

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New Discipline of Collaborative Research Crossing Borders through Supercomputing Infrastructure

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Despite of border of nation, community of researchers is borderless. The recent advancement of cyber infrastructure is tremendously bridging the gap of research collaboration. Shortly after the operation of TSUBAME of Tokyo Institute of Technology, the highest performance supercomputer in Asia, the feasible issue of international research collaboration using TSUBAME has been considered to provide the excellent ground of knowledge-sharing and benefit to international community. Under this new discipline, the collaboration on large-scale computation of tsunami simulation with Chulalongkorn University was realized by the continuing efforts from both sides to pioneer this first kind of collaboration. It is expected that the research outcome with support from Thailand's authorities can pave a way to the integration of the tsunami early-warning system of Thailand and extend the merit to the neighboring regions.

1. Background

Tokyo Institute of Technology (Tokyo Tech) has been collaborating with Thai universities in many instances over decades. However, facilities and infrastructures required for collaborative researches cannot be easily facilitated crossing two nations. Due to the recent advancement of cyber infrastructure including the high speed Internet, the new discipline of international collaboration is able to accomplish for knowledge-sharing and mutual benefit to both parties.

Since April 2006, Tokyo tech has deployed the fastest supercomputer, TSUBAME, which is ranked no.1 in Asia and no.14 in the world [1]. Variety of researches undergoing at Tokyo Tech on high-performance computing and simulations have been remarkably accelerated. Not only home but abroad, this supercomputing infrastructure can encourage international research collaborations emerged between Tokyo Tech and overseas organizations.

This report aims to review the research setup process under this new discipline as well as addressing some preliminary results. It is expected that this kind of research initiation can provide some guiding basis for other researchers who wish to start their international research collaborations with overseas partners.

2. Paradigm of International Collaboration

Disaster caused by tsunamis has drawn awareness in Thailand since the devastation of Indian Ocean tsunami occurred in December

2004. Pre-computed tsunami database is one of the preventive measures to estimate the effect of tidal wave based on the simulation of tsunamis triggered by earthquake. Therefore, Faculty of Engineering, Chulalongkorn University (CU) has started the research project aiming to develop the early warning tsunami database. However, this research requires supercomputing facilities which is seen to be insufficiently available in Thailand. Coincidentally, the issue of international collaboration using TSUBAME has become feasible through Global Scientific Information and Computing Center (GSIC) of Tokyo Tech. This prospect led CU to observe TSUBAME in Jul.'06. Then, the proposal of collaborative research was initiated in Oct.'06, following by discussion on possibilities of collaboration in Nov.'06 at CU. The trial analysis was performed on TSUBAME at Tokyo Tech with dialogue on set-up of research collaboration in Mar.'07. Memorandum of Understanding (MOU) was discussed in Apr.'07 at CU. Also, parallel computing and tuning techniques were exchanged with CU in Sep. at CU and Oct.' 07 at Tokyo Tech by experts of both sides.

3. Setup of Collaborative Agreements

The framework for research collaborators who are external users of TSUBAME was achieved. MOU tied between the Faculty of Engineering of CU and GSIC of Tokyo Tech in collaborating joint researches has been officially made to facilitate the collaboration in Jun.'07. The computer program developed for

PC cluster of CU is subject to tune up and test on TSUBAME for investigating a high performance of TSUBAME and for evaluating the efficiency of parallel computing in large-scale computation. It was agreed that outcome of joint researches will make public disclosure and can be used as a reference in a proposal applied to disaster warning projects of Thai government. Moreover, to cover scope of collaboration and allocation of resources, the particular agreement with GSIC was concluded as the pioneered collaboration under research theme “Simulation of Tsunamis Generated by Earthquakes using Parallel Computing Technique” in Nov.’07. Details of research implementation, researcher data, right in works, dispute and revision, international issues and collaborative period must be clarified. Article on international issues ensure that any technology or results will not be used for the purpose of weapon development. This agreement has to renew and consider year by year. Finally, the approval from the committee of GSIC was obtained to issue TSUBAME accounts accessible from Thailand to CU collaborators. Also, Contract of Collaborative Research Agreement with the industry liaison office of Tokyo Tech was signed in Jun.’08 to manage payment from CU to Tokyo Tech for the expense caused by using TSUBAME. List of consent documents is shown in Table 1.

Table 1 Consent documents between both sides

Consent documents	Period
Memorandum of Understanding (GSIC-CU)	From: 2007/6/20 To: 2012/6/19
Agreement for International Research Collaboration using TSUBAME	From:2007/11/16 To: 2008/3/31
Renewal of Agreement for International Research Collaboration using TSUBAME	From: 2008/4/1 To: 2009/3/31
Contract of Collaborative Research Agreement	From: 2008/6/16 To: 2009/6/15

4. Preliminary Results of collaboration

A series of tsunami simulation will be conducted for 1000 possible focal mechanisms in tsunami prone area along Indian Ocean and South China Sea. The calculation of wave height and arrival time involves parallel computing techniques to effectively shorten computation time needed for several cases and sub-regions in coastal zones. The computation code used for the analysis is the program modified from TUNAMI (Tohoku University’s Numerical Analysis Method for Investigation of tsunamis). The preliminary result is shown

in Fig. 1. The outcome of this study will realize the early-warning system of National Disaster Warning Center (NDWC). Presentation about disastrous simulations was performed during the observatory visit to NDWC. (see Photo 1).

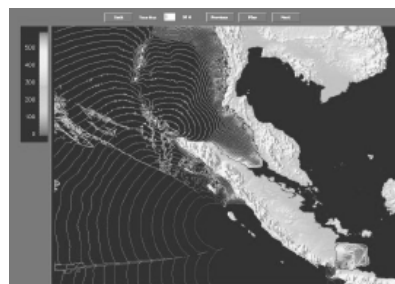


Fig. 1
Preliminary
results with
visualization
portal
developed by
CU [2]



Photo 1 Observatory
visit to NDWC with
presentation about
disastrous simulations
by a group of
researchers from CU
and GSIC (2007/9/24)

5. Conclusions and recommendations

The international research collaboration using supercomputer between GSIC of Tokyo Tech and Dept. Engineering of CU was introduced in summary. It is believed that the results of these continuing efforts can contribute to Thailand on disaster preventive measure. Substantial support from Thailand’s authorities is desired to promote the collaboration and to extend the research accomplishments to the real practice.

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Media and Education for Sustainable Development

Thailand's Newspapers Coverage of Climate Change

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HS-D06

The study is aimed to understand how Thailand's newspapers cover climate change issues, and to suggest how Thailand's newspapers cover climate change stories in the context of ESD. Methodologies are based on the triangulation of the interview with eight key informants and the content analysis of three national newspapers. The study yielded two main findings. *The status quo of Thailand's newspapers coverage on climate change*: Thailand's newspapers have prioritized climate change but there were some differences between quality newspapers and popular newspapers. *Suggestions to cover climate change in the context of ESD*: generally, the make the coverage of climate change in the context of ESD shared many things in common with producing good environmental coverage. However the coverage in the context of ESD should reflect the interconnection among the main three pillars of sustainable development and the future-oriented view. Moreover, the successful ESD story should be a compelling story with impact.

1. Introduction

During the World Summit on Sustainable Development (WSSD) in 2002, the UN General Assembly designated 2005-2014 as the "Decade for Education for Sustainable Development". Among the core Education for Sustainable Development (ESD) issues, climate change has become a prime global threat as it was identified in *Working Paper: Asia-Pacific Regional Strategy for ESD* [1]. The *Working Paper* identified media as one of the five key groups of stakeholders in promoting ESD. In Thailand, newspapers are considered as one of the most influential Media according the first suggestion by Srisawang [2].

The present study has two main goals: 1) to understand how Thailand's newspapers cover climate change issues, and 2) to suggest how Thailand's newspapers cover climate change stories in the context of ESD.

2. Methodology

The study employed the triangulation of two methodologies—content analysis and interview. To execute the content analysis of Thailand's newspapers, the following steps were modified, [3] and [4].

- Identified a body of material to be analyzed (*Thairath*, *Matichon* and *Bangkok Post* in 2007).
- Located articles through Matichon e-Library.
- Thoroughly reading and coding general information of the articles in Code Note.
- Quantified data by counting frequencies, located placement, checked month, visuals, and presentation style.

- Analyzed the selected case studies in details.
- Drew the conclusions based on the quantitative and qualitative findings and integrate them with interview findings.

Concerning the interview, the author divided informants into two main groups—media and ESD informants. Eight informants were selected in total. The combination of methodologies and research design yielded two main findings, the status quo of Thailand's newspapers coverage on climate change and suggestions to Thailand's newspapers to cover climate change stories in the context of ESD.

3. Results and Discussion

The status quo of Thailand's newspapers' climate change coverage

It was found that Thailand's newspapers have prioritized climate change issues. The rising importance of climate change in Thailand's newspapers could be noticed from the three main indicators; frequency, placement in the front page and visuals in the coverage. However, there were some differences between quality newspapers (*Matichon* and *Bangkok Post*) and popular newspapers (*Thairath*). Based on the mentioned indicators, quality newspapers seemed to give more priority to the climate change coverage than popular newspapers. This might widen the climate change knowledge and perception divide between the readers of quality and popular newspapers.

Regarding the content, international news seemed to be the biggest frame covering climate change issues. IPCC, UNFCCC and Al Gore were the key figures in the coverage.

National stories tended to focus on the caution of diseases or natural calamities due to climate change. Although there were several reports could be seen, quality of the coverage and the lack of certain space was a big concern.

Climate change coverage in the context of ESD

Generally, the covering climate change in the context of ESD shared many things in common with producing good environmental coverage. However, covering climate change story in the context of ESD should be reported with two main messages. The first one is interconnection among the main three pillars sustainable development notion—environment, economic and society. The second one is future-oriented view. Moreover, the successful ESD story should be a compelling story with impact as could be seen in the case studies presented [5].

4. Conclusions and Recommendations for Thailand

To cover climate change story in the context of ESD, journalists, editors and policymakers should keep the following points checked;

Suggested content

- Climate change is a global problem.
- Everyone is affected but could make a difference.
- Preventing greenhouse emissions could be done in our daily life without affecting our quality of life.
- Actions to address climate change needed to be taken at all levels by everyone.
- The coverage should be future-oriented, think about the effect in the future.
- Skeptics' view should be kept.
- More analytical style is preferred.
- Story has to be interesting yet educational and informative that encourages readers to think further.
- The coverage has to be linked with other aspects in a way that made the readers to realize the impact of climate change.

Suggested writing and presentation style

- Explanation on what is possible and what is being done.
- Report on case studies would reflect problems and solutions.
- Exaggerated claims should be filtered.
- Communication to the audience should be in a highly understandable way.
- Jargons and English terms should be avoided.

- Comments and opinions from experts should be added.
- Informing people about conventions and international agreements
- Graphics, cartoons, and the story of a certain case are recommended.

Suggested actions for journalists and newspapers

- Journalists needed to update and equip themselves with climate change information.
- Certain space is needed.
- Popular newspaper should play more role as it has a mass readership.

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Thermophysical Properties of Arylamine-based Benzoxazine Resins Alloyed with Epoxy Resin

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In this research, we investigated and analyzed effects of an addition of bisphenol A based-epoxy resin on thermophysical properties various arylamine-based benzoxazine resins, i.e. aniline (BA-a), *m*-toluidine (BA-mt), and 3,5-xylydine (BA-35x). The curing conditions of these arylamine-based benzoxazine resins alloyed with the epoxy resin are investigated by differential scanning calorimetry (DSC). The glass transition temperature (T_g) and room temperature storage modulus (E') are evaluated by dynamic mechanical analysis (DMA). From DSC, there exists only one exothermic peak in the neat BA-a and two exothermic peaks in BA-mt and BA-35x resins. T_g values of BA-a and BA-mt alloyed with epoxy resin were found to show a maximum at the benzoxazine:epoxy of 80:20 mass ratio with the values of 182 °C and 213 °C, respectively. However, in the BA-35x and epoxy, the decreasing trend in T_g with an addition of epoxy resin was observed. Storage modulus of arylamine-based benzoxazine alloyed with epoxy resin was found to increase with increasing the amount of each benzoxazine resin.

1. Introduction

Benzoxazine resins are a novel kind of thermosetting phenolic resin. Their polymerization proceeds without using a curing agent and the resins do not produce by-products during cure [1]. Additionally, polybenzoxazines have some outstanding properties such as relatively high glass transition temperature, high thermal stability, near-zero volumetric shrinkage, etc [1-3].

A series of benzoxazine resins can be synthesized using different types of amine groups to yield polybenzoxazine of various property ranges. According to Ishida and Sanders [3], benzoxazine resins with arylamine showed their improved mechanical properties, including higher crosslink densities and glass transition temperature. From Ishida and Allen's work on benzoxazine-epoxy systems [2], the great increase of the crosslink density of the alloy systems was found to strongly influence their mechanical and thermal properties.

This research will examine the effect of the three types of arylamine-based benzoxazine resins, i.e. aniline, *m*-toluidine, and 3,5-xylydine, on the thermomechanical properties of benzoxazine-epoxy alloys.

2. Experimental

Aniline-based benzoxazine resin (BA-a) was synthesized from bisphenol-A, paraformaldehyde, and aniline at a molar ratio of 1:4:2. The mixture was heated to 110 °C in an aluminum pan, and then was mixed rigorously for about 30 minutes to yield light

yellow solid monomers. The same procedure was also used to synthesize BA-mt or BA-35x by replacing aniline with *m*-toluidine or 3,5-xylydine.

Curing behaviors of samples, a range of 3-5 mg, were studied using a differential scanning calorimeter (DSC) model 2910 from TA Instruments. Each specimen was sealed in an aluminum pan with lid. The heating rate used was 10 °C/min from room temperature to 300 °C.

A dynamic mechanical analyzer (NATZSH, model DMA242) was used to obtain a storage modulus (E') and loss modulus (E'') of the polymeric specimens. The specimen, with dimension of $10 \times 50 \times 2 \text{ mm}^3$, was tested using a 3-point bending mode at the frequency of 1 Hz and heating rate of 2 °C/min from room temperature to the temperature beyond the glass transition temperatures (T_g) of each specimen.

3. Results and Discussion

The curing behaviors of the neat arylamine-based benzoxazine monomers are shown in Fig. 1. It can be observed that BA-a showed only one exothermic peak, while BA-mt and BA-35x types benzoxazine resins showed overlapped exothermic peaks. The curing mechanism in the first exothermic peak of BA-35x resin is as same as that of BA-a resin [4], whereas the second shoulder exothermic peak at high temperature corresponds to the side reactions which generate the bisphenolic methylene linkages and possible reaction to the *para* position of

the arylamine ring [5]. Fig. 2 exhibits effects of epoxy on curing behaviors of its mixture with BA-35x. The exothermic peak of BA-35x was observed to systematically shift to higher temperature with an addition of epoxy resins. The curing condition of all specimens in this work was determined by DSC to be 150 °C/1 hr, 170 °C/1 hr, 190 °C/1 hr, 200 °C/4 hrs.

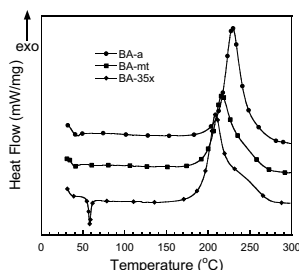


Fig. 1 DSC thermograms of three types of arylamine-based benzoxazine resins.

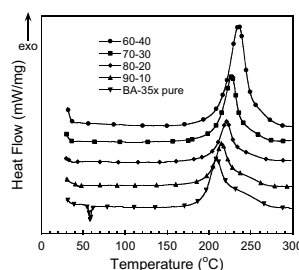


Fig. 2 Curing behaviors of BA-35x alloyed with epoxy resin at various compositions.

Table 1 Glass transition temperature (T_g) and room temperature storage modulus (E') of the three arylamine-based benzoxazine resins alloyed with epoxy resin at various epoxy contents.

	BA-a		BA-mt		BA-35x	
	T_g (°C)	E' (GPa)	T_g (°C)	E' (GPa)	T_g (°C)	E' (GPa)
60:40	174	4.76	207	4.43	223	3.81
70:30	180	4.97	209	4.50	230	4.12
80:20	182	5.28	213	4.86	235	4.30
90:10	178	5.60	212	5.09	238	4.60
Pure	172	5.94	210	5.32	241	4.98

The glass transition temperatures (T_g) and storage modulus (E') of the three arylamine-based benzoxazine resins alloyed with epoxy resin at various epoxy contents are listed in Table 1. Among these alloys, T_g of BA-35x alloyed with the epoxy resin showed highest values because the amounts of additional cross-links (i.e., methylene linkages) would increase T_g of the network significantly [5]. However, the values tended to decrease with an addition of the epoxy. On the other hand, T_g maxima were observed in the BA-a/Epoxy and BA-mt/epoxy systems. The complementary properties of greater molecular rigidity of

benzoxazine resin and the higher crosslink density of the epoxy resin might attribute to the synergistic behavior in T_g . Finally, the room temperature storage modulus of the three arylamine-based benzoxazine resins alloyed with epoxy resin were found to increase systematically with the amount of the benzoxazine as a result of a greater molecular rigidity of the benzoxazine resins.

4. Conclusions and Recommendations for Thailand

The maxima in glass transition temperature were observed in BA-a and BA-mt alloyed with epoxy, whereas BA-35x showed the decreasing trend with an epoxy content. However, all three benzoxazine-epoxy alloys can yield polymer matrices with T_g s of greater than 200 °C, which are considered as high temperature polymer. The room temperature storage modulus of the three arylamine-based benzoxazine alloyed with epoxy resin was found to increase with increasing the amount of the benzoxazine. This high temperature polymeric matrix can potentially be used for printed circuit board fabrication which is a crucial part of the electronic industry in Thailand.

Acknowledgments

This work is supported by the research grant for TRF Research Scholar (S. Rimdusit) and by TRF-MAG scholarship (P. Kunopast) of the Thailand Research Fund.

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Characterization of Benzoxazine-Urethane Polymer Networks

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Polybenzoxazine (BA-a), a new thermoset plastic, possesses some advantageous properties such as good processing properties, high thermal stability and excellent mechanical properties. However, one shortcoming of this resin is its rather high rigidity making the polymer unsuitable for some applications. To widen the range of its application, copolymerization with urethane elastomer (PU) is developed. In this study, we investigate the resin curing by FT-IR while a dynamic mechanical analyzer (DMA) is used to determine glass transition temperature (T_g) and rubbery plateau modulus (E'). Universal testing machine is used to examine flexural properties. At completion of curing the vibration bands at 941 , 1230 cm^{-1} (C-O-C of benzoxazine) and 2242 cm^{-1} (NCO group of PU) disappeared suggesting the formation of BA-a/PU hybrid network. Synergistic behavior in T_g was also observed in this polymer alloy. Finally the maximum in flexural strength was observed at the BA-a/PU ratio of 90/10.

1. Introduction

Polybenzoxazine possesses various useful properties such as high thermal stability, excellent mechanical properties and ability to alloy with various types of resins [1]. Nevertheless, the application of this polymer is still limited to certain application because of its rather high rigidity. To expand its range of application, alloying with urethane elastomer has been studied to solve the above shortcoming. Urethane elastomers represent one of the most attractive elastomers because they possess excellent flexibility and good weathering resistance etc.

In this study, we investigate a network formation of polymer alloys between urethane prepolymer (PU) and benzoxazine resin (BA-a). The effect of the urethane contents on glass transition temperatures and flexural properties of the fully cured network are also examined.

2. Experimental

Benzoxazine monomer used was derived from bisphenol A, aniline and formaldehyde at an 1:2:4 molar ratio. The monomer synthesis was based on the patented solventless synthesis technique [1].

The urethane prepolymer was prepared by reacting polypropylene glycol with a molecular weight of 2000 with 2,4-tolulene diisocyanate (TDI) at a 1:2 molar ratio.

Appropriate amounts of BA-a and PU warmed up about 80°C and mixed until a homogeneous mixture was obtained. The specimens were cured in an air-circulated oven. After having been left to cool down to room temperature, the specimens were ready for characterizations.

FT-IR spectra were obtained using a Perkin Elmer (spectrum GX) to monitor the curing process of the resin mixture. Dynamic mechanical analyzer (DMA) model DMA242 from NETZSCH was used to evaluate viscoelastic properties. All specimens were heated at a rate of $2^\circ\text{C}/\text{min}$. The dimension of each specimen was $50 \times 10 \times 2\text{ mm}^3$. Mechanical properties were recorded on universal testing machine (model 5567) from Instron Co., Ltd. The dimension of sample was $50 \times 25 \times 2\text{ mm}^3$ and tested at a crosshead speed $0.8\text{ mm}/\text{min}$.

3. Results and Discussion

Figure 1a shows FT-IR spectra of BA-a monomer, the characteristic peaks due to the formation of the benzoxazine ring (C-O-C) were found at 941 and 1230 cm^{-1} [2]. Those absorptions disappeared with the opening of benzoxazine ring after the thermal cured step at 150°C , 170°C , 180°C , 190°C each for 1 hour and 200°C for 2 hours in Figure 1b.

Figure 1c depicts the characteristic bands of benzoxazine and urethane moieties of the resin mixture. The band at 2242 cm^{-1} was from the NCO group of PU. Figure 1d presents the spectrum after curing completion, the absorption at 941 , 1230 cm^{-1} (C-O-C) and 2242 cm^{-1} (N-C-O) disappeared [2], suggesting the formation of BA-a/PU polymer network.

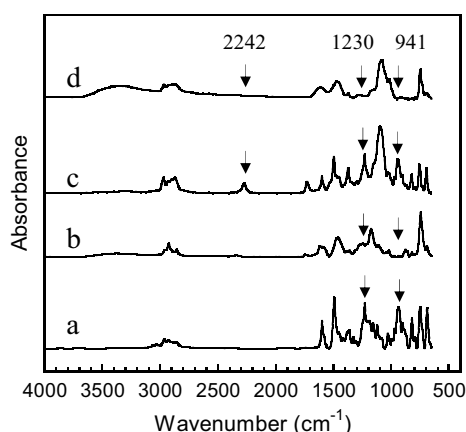


Fig. 1: FT-IR spectra of a) benzoxazine monomer. b) polybenzoxazine. c) BA-a/PU 60/40 before curing. d) BA-a/PU 60/40 after fully cured.

Table 1: Properties of BA-a/PU Polymers

BA-a/PU	T _g (°C)	E' at rubbery plateau (MPa)	Crosslink density (mol/m ³)	Flexural strength (MPa)	Flexural modulus (GPa)
100:0	166	56	4661	130	5.49
90:10	177	78	5202	142	4.10
80:20	192	102	5613	120	3.47
70:30	220	118	5833	89	2.57
60:40	245	148	7955	60	2.11

Viscoelastic properties of BA-a/PU systems were shown in Table 1. Synergistic behavior of T_g of the polymer network is evidently observed i.e. the T_g's of all copolymers are greater than the values of 166°C of BA-a and -70°C of PU. The T_g of the BA-a/PU copolymers increased with the PU contents.

Crosslink density of polymer network can be estimated by an equation from the statistical theory of rubber elasticity by Nielson [4].

$$\log\left(\frac{E'}{3}\right) = 7.0 + 293(\rho_x) \quad (1)$$

Where E' is a storage modulus in rubbery plateau, ρ_x is crosslink density that means the mole number of network chains per unit volume of the polymers. Table 1 suggested that the crosslink density of the BA-a/PU copolymers increased with the mass fraction of the PU. A higher crosslink density of the alloys led to a higher T_g of the matrix as described by Fox and Loshaek equation.

$$T_g = T_g(\infty) - \frac{k}{M_n} + k_x \rho_x \quad (2)$$

Where T_g(∞) is the T_g of infinite molecular weight linear polymer. k and k_x are the numerical constant. M_n is the number averaged molecular weight and ρ_x is the crosslink density respectively.

Table1 also exhibits flexural properties of BA-a/PU alloys at various compositions. The flexural strength of the BA-a/PU ratio at a 90/10 was observed to show a maximum value. In principle, the addition of the softer PU fraction in the alloys should result in the decrease of their strength. However, we also knew that the addition of PU helped improve the crosslink density. This implies that the effect of crosslink density on the alloy's strength dominates the effect of the lower stiffness of the PU if the PU mass fraction is below 10wt%. Finally, the lower flexural modulus with the PU addition was due to the presence of the softer urethane elastomer in the more rigid polybenzoxazine [3].

4. Conclusions

Hybrid network structures were formed in curing of PU prepolymer with BA-a resin with disappearance of IR bands at 941, 1230 cm⁻¹ (C-O-C) and 2242 cm⁻¹ (NCO). BA-a/PU alloys showed synergistic behavior in T_g. A maximum in flexural strength was also observed at the BA-a/PU mass ratio of 90/10. Finally, the flexural modulus of the alloys was found to systematically decrease with an addition of the PU. These high thermal and mechanical properties suggested that BA-a/PU can be potentially used as high performance polymers or composite matrices for part of the electronic and ballistic armor in Thailand.

Acknowledgments

This work is supported by the research grant for TRF Research Scholar (S. Rimdusit) and by TRF-MAG scholarship (W. Bangsen) of the Thailand Research Fund.

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High Thermomechanical Performance Hybrids of Dianhydride Containing Polybenzoxazine

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Thermomechanical properties of benzophenone-3,3',4,4'-tetracarboxylic dianhydride (BTDA) containing polybenzoxazine (BA-a) was investigated. The experimental results reveal that the enhancement in the glass transition temperature (T_g) which depicted with the viscoelastic analysis of the BA-a/BTDA blends is clearly observed, i.e., T_g of the BA-a/BTDA blends are significantly higher (T_g beyond 200°C) than that of polybenzoxazine, i.e. 165°C. The enhanced T_g of the BA-a/BTDA blend at 1.5/1 mole ratio is found to be 250°C. Furthermore, the degradation temperature and the char yield values with the thermogravimetric analyzer (TGA) of the BA-a/BTDA blends are found to significantly improve with the presence of the BTDA which is molecular structure consisted of aromatic rings. Increasingly, the flexibility of the crosslinked BA-a/BTDA was greatly enhanced compared with the neat poly(BA-a).

1. Introduction

The polybenzoxazine is a novel class of thermosetting polymer that combined the thermal properties and flame retardant of phenolic resin with mechanical performance and molecular design flexibility of epoxy resin [1-2]. The chemistry of benzoxazine synthesis offers a wide range of molecular design flexibility by using derivatives of phenol, aldehyde, and primary amine. Improvements of polybenzoxazine properties to be excellent candidates for high-performance materials such as high thermal stability, high char yield, and high glass transition temperature (T_g), are becoming more and more attractive in many methods, which can be mainly classified into two procedures. By taking advantage of its design flexibility of benzoxazine chemistry, thermal and thermo oxidative stabilities of polybenzoxazine have been improved by altering the functional group on the phenol and/or amine. However, the functional groups of the aromatic amines are difficult to prepare and significantly raise the product's cost. The other procedure to obtain high-performance materials is modification utilizing polymer alloy/or blend technology. Therefore, the purpose of this work is to study the effect of BTDA incorporated into polybenzoxazine on thermal properties and mechanical characteristics as a high performance polymer, which makes them suitable for more extensive applications, i.e., in protecting coating, thermal insulating materials through the investigation of thermal stability, and dynamic moduli.

2. Methodology

The BA-a/BTDA mixtures to be investigated are BA-a/BTDA 1:1 to BA-a/BTDA 5:1. The number after letters is the mol ratio of the benzoxazine resin and BTDA in the respective order. The mixture was dissolved and

stirred in NMP at 80°C for few minutes until the homogeneous mixture was obtained and then the solution was cast. The NMP solvent was removed by drying in vacuum oven at 80°C for 24 h before undergoing a step cure in an air-circulating oven. The sample were then cured sequentially at 170°C-240°C for 1 h to ensure fully cure of the mixture.

Dynamic viscoelastic measurements were conducted on Perkin Elmer model Pyris Diamond in the tension geometry at 1 Hz from 30 to 350°C at 2°C/min. TGA was determined with Perkin Elmer model Diamond TG/DTA. Sample mass of 10 mg was heated from 40 to 820°C at a heating rate of 20°C/min under nitrogen.

3. Results and Discussion

Dynamic mechanical analysis can provide important viscoelastic properties of BA-a/BTDA blend systems as illustrated in Fig. 1. From the figure, we can clearly see that the storage modulus of the BA-a/BTDA blends is higher than that of the neat poly(BA-a). The storage moduli at the room temperature of the BA-a/BTDA blend systems exhibit the values in the ranges of 6.6-9.4 GPa at desirable compositions whereas that of the neat poly(BA-a) is of 4.5 GPa. The increase of the storage modulus value may be due to a result of the more rigid molecular characterization of dianhydride used. Since the BTDA molecule contains a number of the rigid molecule structure of benzene ring which significantly induced the materials more rigid. Thus, we can see that the modulus in the rubbery plateau of the BA-a/BTDA blend systems was clearly increased with the content of the BTDA. This evidence suggests that the increase of the BTDA composition results in a greater cross-linked density of the BA-a/BTDA blend systems.

All of BA-a/BTDA blends were homogeneous and transparent, implying that no phase separation occurred at the scale exceeding the wavelength of visible light. However, the BA-a/BTDA blends were subjected to thermal analysis to confirm the miscible characteristic with considering glass transition temperature (T_g) behavior. From the inset in Fig.1, the T_g value determined from the maximum of the loss modulus curve of the neat poly(BA-a) was reported to be about 165°C and the T_g value of the neat poly(BA-a) was found to enhance by blending with the BTDA. For the cured BA-a/BTDA blends, the compositions of these blends show single T_g 's, i.e. 200°C to 250°C. Interesting feature was observed that the BA-a/BTDA 1.5:1 blend shows synergistic behavior compared to other BA-a/BTDA blend compositions, which expects that the reaction of the functional groups by stoichiometric ratio between the BA-a resin and the BTDA may be strongly affected.

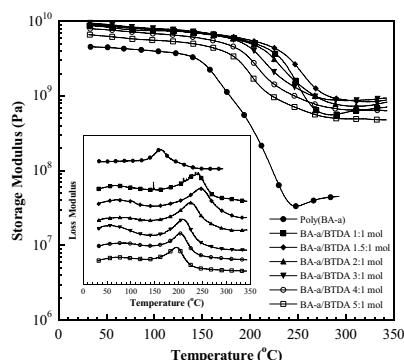


Fig. 1 Viscoelastic analysis of Ba-A/BTDA blends

The thermal stability of BA-a/BTDA blends was investigated by TGA. The values of 5 and 10% weight loss temperatures and the char yield are summarized in Table 1. As evidently seen in the table, the degradation temperature (T_d) reported at 5 and 10% weight loss of the BTDA containing poly(BA-a) showed higher than these of the neat poly(BA-a). Again, the synergistic behavior is observed, with the T_d of 364°C belonging to BA-a/BTDA 1.5:1 composition while the T_d of the neat poly(BA-a) used in this study has been reported to be about 339°C at 5% weight loss due to the presence of the BTDA into poly(BA-a) is plausible to propose that weight loss from segmental decomposition via gaseous fragments could be suppressed by an aromatic structure of the BTDA. Thus, incorporating the BTDA into poly(BA-a) can open an effective way to an improvement on the thermal stability of the neat poly(BA-a).

Another interesting feature in the Table 1 is a char yield value of the BA-a/BTDA blend systems reported at the temperature 800°C. Positive deviation (synergism) of char yield values was observed in the BA-a/BTDA blend systems as also observed in the T_g behavior, i.e., the char yields of all compositions show the values greater than that of the neat poly(BA-a). In particular, the cured BA-a/BTDA 1.5:1 composition shows synergistic behavior compared to the other compositions, which suggests that this is due to the presence of the

BTDA structure consisted of aromatic rings into the polybenzoxazine. The highest char residue of the BA-a/BTDA 1.5:1 is remarkably high considering the good processibility of the poly(BA-a) containing BTDA as well as the relative flammability also can be judged from their char residue.

Composition (mole ratio)	T_d (°C) at 5% wt loss	T_d (°C) at 10% wt loss	Char yield at 800°C (%)
Poly (BA-a)	339	369	39.9
BA-a/BTDA1:1	353	432	59.8
BA-a/BTDA1.5:1	364	414	61.5
BA-a/BTDA2:1	363	405	59.3
BA-a/BTDA3:1	345	395	59.5
BA-a/BTDA4:1	336	381	57.5
BA-a/BTDA5:1	331	378	54.7

Table 1 Heat resistance of BA-a/BTDA blends

The appearances of the cured BA-a/BTDA blend samples are shown in Fig. 2. The poly(BA-a) sample of 100 μ m thickness is very brittle, and the sample can be not bent more than as is shown in Fig. 2(a) whereas all the BA-a/BTDA blend samples as seen in Fig. 2(b-d) showed remarkably improved flexibility.

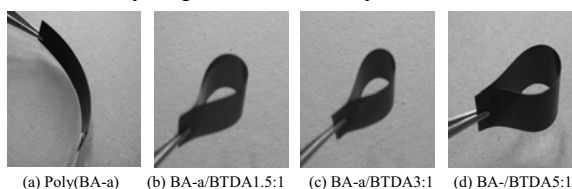


Fig. 2 Appearance of the fully cured BA-a/BTDA samples.

4. Conclusions and Recommendations for Thailand

Poly(BA-a) blends with improved thermal, some mechanical properties and flexibility characteristic have been achieved. The T_g values of the BA-a/BTDA blend were 200-250°C, much higher than the T_g of the typical poly(BA-a) [165°C]. The incorporation of the BTDA into the poly(BA-a) can improve the stiffness. Thermal stability of the BA-a/BTDA blend systems depended on the BTDA content. Therefore, high performance polymers with high thermal stability as indicated by those experimental results are increasing demanded in an advanced composite system as a matrix resin and in the electronic industry for packaging application in Thailand.

Acknowledgements

This work is supported by the research grant for TRF Research Scholar (S. Rimdusit) and by TRF-MAG scholarship (W. Bangsen and P. Kunopast) of the Thailand Research Fund.

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Mechanical and Physical Properties of HDPE/Corn Starch Composite

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This research has concerned feasibility study on using corn starch, as filler in high density polyethylene (HDPE). The filler content used range between 0-40 percent by weight. The HDPE/corn starch compounding was prepared by using a single screw extruder. From the results, it was found that the incorporation of corn starch into HDPE increased tensile modulus of the composite material at the expensed of its tensile strength. The decreases in the mechanical properties of HDPE with corn starch were explained in the light of the presence of interface defects between corn starch and polymer. Degradation studies demonstrated that the higher filler contents of HDPE/corn starch composites increased degradability at the given degradable environment. The information implies that this composite could be utilized as a degradable plastic.

1. Introduction

Starch is an abundant, inexpensive and natural raw material which is available from corn or other crops. Starch is totally biodegradable in wide variety of environments and could permit the development of degradable products for market demands. Degradation or incineration of starch products would recycle atmospheric CO₂ trapped by starch-producing plants and would not increase potential global warming [1]. Starch can be used as natural filler in traditional plastics and particularly in polyolefins. Since polyethylene is one of the most extensively produced non-degradable polymer and various types of polyethylenes are used in many field including food-packaging film and agricultural [2]. With the development of the plastic industry, starch/polyethylene with good degradability and compatibility are increasingly desired [3]. Starch-filled polyethylene plastics have been reported by many researchers [2-3]. The dry native starch was directly mixed in the polyethylene matrix with blends used for many products. An example of the contribution of starch is promoting of photodegradable low density polyethylene (LDPE). This research study of physical and mechanical properties of high density polyethylene (HDPE) filled with corn starch. The effect of starch content will be study on degradable property of the composites.

2. Methodology

Commercial-grade HDPE and corn starch were compounded in high speed mixer before compounding in single screw extruder (HAAKE/Polydrive Rheomex R25) at 0-40 percent by weight of starch. Mixing temperatures at zone 1, zone 2, zone 3 and die

zone were 140/150/160/170 °C, respectively at speed of 60 rpm. Compounds were molded in compression molding. Molded dogbone-type specimen dimension was in accordance with ASTM D638. The molded specimens were used in determination of tensile properties on universal tensile testing machine (Instron 5569) at speed of 100 mm/min. Thermal analysis of about 10 mg. of the compound in Al pan was done using Differential Scanning Calorimeter (Perkin Elmer/DSC7) within 50 °C – 200 °C range. The heating rate was 20 °C. Finally measure weight loss of the specimen before and after bury in soil. The weight loss percent was determined as the following method: Prior to the experiment, the specimen was accurately weighed. After the specimens were buried in soil for 3 months, they were also accurately weighed. The ratio of the weight reduction of the film after degradation to the original weight of the specimen prior to degradation was defined as weight loss percent. The formula of weight loss percent was as follows:

$$weightloss (\%) = \frac{(w_0 - w_1) \times 100}{w_0} \quad (1)$$

where w_1 refers to the weight of the specimen after degradation; w_0 refers to the weight of the specimen before degradation.

3. Results and Discussion

3.1 Mechanical Properties of HDPE/Corn Starch Composite

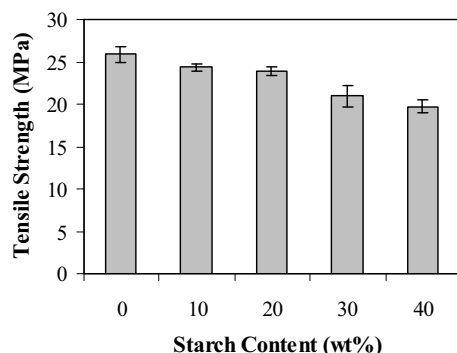


Fig. 1 Tensile Strength of HDPE filled corn starch 0-40 wt%

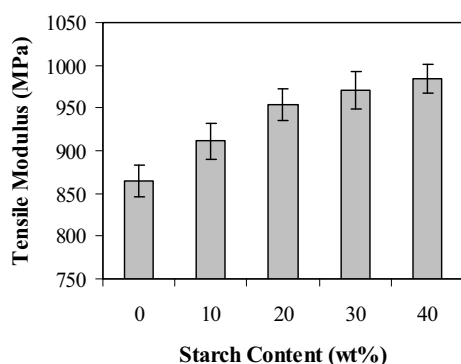


Fig. 2 Tensile Modulus of HDPE filled corn starch 0-40 wt%

The tensile strength of all HDPE/corn starch composites (Fig. 1) decreased with increasing starch content. This indicated that starch behaved as non-reinforcing filler and less interaction between the compounds resulted in decreasing the tensile strength. Tensile Modulus values in Fig. 2 increased when increasing starch content. In general, the modulus is closely related to the rigid domains of the material [4]. Starch added up the rigidity which increased stiffness of the composites.

3.2 Weight Loss Percent of HDPE/Corn Starch Composite

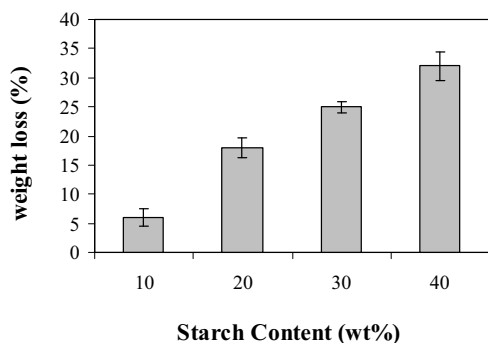


Fig. 3 Weight Loss of HDPE filled corn starch 10-40 wt%

The higher starch content showed higher in weight loss in Fig. 3. The weight loss of the composite was due to the biodegradability or light-oxidation degradability under the given degradable environments. The reduction in weight of the composite revealed that higher in starch content had better degradability [3].

4. Conclusions and Recommendations for Thailand

Corn starch, as filler, increased tensile modulus of HDPE where as decreased in tensile strength of the composites. The starch also promoted properties in stiffness and increased degradability of the composites. The research showed not only the potential of using corn starch, natural biomaterials, as filler in HDPE but also the potential of the material for sustainable development in both the aspects of degradable which contributes for waste management and energy conservation in Thailand.

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Development of Single Chamber Solid Oxide Fuel Cell using BaLaIn₂O_{5.5} (BLI) Solid Electrolyte: Introduction of Sublimation Materials as Pore Former in Electrode Preparation

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BaLaIn₂O_{5.5} (BLI) exhibits higher oxide ion conductivity than yttria-stabilized zirconia; however, it is difficult to use as a solid electrolyte in conventional dual chamber solid oxide fuel cells (SOFCs) because In ion suffers reduction under reducing atmosphere in the vicinity of a fuel electrode. Since Single Chamber Solid Oxide Fuel Cells (SC-SOFCs) operate in a mixture of fuel and oxygen which has more benign reducing atmosphere than the dual chamber, BLI is applicable to the SC-SOFCs application. Pore-former materials have been employed to the electrode preparation. Its function is to create diffusion path for gas in electrodes, hence easing the gas flow and increasing the gas velocity. Here, a novel study proposed by our research group is the introduction of sublimation materials as pore formers. Two types of sublimation materials have been studied; phthalic acid and fumaric acid. The results have been compared to the common pore former; carbon. According to the results, it was found that the performance of cells with sublimation materials as pore formers were better than the cells with carbon materials. This suggests that the cell performance of SC-SOFCs can be improved by enhancing the gas diffusion in electrodes by means of sublimation materials.

1. Introduction

Due to its higher oxide ionic conductivity than yttria-stabilized zirconia (YSZ) [1], BaLaIn₂O_{5.5} (BLI) [2-4], which has a defective perovskite-related structure, is chosen to serve as solid electrolyte in solid oxide fuel cell. In a conventional dual chamber system, BLI cannot be utilized because indium ion is reduced at oxygen partial pressure as low as that of fuel electrode. Therefore, we have developed a single chamber system with mild reducing atmosphere such as a mixture of methane and air, which allowed the utilization of BLI.

It has been observed that one of the major causes to low performance of solid oxide fuel cell in the single chamber system is its impedance, especially, from electrochemical reaction occurring at the electrode. The aim of this study is, thus, to improve cell performance by enhancing the electrochemical reactions by means of utilization of sublimation materials as pore formers in electrode material preparation.

2. Experimental

BaLaIn₂O_{5.5} (BLI) powder was prepared by a solid-state reaction of barium carbonate, indium oxide, and lanthanum oxide. The obtained powder was shaped into a disk, pressed under 392 MPa and sintered at 1400°C for 10 h. An 11-to-15-mm in diameter pellet electrolyte with a thickness of 0.5 mm was then obtained. (La_{0.75}Sr_{0.25})_{0.9}Cr_{0.5}Mn_{0.5}O_{0.3} (LSCM) mixed with 5wt% NiO and Sm_{0.5}Sr_{0.5}CoO₃ (SSC) were used as anode and

cathode, respectively. In this study, phthalic acid, fumaric acid, and benzoic acid were selected as pore-former materials due to their sublimation property. Each material was added to both LSCM and SSC at various compositions. The compositions of the pore-former materials were tested at 5, 10, 15, 20 and 30 wt%. The mixture was then painted on each face of BLI electrolyte pellet. The painted pellets were thermally treated for sublimation of the pore former and then pores or voids were created within the electrodes. Subsequently, the pellets were heated at 1000-1200°C. The power generation tests at 800°C were carried out to examine the cell performance. A mixture of methane and air was supplied with 1:1 volume ratio.

3. Results and Discussion

The cell performance was investigated by power generation test through the measurement of cell's open-circuited voltage (OCV) and maximum power density (MPD). The power generation results obtained at optimum composition of each sublimation pore-former material, 10 wt% for phthalic acid, 30 wt% for fumaric acid, and 10 wt% for benzoic acid, are shown in Fig. 1. For comparison, the results of carbon materials, acetylene black (AB), ketjen black (KB), and artificial graphite, as pore formers are shown in Fig. 2. Such carbon materials were often employed as pore formers. The composition ratios of these carbons were optimized. In

addition, the results from sublimation pore-former materials and carbon pore-former materials are compared and summarized in Table 1. The sublimation pore-former materials achieved higher performance than the carbons in terms of MPD.

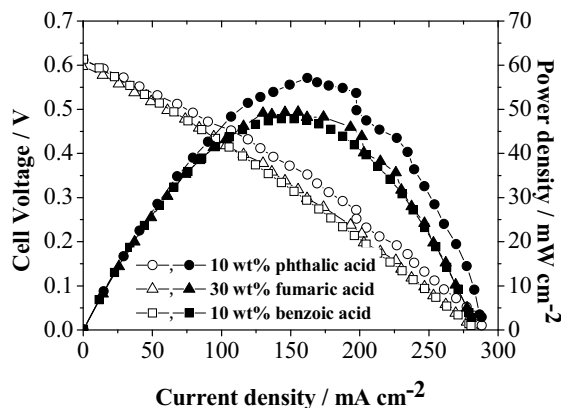


Fig.1 Power generation results of single chamber cell using BLI fabricated with sublimation pore-former materials.

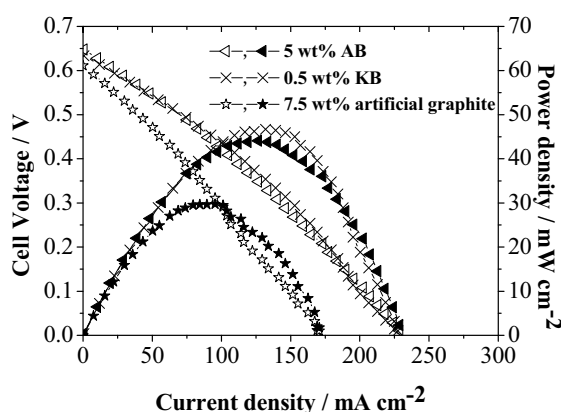


Fig.2 Power generation results of single chamber cell using BLI fabricated with carbon pore-former materials.

Table 1 Performance of the single chamber cell using BLI

pore-former materials	OCV/mV	MPD/ mWcm ⁻²
10 wt% phthalic	612	57.1
30 wt% fumaric	598	49.4
10 wt% benzoic	614	47.8
5 wt% AB	648	44.1
0.5 wt% KB	633	46.6
7.5 wt% artificial graphite	611	29.7

In conclusion, BLI cell fabricated with 10 wt% phthalic acid yielded the highest performance in all pore-former materials in this study. It is proved that sublimation pore formers are promising materials that can be applied to electrode for BLI electrolyte utilization to enhance the BLI cell performance.

4. Recommendations for Thailand

At present, the number of researches concerning about fuel cells has been increasing. This research can be contributed as a reference source to the research and development of solid oxide fuel cell as an alternative energy source in Thailand. However, the technology level of this research has not yet reached the practical application. Further research and development are required in order to apply this project into industrial process.

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Development of an Electric Wheelchair Using PEM Fuel Cell

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This paper introduces a prototype of electric wheelchair using fuel cell, and refers to energy management of the wheelchair system. It consists of a PEM fuel cell stack as a power supply, an EDLC bank as an energy buffer, and two electric DC motors which are driven by a newly designed four-quadrant DC chopper, etc. The study aims to save energy by managing energy flow of the wheelchair system, and to accomplish efficient drive of the DC motors. In order to achieve high efficiency of the system, the EDLC bank works properly depending on drive conditions of the system. Essential characteristics of the fuel cell and performance of the wheelchair have been investigated by many kinds of experiments. According to the experimental results, fundamental driving ability of the wheelchair has already been proved. Also, it is cleared that the fuel cell has enough capability and is appropriate to the electric wheelchair system. Consequently, some ideas and technologies which are applied to the system will be able to contribute to design for other kinds of electric vehicles and transportation in the near future.

1. Introduction

Recently, many discussions on fuel cells have come up. For problems of the global environment and exhaustion of the fossil fuels, the studies on application of fuel cells are notable issues. On the other hand, several types of electric vehicles have been developed by a lot of car manufacturers and institutes. Then, investigation into combination of fuel cells and electric vehicles, which include wheelchair, is important subject [1]-[2].

In particular, there is a big problem of air pollution in many metropolises, even in Thailand. From the viewpoint of it, this study is supposed to be worthwhile.

This paper shows a prototype of electric wheelchair using a PEM (Proton Exchange Membrane) fuel cell stack. The wheelchair system also has an EDLC (Electric Double Layer Capacitor) bank as an energy buffer, and a four-quadrant DC chopper which drives two electric DC motors. The motors are mounted on both of the wheels.

2. Structure of Wheelchair System

Figure 1 shows a picture of the electric wheelchair. It originally has the following specifications; diameter of both the wheels is 22 inches, maximum speed is 6km/h, output power of both DC motors is 90W, power supply is a Li-ion battery (25.9V/6Ah).

The electric wheelchair has been improved on several points. Especially, the power supply has been replaced by the PEM fuel cell stack with a set of hydrogen storage alloys, which are shown in Fig. 2. The two DC motors are driven by the newly designed DC chopper, and the EDLC bank is employed to manage energy flow of the system.



Fig. 1 Electric wheelchair

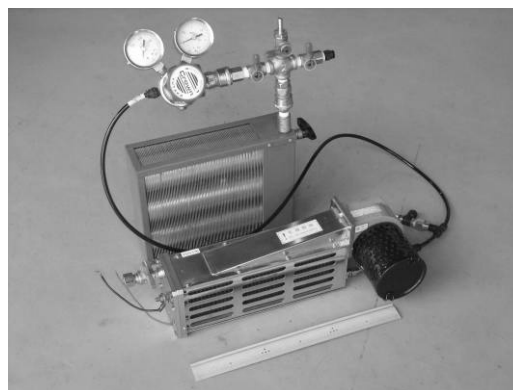


Fig. 2 PEM Fuel cell & Hydrogen storage alloys

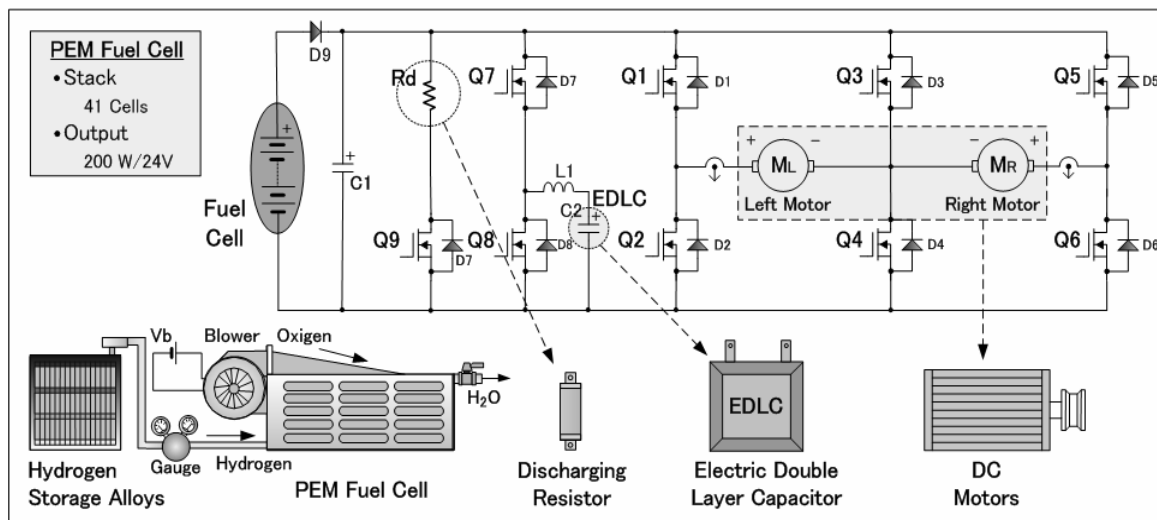


Fig. 3 Energy management and motor drive

Major specifications of the main devices of the wheelchair system are as follows.

- (1) PEM fuel cell (output): 200W-24V,
- (2) Hydrogen storage alloys (capacity of H_2): 500 liters,
- (3) DC motor (output power): 90W,
- (4) EDLC: 1350F-2.7V.

Figure 3 shows the architecture of energy management of the system and the drive circuit for the two DC motors. Regarding to the PEM fuel cell stack, hydrogen is supplied from the hydrogen storage alloys, and oxygen contained in the air is inhaled using a blower.

The EDLC bank is charged or discharged depending on drive conditions of the system. For example, it supplies energy to the motors when the output power of the fuel cell lacks for motor drive. When regeneration occurs, energy flows from the motors to the EDLC bank.

3. Experiments and Discussion

As described above, the prototype of electric wheelchair system using the PEM fuel cell stack have already been completed. To examine the performances of the fuel cell and the motor drive circuit, many kinds of experiments were carried out.

According to the experimental results, some important knowledge has been obtained. Firstly, the fuel cell has sufficient output power (about 200W) because the maximum power of the two motors is 180W. Secondly, the motor drive circuit operates adequately for essential drive modes, i. e., forward or backward drive, right or left turn, pivot movement, and combination of these modes [3]-[4].

The next stage of the study is to inspect energy management and to achieve high efficiency of the electric wheelchair system. Therefore, it is important to analyze the energy

flow for any conditions of the system by computer simulations and experiments.

4. Conclusions and Recommendations for Thailand

The problem of air pollution has been discussed amazingly these days in Thailand, especially in Bangkok. This study will surely contribute to the problem because fuel cells do not exhaust any harmful gases. Naturally, some ideas and technologies applied on the electric wheelchair system will be able to utilize for design of the future vehicles. In addition, the means of energy management and save energy would contribute to the future transportation and lifestyle, not only in Japan but also in Thailand.

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High Efficient Dye-Sensitized Solar Cells Using TiO₂ Nanoparticles/Nanofibers as Photoelectrode

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Specific applications of 1-D materials are being developed in order to improve the electron transport and enhance the light confinement leading to higher conversion efficiencies of dye-sensitized solar cells (DSCs). Electrospun TiO₂ nanofibers are one of the promising 1-D materials. Recently, we have successfully prepared electrospun TiO₂ nanofibers which were very long over several cm. Calcination of the composite fibers at 450°C resulted in predominant content of anatase titania nanofibers. The effects of temperature and time of calcination on the crystalline phase and size of the as-spun TiO₂ fibers were also investigated. When the TiO₂ nanofibers were fabricated on top of the particle-electrode, we observed remarkable enhancement of photovoltaic performance attained power conversion efficiency of 8.14% (0.25 cm²) compared with conventional TiO₂ nanoparticles (7.47%). The maximal power conversion efficiency was attained to be 10.3% (N719 dye system) by using 0.0515 cm² mask.

1. Introduction

Dye-sensitized solar cells (DSCs) by using TiO₂ nanoparticles have been studied for over a decade expected as low cost alternatives to conventional silicon devices. One limiting factor in the performance of DSCs with nanoparticles is electron transport. Grain boundaries and small cross-sectional area at the interfaces of the nanoparticles lead to the enhancement of the scattering of free electrons, and such scattered electrons reduce the electron mobility and promote the electron recombination.

Specific applications of 1-D materials are being developed in our laboratory in order to improve the electron transport and enhance the light confinement leading to higher power conversion efficiencies. Electrospun TiO₂ nanofibers are one of the promising 1-D materials [1,2]. In this context, a specific application of electrospun TiO₂ nanofibers was reported for electrodes of DSCs as a light harvesting layer.

2. Experimental

The TiO₂ nanoparticles-paste was first coated on fluorine-doped SnO₂ conducting glass (FTO) by doctor-blade technique. TiO₂ nanofibers were electrospun directly onto the nanoparticles from a solution in methanol of poly(vinyl pyrrolidone) (PVP), titanium(IV) butoxide (TiBu), and acetylacetone (ACA), which is different from other previously reported procedures [3]. ACA was used to slowdown the hydrolysis and the condensation reactions for preventing of breakage of fibers during those reactions. The spinning solution was loaded into a syringe and connected to a

high voltage power supply. An electrical potential of 15 kV was applied between a nozzle and the ground over the collection distance of 15 cm. The obtained fibers were left exposed to moisture for approximately 5 h to allow complete hydrolysis.

In order to prepare the DSC, obtained nanoparticles/nanofibers electrode was consequently subjected to calcination at 450°C for 3 h. The microstructure and crystalline structure of the prepared nanofibers and obtained electrode were observed and measured by using a scanning electron microscopy (SEM) and X-ray diffraction (XRD), respectively. Calcined TiO₂ electrodes were sensitized by immersing in a 0.3 mM of ruthenium (II) dye (known as N719) in a mixture of *t*-butanol and acetonitrile. The electrolyte which we utilized in this work was composed of dimethylpropyl imidazolium iodide, lithium iodide (LiI), iodide (I₂), and 4-*tert*-butylpyridine in acetonitrile. Photocurrent-voltage (*I-V*) curve was measured under simulated solar light (AM 1.5, 100 mW/cm²).

3. Results and Discussion

The obtained TiO₂ nanofibers showed 1-D structure with diameters ca. 250 nm, which were very long over several cm. Calcination of the composite fibers at 450°C for 3 hr resulted in predominant content of anatase titania nanofibers with high crystallinity.

Figure 1 (right) shows SEM images of both types of obtained photoelectrodes (nanoparticle electrodes with and without nanofibers). Size of nanoparticles was ca. 15 nm which is beneficial for high surface area and high dye adsorption. The nanofibers-layer

with thickness up to ca. 1 μm could be fabricated. From UV-vis absorption spectra of both of electrodes, nanoparticles/nanofibers electrode showed higher light absorption in visible region. It can be described that the optical path length of incident light with longer wavelength could be prolonged by light scattering at the layer of TiO_2 nanofibers. In other words, light harvesting efficiency was improved by a combination of nanofibers.

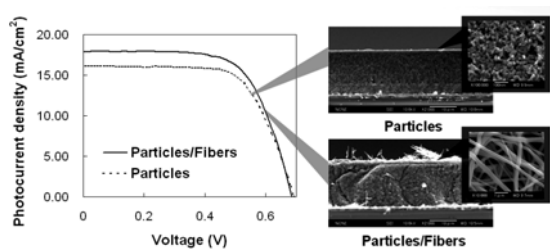


Fig. 1 Photocurrent density versus voltage characteristics (left) and SEM images (right) of DSCs with and without TiO_2 nanofibers-introduced on nanoparticles-electrode [3].

Figure 1 (left) shows some examples of photocurrent-voltage characteristics of the devices with nanoparticles/nanofibers compared with conventional TiO_2 nanoparticle DSCs. When the TiO_2 nanofiber electrode was used, enhanced photovoltaic performance was attained with power conversion efficiency of 8.14% compared with conventional TiO_2 nanoparticles (7.47%). The maximal power conversion efficiency was attained to be 10.34% (N719 dye system with 0.0515 cm^2 mask) by some optimizations. The successful increase about 8% in efficiency by combination of thin nanofibers-layer indicates the increasing in light harvest efficiency as described above. Addition of large sized nanoparticles on top of photoelectrode acting as light-scattering layers to increase the light harvest efficiency was also reported previously. The nanofibers showed more advantageous than that topology as: (1) The well aligned nanofibrils in 1-D nanofibers may contribute to better charge transportation (2) efficient penetration of the electrolyte into the TiO_2 particles-electrode can occur easily through many pores in the web, and (3) nanofibers can be directly fabricated on top of particles-electrode in one step with uniform large-area and good adhesion with particles. In addition, the details of microstructures, physical properties, and photovoltaic properties of the other devices with TiO_2 nanofibers were also investigated and will be reported.

4. Conclusions and Recommendations for Thailand

Anatase TiO_2 nanofibers were directly fabricated on thick nanoparticles electrode through electrospinning and sol-gel techniques, and applied for dye sensitized solar cells. IPCE of 85% at the wavelength of 540 nm and conversion efficiencies of 8.14 and 10.3% with area of 0.25 and 0.0515 cm^2 , respectively, were obtained. These results suggest light harvesting 1-D nanofibers-combined nanoparticles might be very promising materials for the electrode of DSC. This research is beneficial for Thailand because Thailand is a tropical country which has sunshine in several months a year. Thailand's climate makes it an ideal location for the development of renewable energy technologies, especially solar cells. The fabrication of DSC photoelectrodes by combination of TiO_2 particles and nanofibers by above simple method is seems to be able to carryout in Thailand. However, it still needs to undergo further research and development to enhance its efficiency versus cost and the potential to use DSCs in a commercial level.

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Microstructure and Fatigue Crack Growth Behavior of Friction Stir Welded 6063 T-5 Aluminium Alloys

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The influence of friction stir welding on the microstructure and fatigue crack growth behaviour of 6063 T-5 aluminum alloys were investigated. For this propose, fatigue crack growth (FCG) curves were determined for crack growing in different locations of notch, including base materials (BM), middle of welded zone and heat affect zone (HAZ). The crack initiation and crack propagation of the FSW specimens were presented slower than base material specimens. Results are completed with microhardness measurements and scanning electron microscopy (SEM) observations. The material affected by the welding process presents a fine stirred grain structure and the material near the heat affected zone (HAZ) presents regular grains.

1. Introduction

Friction stir welding (FSW), is a solid - state joining process developed and patented by Wayne Thomas at TWI in 1991 [1-4], This joining technique has enabled us to butt-weld aluminum alloys, which are often difficult to fusion weld, without voids, cracking, or distortion. Furthermore it is energy efficient, environment friendly and versatile [1].

The process was developed initially for aluminum alloys,[1-4] but since then FSW was found suitable for joining a large number of materials. In aeronautics, riveting is the preferred manufacturing process for aircraft fuselage structures [2]

In this study is contribution about the influence of the FSW technique on the fatigue crack growth and microstructure of FS welded and base materials specimens of AA 6063 T-5.

2. Experimental procedures

The base material used in this present study was the Al alloy 6063 T-5. The Chemical composition shown in Table 1 The 5 mm-thick plates were friction stir welded.

Table 1 Chemical composition of the Al 6065 T-5

Al	Cu	Fe	Mg	Mn	Si	Ti	Zn
Bal	0.01	0.18	0.48	0.04	0.44	0.01..0.01	

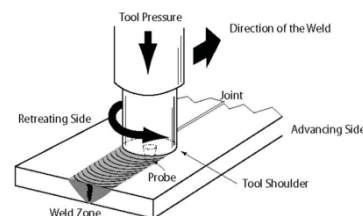


Fig. 1 Shows metal plates butted together with probe and tool shoulder of FSW process

The middle tension, M(T), specimens were used in FCG test. The geometry are in accordance with ASTM specification E 647-95a [5].

Stress intensity factor range, ΔK of M(T) specimen were calculated as follow:

$$\Delta K = \frac{\Delta P}{B} \sqrt{\frac{\pi \cos \frac{\pi \cos}{2}}{2W}} \quad (1)$$

Where $\cos = 2a/W$; $2a/W < 0.95$

B: Thickness, W: Width

Scanning electron microscopy (SEM) were used for observation of grain structure and hardness were measured on transverse cross-section of weld.

3. Results and Discussion

3.1 Microstructure analysis

The friction stir weld is characterized by three different zones as shown in Fig.2 as follow: stir zone (SZ) included; thermo mechanically affect zone (TMAZ) and welded nugget, heat affect zone (HAZ) which surrounding the SZ, and unaffected base metal (BM). In Fig. 2 (1),(2),(3) the effected zone by FSW presented a fine grain size .On the other hand HAZ (3) and base material (5),(6) presented regular grains size.

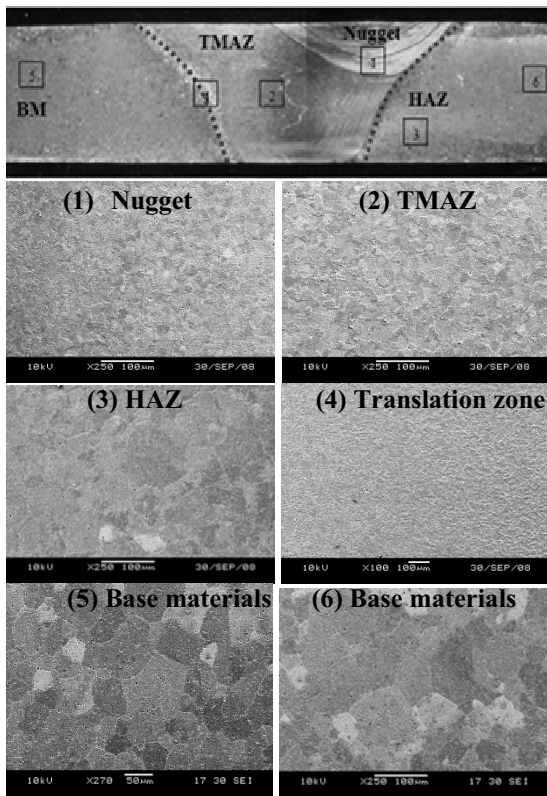


Fig. 2 Macro and microstructure

To determine the grain size diameter, the grain size on base material have an average diameter of 60-70 μm and weld zone (TMAZ and nugget) present diameter of 25-30 μm .

3.2 Microhardness measurements

The Vickers micro hardness test obtained along 3 lines (Top, mid and bottom) on cross-section are presented in Fig.3. Hardness minimum appeared in heat affected zone and hardness decrease in weld zone was found to be significantly slightly lower than the base material. This hardness variation was due to the different micro-structures of base material (BM) and welded zone.

3.3 Fatigue crack growth curves

Fig.4 summarizes the results obtained for different location of notch under $R=0.1$

The crack initiation and crack propagation rate of the middle welded are lower than crack initiation and crack propagation rate of HAZ and base material. This behavior relate to different grain size at different location of notch.

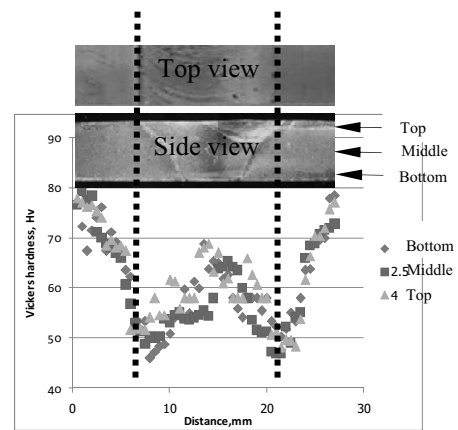


Fig. 3 Micro hardness profile

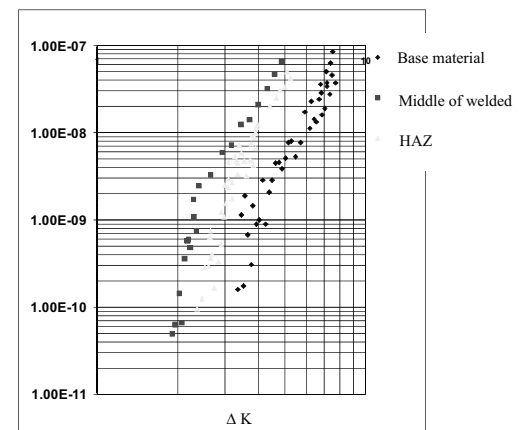


Fig. 4 Fatigue crack growth curves

4. Conclusions and Recommendations for Thailand

The fatigue crack growth of the FS welded of 6063 T-5 Al alloy present the crack initiation and crack propagation of the FSW specimens are slower than base material specimens and microstructure presents a fine stirred grain structure of welded zone and the base material near the heat affected zone (HAZ) presents regular grains due to the hardness test was found to be significantly slightly lower than the base material. The papers can contribution to Thailand.

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Robust Pattern Detection Using Quantum-Inspired Evolutionary Algorithms

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In this research, we apply Quantum-Inspired Evolutionary Algorithms to the Pattern Detection problem. Quantum-Inspired Evolutionary Algorithms are the learning algorithms based on the basis of Quantum Computation, the new paradigm of computing. Even though Quantum-Inspired Evolutionary Algorithms are processed on classical computer model, it uses many elegant concepts from Quantum Computation such as the analog representation on the probability of each data and chromosome. That makes it suitable for Artificial Intelligence system and has been applied widely. In this research, we will apply Quantum-Inspired Evolutionary Algorithms to Pattern Detection problem focused on Robot Vision System. The result shows that we can produce fast and correct Pattern Detection System using this method.

1. Introduction

Quantum Computation [1] is the new paradigm of computing that is expected to replace personal computer in the next few decades [2]. Using Quantum Mechanics as a base to build a new type of computer, Quantum Computer is not only compact and fast, but also changing the way to solve computational problems make computer able to solve many problems, which are mostly hard to solve in classical computer. Factoring, Discrete Logarithm, and Abelian Hidden Subgroup Problems [3] are examples of this type of problems. Moreover, because of the fact that Quantum Computer processes the data in parallel, Quantum Grover's Search Algorithm [4] is significantly faster than any classical search algorithm. Since most of Artificial Intelligence system is based on searching, this makes Quantum Computation suitable for AI system. Quantum Neural Network and Quantum Genetic Algorithms is said to be faster, and more natural.

Although, D-Wave have announced that they have public the first Quantum Computer and use their Quantum Computer to solve many problems such as Image Matching [5], Factoring, and Quantum Cryptography, many believe that we are still far from the commercial Quantum Computer. Despite that fact, we can use many interesting concepts from Quantum Computation to make the algorithms in classical computer better. Quantum-Inspired Evolutionary Algorithms (QEAs) [6] are the algorithms interested in this research. Using the concept about the linear superposition of the qubits and the rotation of qubits in Grover's Search Algorithm, QEAs have been shown faster, and consume much less memory. Because of this fact, it has been

applied widely to Combinatorial Optimization Problem [7], Image Segmentation [8], Face Detection [9], or User Detection in Wireless Sensor Network [10]. In this paper, we will focus on another Image Processing Problem that is Pattern Detection in Robot Vision. This problem has already been explored in the paper about Quantum Robotics by Benioff [11] and Dong et al. [12], but they research on the algorithm on Quantum Computer, contrast to Quantum-Inspired Algorithm in classical computer in our research.

2. Methodology

The QEA consists of 2 parts, training and evaluation. Training is the process that we use a large number of examples to train the computer to recognize our patterns, and evaluation is the process which we make the computer decides whether the input image can match our patterns. Our Algorithm is based on Principal Component Analysis (PCA) method.

For Training process, we use 100 examples. In each example, we do some image preprocessing [13] such as remove noise, resize into 50x50 pixels image, and convert into Monotone Picture. Then, we find the eigenvalues and eigenvectors. The eigenvectors that correspond to a large eigenvalues seem to present the important information in the image. We call these eigenvectors as "Principal". Assuming that the pattern can be rotated into any angle, we rotate every image to make the first Principal of them point to the same way.

Next, we find the pattern of the training examples by finding the covariance matrix of each point in 50x50 pixels image. We will use this covariance matrix together with QEA to recognize the patterns.

To detect the pattern from the image, we first find candidate of the pattern by using Hough Transformation or other simple object recognition techniques. As a result of those techniques, we select 100 candidates that have the most possibility to match our patterns. Then, we apply the preprocessing algorithms that have been applied on the training examples and extract the covariance matrix. The comparison between the input's covariance matrix and training example's covariance matrix is used to evaluate whether the input can be matched to the pattern using QEA.

QEA is almost the same as Genetic Algorithm. The algorithm consists of the generation of the initial population, the mutation, the crossing over similar to Genetic Algorithm. But each bit in chromosome is replaced by qubits that is the bits that we are unable to decide what it is – 0 or 1, until we measure it, but the possibility of 0 or 1 will be computable. Since we use qubits instead of the classical bits, in the end of the genetic loop, we perform the measurement and use the result of the measurement to evaluate the chromosome.

3. Conclusions and Recommendations for Thailand

Theoretical Computer Science is very broad, but the number of researchers in Thailand on this field is so few. Thus, Thai researchers can hardly pursue the advance on this field. Besides, Quantum Computation is relatively new and interesting topic that we have not been explored. In the near future, as Quantum Computer gain more importance, using this technology as a pioneer might be very beneficial for Thailand.

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Computer Vision for Thailand's Future

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Computer vision is the technology of machines that see and analyze scientifically. Simply speaking, it is the use of computer techniques to theoretically extract and methodically interpret information in visual images. It is needed for automated systems to keep pace with real-world activities. Recently, computer vision is a rapidly developing and extremely interdisciplinary field of computer science. An increasing number of leading researchers around the world are turning their attention to the development of vision applications. In this paper, we survey the existing vision based-applications in recent years. Topics covered in the paper include: introduction to computer vision, computer vision in science fiction movies and computer vision for musical applications (i.e. piano and guitar). Also, we briefly address specific needs for computer vision research in the context of Thailand in the future. We believe that computer vision could be a useful key to emerge the innovative technologies in Thailand in coming future.

1. Introduction to Computer Vision

Vision is an important sense that humans have. Computer vision is the technology to endow machines with similar capabilities to interpret visual input, and to act upon it. Generally speaking, it is the method to allow computer to visually understand something from the images. Figure 1 shows a sample of recognizing emotions expressed by body pose using computer vision technology [1].

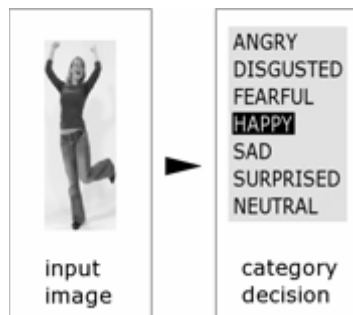


Fig. 1 Sample application of computer vision for recognizing emotions expressed by body pose [1]

Many ideas of computer vision have been appeared in various movies. For example, in the science fiction movie “Minority Report”, in which Tom Cruise plays a futuristic police officer shuffling computerized information around simply by moving his hands and fingers (Figure 2), the idea of computer vision technology for hand detection has been appeared. Another example can be found in the science fiction movie “The Matrix Reloaded” (for new viewpoint analysis technology in computer vision). Moreover, in movie “Resident Evil”, the concept of human detection in computer vision has been appeared. Imagine how interesting is if all of these ideas in the science fiction movies can

become true in real life with an emerging technology called computer vision.



Fig. 2 Tom Cruise in the science fiction movie “Minority Report” which inspires computer vision technologies in the future [www.imdb.com/title/tt0181689/]

2. Computer Vision for Musicians

Computer Vision can be applied to many fields. One of them is about vision-based research for musicians. For instance, Gorodnichy and Yogeswaran [2] present a system for monitoring and analyzing the movements executed by piano players, as shown in Figure 3.

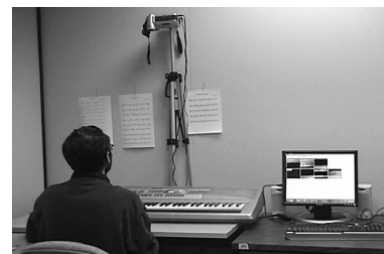


Fig. 3 Vision-Based Monitoring of a Pianist's Movements [2]

Other vision-based research for musical applications is about guitars. It is also a popular topic in the field of computer vision for musical applications. For example, Maki-Patola et al. [3] propose an interesting system

called “Virtual Air Guitar” using computer vision (Figure 4). They create a virtual air guitar which does not require a real guitar (e.g. by using only a pair of colored gloves), but produces music similar to a player using a real guitar.

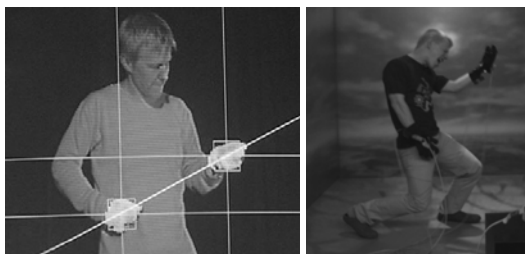


Fig. 4 “Virtual Air Guitar” [3]

Another vision-based application for guitar player is “Interactive Guitar Game” (Figure 5), in our research. By using computer vision technology, it assists guitar learners by automatically identifying whether the fingertip positions are correct and in accord with the fingertip positions required for the piece of music that is being played.



Fig. 5 “Interactive Guitar Game”

The aforementioned guitar application recognizes the guitar chord being played by a guitar learner based on the 3D position of fingering in the virtual guitar coordinate spaces. Then, the system gives real-time feedback to guitar learners telling them if they are using the correct chords required by the musical piece. This application would be invaluable as a teaching aid for guitar learners.

3. Conclusions and Recommendations for Thailand

Recent economic growth in developing regions, together with the widespread use of technology, suggests that there is a potential for technologies to have an impact on development. For this reason, researches about computer vision in developing regions are experiencing fast growth in recent years. Therefore, we believe that the idea of developing and emerging a new computer vision technology is essential for Thailand to keep our place in this world.

In the context of Thailand, computer vision could be beneficial to further apply to solve various existing problems in Thailand. For example, computer vision could be a useful tool to solve the problem of traffic jam in Bangkok by calculating the car used during every particular time. The only limitation of conducting this kind of researches in Thailand is lacking of supporting budgets. If there are enough budget supporters from either private companies or the government, we believe that computer vision technologies could be an emerging key to develop Thailand.

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Research on Weed Detection Methods for Precision Spraying in Lawns

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This paper summarizes image processing based methods of lawn weed detections for automatic weed control systems. Three gray-scale based methods are briefly explained and compared. The performances of the methods together with a chemical-based system, which performs precision spraying, are shown. The methods can destroy more than 70% of weeds existing in the captured images, and can successfully reduce herbicide usages of more than 90%. Other topics which improve performance of the system, such as a post-processing technique, color-based method and hybrid system, and non-chemical based weed control systems, are also briefly described.

1. Introduction

There are many methods for controlling weeds but chemical-based method, i.e., to destroy weeds by using herbicide, is often used because it is convenient and less time required. However, the use of herbicide can cause adverse effects on the environment, and also increases the cost of weed control. Nowadays, automatic weed control systems become an alternative approach. Instead of spraying herbicide onto the entire area, the systems capture the field images, detect the area of weeds, and control a nozzle system to spray herbicide onto only the areas of detected weeds. Consequently, herbicide usages can be significantly reduced. This research focuses on weed detection in lawn fields by using image processing techniques.

2. Methodology

Figure 1 shows the flowcharts of three gray-scale based lawn weed detection methods. The first one (Fig. 1(a)) is called Bayes classifier based method (denoted by BC) [1]. It extracts two texture features from the edge image, and distinguishes weed pixels from lawn background by using Bayes classifier. The second method (Fig. 1(b)), called morphological operation (MO) based method, employs image morphological operations such as opening and closing to detect weed areas [1]. These two methods were proposed by the authors. The third one (Fig. 1(c)), proposed by Ahmad et al. [2], is called gray-scale uniformity analysis method (denoted by UA). It was implemented and compared with the BC and MO methods. The three methods were tested on a lawn weed database which consists of four different datasets taken from four different seasons in Japan. The database contains 20 training images and 100 test images. Examples of lawn weed images and

detected results are shown in Fig. 2 and Fig. 3, respectively.

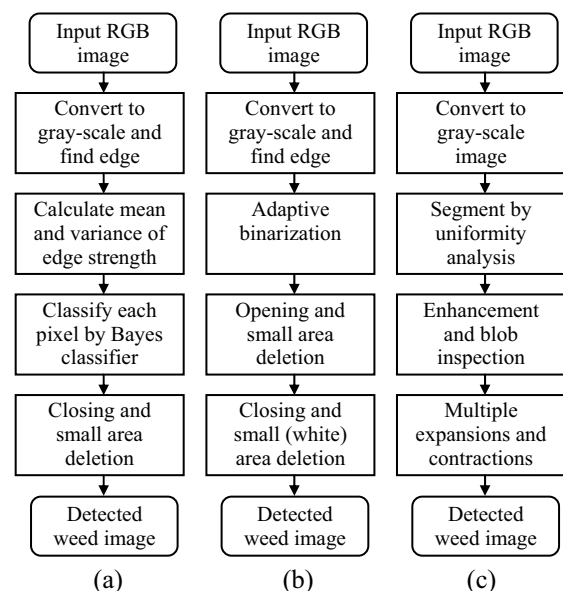


Fig. 1 Weed detection methods: BC methods (a), MO method (b), UA method (c).

3. Results and Discussion

Table 1 shows the performances of all three methods when they are simulated on a chemical-based weed control system. Three evaluation values are shown. Killed weed rate (KWR) is the ratio of destroyed weeds to all weeds existing in the test database. Correct spray rate (CSPR) describes accuracy of spraying. Herbicide reduction rate (HBR) describes how much herbicide can be reduced, compared with spraying herbicide onto the entire area. The result shows that all three methods succeed in herbicide reduction (HBRs of more than 90%) but the proposed methods (BC and MO) outperform the compared method (UA) in weed destruction performance (KWR) and spraying accuracy (CSPR). Because the proposed methods were designed



Fig. 2 Example of lawn weed images.

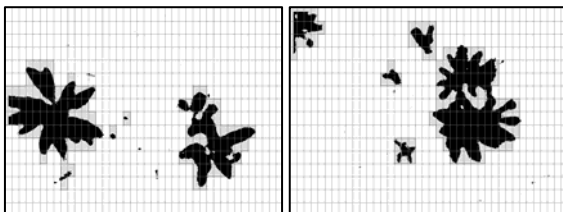


Fig. 3 Detected result of the weed images in Fig. 2 (black areas) and sprayed areas (grey blocks).

Table 1 Performance of chemical-based system

Method	KWR	CSPR	HBR
BC	72.87%	89.44%	93.94%
MO	73.94%	89.66%	92.92%
UA	70.74%	86.74%	93.49%

based on the difference of weed and lawn textures, they can still valid even in the case that weed density gets larger.

The other topics, which can be used to improve the performance of automatic weed control systems, are described as follows:

- In [3], a post-processing technique based on grass-edge model filterbank was proposed to remove misclassified blobs after weed detection was performed.
- In [4], a fast and simple color-based method for detecting weeds in winter (in which the lawn color has completely changed and is different from weed colors) was proposed. It outperforms the gray-scale based methods in detecting weeds of winter dataset. Also the idea of hybrid system that integrates both gray-scale based and color-based methods was described.
- In [1], another type of automatic weed control system, i.e., electrical-based system, was considered and tested. The system would destroy weeds by using electrical spark discharges. Consequently, it does not use any chemical substance.

4. Conclusions and Recommendations for Thailand

Various techniques of lawn weed detection have been summarized, and a portion of results was shown. For Thailand, the target of the research (i.e., lawn fields) would be extended to agriculture fields because Thailand is an agriculture country. The use of automatic weed control systems would help farmers protect

their products effectively, increase quality and quantity of the products, and also reduce the amount of herbicide used in weed control, leading to cost reduction and environment preservation. For that case, we hope that it would highly benefit Thailand.

In the case of agriculture fields, color information can effectively be used to distinguish plants (weeds and crops) areas from soil backgrounds before performing weed/crop classification. The proposed lawn weed detections may be applied if the textures of weed and crop surfaces are different. However, when the shapes of weeds and crops are alike, it is difficult to classify them in visible-light domain. A hyperspectral imaging system should be exploited to capture the difference in the internal structures of weeds and crops in the other spectral bands.

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Sustainable Management of Ground Anchor Maintenance using Markov Process

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It has been highlighted that ground anchors deteriorate their performance with time as a result of physical and/or chemical effects. Nowadays, road administrators face serious problem associated with decision-making when and how to carry out inspection, maintenance and replace of a large number of pre-existing ground anchors under the limited budget allocated to road maintenance. This paper proposes a systematic method for maintenance management of ground anchor based on limited inspection data. The proposed method assumes that deterioration process can be modeled as a Markovian process using categorized inspection results.

1. Introduction

Ground anchors deteriorate their performance with time as a result of physical and/or chemical degrading processes which are considered as a stochastic process. To clarify these tasks, Markov process is introduced in this research since Markov process is known as a special class of stochastic process that uniquely determines the future behavior by its present state.

Sharabah et al [1] has utilized the Markov chain for deterioration modeling of infrastructure assets owned by local councils in Australia. Mizutani [2] proposed a maintenance planning method (MPM) for deteriorating structures using Markov chain associated with both maintenance and loss expenditures. However, very few of such a model was applied to strategic maintenance management of road slope considering ground anchor degradation. The problem is arisen when the state's prediction is situated under constraints of limited access to ground anchor condition data. In this paper, an approximation method is then proposed by utilizing iteration method in association with polynomial equation solving in order to determine the transition probability matrix based on the proposed assumptions using the categorized inspection results.

An approximation method is also combined with a discrete Markov chain model for future performance prediction to determine the optimum maintenance plan that complies with the budget constraints and satisfies the required objectives.

2. Methodology

A Markov chain is a special type of the Markov process whose development can be treated as a series of transition between certain

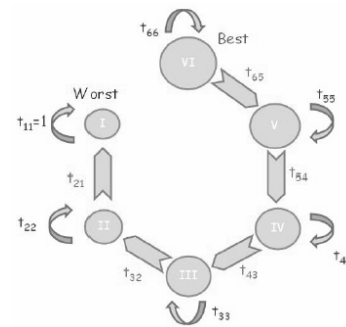


Fig. 1 Six-state Markov chain

states. When time is measured in discrete intervals the model is called the *Discrete Time Markov Chain* (DTMC). The performance of ground anchors were inspected and categorized into 6 ranks, best rank (VI) to the worst rank (I). Due to the short transition time, a decaying probability by more than one state in one year is assumed to be negligible as shown in Fig. 1. The Markov properties are characterized through the transition probability matrix. In this study, the Markov differential equation is developed by describing the probability of being in each of the state at time $t+\Delta t$ as a function of state of the system at time t resulting in the following equations:

$$\begin{bmatrix} dS_6(t)/dt \\ dS_5(t)/dt \\ dS_4(t)/dt \\ dS_3(t)/dt \\ dS_2(t)/dt \\ dS_1(t)/dt \end{bmatrix}^T = \begin{bmatrix} S_6(t) \\ S_5(t) \\ S_4(t) \\ S_3(t) \\ S_2(t) \\ S_1(t) \end{bmatrix}^T \cdot \begin{bmatrix} T_{66} & T_{65} & 0 & 0 & 0 & 0 \\ 0 & T_{55} & T_{54} & 0 & 0 & 0 \\ 0 & 0 & T_{44} & T_{43} & 0 & 0 \\ 0 & 0 & 0 & T_{33} & T_{32} & 0 \\ 0 & 0 & 0 & 0 & T_{22} & T_{21} \\ 0 & 0 & 0 & 0 & 0 & T_{11} \end{bmatrix}$$

or $\dot{S} = S \cdot T$

where $\mathcal{S}$ represents the state of system at time $t+\Delta t$, S represents the initial state of the system and T represents transition probability matrix.

The difficulties are arisen when the predictions of state are situated under

constraints of limited access to ground anchor condition data. Therefore the systematically method is proposed in the combination of iteration method and polynomial equation solving.

3. Results and Discussions

The total number of inspected ground anchor at 12th year, 16th year and 19th year after operation is 52, 208 and 391, respectively therefore the initial state matrix corresponding to each inspected year are expressed by

$$\begin{aligned} S_{12}(0) &= [52 \ 0 \ 0 \ 0 \ 0 \ 0] \\ S_{16}(0) &= [208 \ 0 \ 0 \ 0 \ 0 \ 0] \\ S_{19}(0) &= [391 \ 0 \ 0 \ 0 \ 0 \ 0] \end{aligned}$$

The state matrices at time t are presented by a number of inspected ground anchor corresponding to each condition rating as shown below:

$$\begin{aligned} S_{12}(12) &= [0 \ 11 \ 36 \ 4 \ 1 \ 0] \\ S_{16}(16) &= [0 \ 0 \ 206 \ 0 \ 2 \ 0] \\ S_{19}(19) &= [0 \ 0 \ 315 \ 76 \ 0 \ 0] \end{aligned}$$

Using iteration method, the trial transition matrix is obtained corresponding to each inspected year. Consequently, each inspected year is extended up to the final inspected year, which is 19th year in this case, using its trial transition matrix as shown below:

$$\begin{aligned} S_{12}(19) &= [0 \ 4 \ 37.1 \ 6.8 \ 4 \ 0.2] \\ S_{16}(19) &= [0 \ 0 \ 205.3 \ 0.3 \ 2.3 \ 0.1] \\ S_{19}(19) &= [0 \ 0 \ 316.3 \ 74.1 \ 0.4 \ 0.2] \end{aligned}$$

The optimized state matrix is defined as the state matrix obtained by summation of each equation above as shown below:

$$S(19) = [0 \ 4 \ 558.7 \ 81.2 \ 6.7 \ 0.4]$$

In consideration of the total number of inspected ground anchor, the initial state matrix can be obtained by summation of each equation in the initial state as expressed by

$$S(0) = [651 \ 0 \ 0 \ 0 \ 0 \ 0]$$

The optimized transition matrix is obtained as shown below by solving polynomial equations in which the S(0) is used as input state and S(19) is used as output state.

$$T = \begin{bmatrix} 0.5580 & 0.4420 & 0 & 0 & 0 & 0 \\ 0 & 0.7273 & 0.2727 & 0 & 0 & 0 \\ 0 & 0 & 0.9889 & 0.0111 & 0 & 0 \\ 0 & 0 & 0 & 0.9876 & 0.0124 & 0 \\ 0 & 0 & 0 & 0 & 0.9929 & 0.0071 \\ 0 & 0 & 0 & 0 & 0 & 1 \end{bmatrix}$$

The predicted state using optimized transition probability matrix is compared with observed data as shown in Fig. 2. It was found that the predicted state using calculated

transition matrix give a small different comparing with observed data in which such an error is caused by uncertainty involved in deteriorating process such as the random of inspected ground anchor as well as their numbers in each inspected year. Therefore, one can conclude that the deterioration process including future state of ground anchor can be clarified and predict efficiently using proposed method.

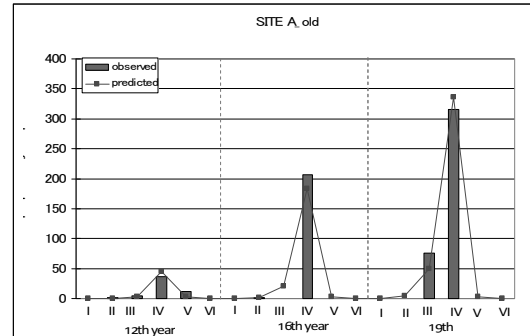


Fig. 2 Comparison between observed-input data

4. Recommendations for Thailand

In Thailand, awareness of infrastructure maintenance management is still deficient therefore the proposed method can be applied into not only ground anchor maintenance but also other infrastructures in which their deteriorating nature can be modeled as the Markovian properties.

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An Optimal Renewal Timing Markov Model for Water Supply Pipelines System

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In megacities, the water work bureaus are facing major challenges with regard to the deterioration of their pipelines system. Pipelines are underground facilities that inspection and repair could not be easily implemented. As a matter of course, it exerts to have high uncertainty in deterioration speed. Under the occurrence of leakage or breakdown, a huge loss in term of social cost and repairing cost would be accumulated. This paper takes into consideration of this risk and thus to develop a model in defining an optimal timing for pipeline replacement so as to minimize the total expected life cycle cost (LCC). The model employs the application of markov process to illustrate the deterioration process of pipelines system. An empirical study was carried out with pipelines system in Osaka city to further verify its applicability

1. Introduction

It has been widely known in the asset management of water supply pipelines system that the deterioration is due to various corrosion mechanisms, such as soil corrosion, bimetallic corrosion, and stray currents. As a sequel of deterioration, the leakage and breakdown will occur and lead to presume head losses, high repairing cost as well as social cost [1].

In the literature of asset management, especially for pipelines system, several methods have been studied in determining the optimal replacement strategies [2,3]. These studies focused both on repair and renewal rules based on the break rate and least LCC estimation approach. In which, non-homogeneous process were employed to illustrate the behavior of deterioration process. The application of Markov hazard model in management of pipelines is somewhat at the outset of development. This study proposes a mathematical model, which is formulated based on markov chain process with use of discrete distinguish conditional states to describe the deterioration, and further apply LCC analysis to define the optimal renewal timing.

2. Mathematical Model

The water distribution network comprises of many different types of pipelines $k(k=1, \dots, K)$. The total length of one type is S^k (km). For ease of management, each section with a pre-defined length is assumed (for instance 0.1 km/section). We further denotes the condition state of pipelines as $i=1, \dots, M$, where M is regarded as absorbing state. The renewal process can be described by equation of time $t_r^d = t_0 + rd$ ($r=0, 1, \dots$). In which, d is

interval duration, and r is number of time in discrete order.

With use of markov hazard model, the deterioration process of section $s(s=1, \dots, S)$ can be represented by conditional transition probability matrix.

$$\text{Prob}[h_s(t_{r+1}^d) = j | h_s(t_r^d) = i] = p_{ij} \quad (1)$$

after repair/renewal, the condition state of pipeline at time t_r^d and t_{r+1}^d are denoted as

$h_s^0(t_r^d)$ and $h_s^0(t_{r+1}^d) = j'$. The probability $P_{ij'}^{\xi}$ of

changing the condition state $h_s^0(t_r^d) = i$ into $h_s^0(t_{r+1}^d) = j' = j'$ can be formed as the following equation

$$P_{ij'}^{\xi} = \sum_{j=1}^M p_{ij} q_{jj'}^{\xi} \quad (2)$$

where $q_{jj'}^{\xi}$ is action matrix the value equal to 1

when $\eta^{\xi}(j) = j'$ and equal to 0 otherwise. j' is the state after repair/renewal being made ($j=1, \dots, M; j'=1, \dots, j$). The deterioration level of pipelines system can be seen as the relative frequency of total number of section s in condition level i on the total number of section S .

$$\pi^{\xi}(t_r^d) = \{\pi_1^{\xi}(t_r^d), \dots, \pi_M^{\xi}(t_r^d)\} \text{ and } \sum_{i=1}^M \pi_i^{\xi}(t_r^d) = 1 \quad (3)$$

$$\pi_i^{\xi}(t_r^d) = a_i^{\xi}(t_r^d)/S, \quad a_i^{\xi}(t_r^d) = m_i \quad (i=1, \dots, M).$$

m_i is measured in km. From (2), we obtain the following equation for the change of relative frequency from t_r^d to t_{r+1}^d .

$$\pi_j^{\xi}(t_{r+1}^d) = \sum_{i=1}^M P_{ij}^{\xi} \pi_i^{\xi}(t_r^d) \quad (4)$$

When taking into account the cost and risk under LCC estimation, we formulate the one-step unit expected cost w_k^{ξ} .

$$w_k^\xi = \sum_{i=1}^{M-1} \sum_{j=1}^M \sum_{j'=1}^j p_{ij}^k q_{jj'}^\xi c_j^{j'} S^k \pi_i^{k\xi} \quad (5)$$

with $c_j^{j'}$ is repair/renewal cost. It is obvious that the w_k^ξ is also a function of d . Therefore, the unit cost with respect to policy ξ can be in the form as

$$W^\xi(d) = \frac{\sum_{k=1}^K w_k^\xi(d)}{d} \quad (6)$$

Beside the direct cost, other fixed cost c_R occurs as social cost due to the level of deterioration. This loss has its own probability $\nu = (\nu_{1,L}, \nu_M)$.

$$R^\xi(d) = \sum_{k=1}^K \sum_{i=1}^{M-1} \sum_{j=1}^M p_{ij}^k \nu_j c_R S^k \pi_i^{k\xi} \quad (7)$$

The optimal timing d can be defined by solving the minimum condition of the following equation.

$$\min_{d, \xi} \{W^\xi(d) + R^\xi(d)\} \quad (8)$$

3. Empirical Application

In this study, we used the data of water distribution network in OSAKA city. We used two condition state $i=1$ for normal operation and $i=2$ for breakdown state. Following results were obtained from numerical analysis on 8567 recorded pipelines sections.

Fig. 1 shows the deterioration curve representing by survival probability throughout the management terms. After about 60 years of operation, the survival probability decreases to 0.5. Fig. 2 displays the plot of expected life cycle cost. In which, the repair cost and social cost are 2,485,000 (yen) and 4,670,000 (yen) respectively. It can be observed from the figure that the minimum LCC gets its value of 12,346,003 (yen), which is equivalent to 44 years. After 64 years, there is a gradually small increase with respect to expected LCC. The value of probability ν is assumed to be $\nu = (0, 0.002)$.

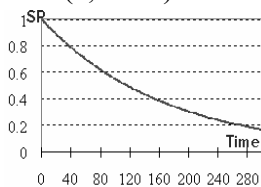


Fig. 1 Survival probability (SP)

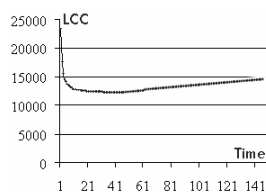


Fig. 2 Life cycle cost (1000 Yen)

4. Conclusions and Recommendations for Thailand

This paper introduces a method based on markov chain model to determine the optimal time for replacement of pipelines. The empirical study was conducted on the dataset of water pipelines system in Osaka city. The estimation shows a cumulative of about 44 years after the construction time for renewal policy to be implemented. The test of the model further proves that the ratio between social cost and repair cost has a great influence on the estimation result.

Regarding the recommendation for Thailand, it can be obvious that the model can be used to apply for maintenance and repair work of pipelines or sewage system in megacity like Bangkok. Moreover, the introduction of using markov process in asset management can bring significant positive impact on the development of asset management in Thailand, where asset management is still in early development stage.

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Sustainable Water Demand Management for Economic and Social Development in Thailand: Case of Lower Chao Phraya River Basin

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Water is the main natural resource that is used in many sectors including industry, agriculture, and domestic. Development of these economic and social activities with increasing population need more water; however, supported or supply water is limited. From this reason, the main question for policy makers is how to develop Thailand with the constraints of water capacity under satisfactions of each user. The aim of this study was therefore to develop water demand management model by integrating engineering (water resources), economic (input-output table and equilibrium analysis with water demand-supply curve), and financial (real option analysis) methods. In this paper, main economic and social activities (industrial, agricultural and domestic sector) in Lower Chao Phraya River Basin in Thailand including Bangkok, the capital of Thailand, were selected to analyses for next 20 years because this area is the center of development in urbanization, economic, and political part. The results show that this model can produce not only water demand in the future but effects from changing economic structure, pricing policy, and risk analysis also. This study suggests that water can be managed in line with demand, provided that combination of engineering, economic, and financial policies to control water demand are put in place.

1. Introduction

From the past, water use was more needed because of increasing population, urbanization, and industrialization. Most studies and designs in water resources engineering seem to agree that there are two schemes to manage water; water supply and demand schemes. Water supply approach is concentrated to increase new water source such as construction of dams or water supply systems but water demand idea reduces water use with constraints of new water sources, for example, recycle, pricing policy, and etc.

However, few studies have concentrated on integration of water demand with combination among engineering, economic, and financial parts. Policy maker should design the possible national economic and social development plan at the first step with the constraints of water. Many questions should be asked in this step as follow. Is it possible that Thailand will be the leader of textile industry, which needs much groundwater in production, under groundwater ban law? Is it possible to export 10 million tons of milled rice per year under existing irrigation system? If the economic target is not possible, how to use water demand schemes to keep that mark? If the government declares the water demand plans, what is the impact to economic and social structure?

Most researches did not focus on how water using structure changes from changing economic activities, and what is the effect from water policy to the users, how to invest water

infrastructure under uncertainties of water demand and supply in the future.

The purposes of this research were: (1) to forecast water demand with effect of changing economic activities by using input-output table; (2) to calculate effects from pricing policy with water demand schemes such as recycle system in each evaluation standard; (3) to increase the value of water infrastructure project by using real option analysis with uncertainties in the future.

2. Methodology

Water demand management model was developed by integrating the engineering, economic, and financial fields in industrial, agricultural, and domestic sectors. The study area is Lower Chao Phraya River Basin that consists of 7 provinces as follow: (1) Bangkok (capital of Thailand); (2) Samut Prakan; (3) Samut Sakhon; (4) Nonthaburi; (5) Pathum Thani; (6) Ayutthaya; and (7) Nakhon Pathom. The model was developed by using data from year 1985 to 2005 to forecast water situations in year 2006, 2015, and 2025. The outputs of each model were shown in provincial and regional scale.

The model consisted of 4 sub-models as follow: (1) water demand model (to forecast changing water demand in the future from changed economic activities by using input-output table with national and regional development plans); (2) water supply model (to analyze all possible water supplies with constraints and scenarios of demand schemes such as recycle system); (3) integrated water

demand management model (to calculate equilibrium point in each governmental scenario by using pricing policy and water demand-supply curve developed from model 1 and 2, and to evaluate the suitable choice with each evaluation standard); and (4) strategic decision making model (to value flexibility of infrastructure investments supported water demand in the future).

3. Results and Discussion

Total water demands including industrial, household, and agricultural sectors were shown in Table 1. Total water demand in year 2025 was varied from the possible maximum and minimum case between 5,038 and 6,734 million cubic meter, MCM depended on situations in each sector. Possible maximum water demand is summation of industrial water in case of all declared strategies, household water in case of varied water use unit and agricultural water in case of low rainfall. If 100 % of possible recycled water in Japan case was applied, it can be saved 573 MCM in year 2025 or approximately 60 % of capacity of Pasak dam. To validate the results, actual water demand should be surveyed and monitored to analyze effects of declared policies and water measures, however, it is difficult to implement because of limited budget.

4. Conclusions and Recommendations for Thailand

Developing new water sources is more difficult because of limited water supply, conflict with environmental viewpoint, and higher cost of water per cubic meter. Policy maker should use water demand side management especially; (1) water saving such as reuse, reduce, and recycle, (2) pricing policy, (3) water right and sharing, and (4) educate water users with conservation options. Water demand management invokes ways to operate within limits of current supplies. However, combination of both measures is normally best. In viewpoint of economic, it is almost certain that development of industrial activities need more water. From this reason, policy makers should carefully consider the target of economic with constraints of each water source in specific area. In case of study area, main industrial types such as food and textile need groundwater in groundwater critical zone. It is the conflict between the target of economic and constraint of water in this area. Policy makers should make decision of economic planning with the maximum

possible capacity of water. The water rights and sharing in the dry season are always the critical period for water shortage problem. Water management system in Thailand is generally planned from the top-bottom or from central government to users. The problem of this method is that right of water in each user was designed and controlled by policy makers that don't use water in that area. One interesting measure used in Japan is bottom-top method or planning from local committee of each area. The committees consist of only water users in each sector such as factory, farmer, and the head of citizen located in that area. The officers from local-central government and specialists from academic fields play a role as only consultants. By this method, the right and sharing of water and benefit was designed by water users.

Table 1 Results of forecasted water demand model

Case		Water demand, MCM		
		2006	2015	2025
T.1	Maximum case	4,064	5,047	6,734
T.2	Minimum case	3,638	4,235	5,038
T.3	T.1 with recycle	4,026	4,918	6,161

Note: T1 or maximum case is summation of industrial sector (case of industrial clusters with FTAs), household sector (case of varied water use unit from changing daily style), and agricultural in drought year. T2 or minimum case is summation of industrial sector (case of normal growth), household sector (case of fixed water use unit), and agricultural in much water year. Recycle means recycled water in industrial sector

Analysis of Biomass Pyrolysis Mechanism for Development in Reactor Design

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Pyrolysis of cellulose using thermogravimetric method was performed under inert atmosphere at different heating rates in order to investigate the pyrolysis behavior of biomass. The decomposition of biomass pyrolysis was shifted to lower temperature when decreasing its heating rate due to longer reaction period. For structural analysis of the residues, FTIR spectra showed a decrease in OH group when increasing pyrolysis temperature. This indicates that the dehydration reaction to produce water proceeded during pyrolysis at low temperature regions. Moreover, XRD patterns also showed a decrease in crystallinity when increasing pyrolysis temperature due to the random glycosidic reaction to produce tar products. Through these analyses, the temperature profile of biomass pyrolysis is very important to effectively design reaction zones for required products distribution and reactor development.

1. Introduction

Biomass has recently been considered as a renewable resource, due to its environmentally benign characteristics. Biomass has a very complex structure, consisting of cellulose (30-50 wt%), hemicellulose (10-30 wt%), and lignin (15-40 wt%); however, cellulose has a simple structure and is often selected for investigations of pyrolysis behavior. Most investigators have studied the mechanism for cellulose pyrolysis, and generally recognize at least two competitive pathways; dehydration, i.e. cross-linking reactions, and depolymerization, i.e. the splitting of glycosidic bonds. The effects of pyrolysis conditions on product yields and distribution can be explained by these two competitive pathways. In this work, pyrolysis behavior of biomass was preliminarily investigated using thermogravimetric method. The structural properties of biomass pyrolyzed at low temperature region were further studied. Finally, pyrolysis mechanism at low temperature region was simply proposed.

2. Experimental

Using thermogravimetric (TG) method, cellulose and biomass samples weighed about 1.5-3.0 mg were heated under inert atmosphere at various heating rates, 5, 10, 20, and 50 K·min⁻¹ to 900 °C before they were completely combusted with air to determine carbon conversion and char yields. The samples were also pyrolyzed with a heating rate of 3000 K·s⁻¹ using a Curie-point pyrolyzer (CPP) at different temperatures for comparison. Moreover, the samples 50-100 mg were also treated under nitrogen atmosphere in quartz tube reactor with the flow rate of 100 cc·min⁻¹ to various low temperatures of 300-500 °C.

Then, the pyrolyzed samples were dried before analysis using Fourier transform infrared spectroscopy (FTIR) and X-ray diffraction (XRD) for structural analysis of the residues.

3. Results and Discussion

3.1 Analysis of Biomass Pyrolysis Rate

Thermogravimetric analysis was used to preliminarily investigate the effect of heating rate on the kinetic behavior of cellulose pyrolysis as shown in Fig. 1. With decreasing the heating rate from 50 to 5 K·min⁻¹, the beginning temperature of cellulose decomposition were gradually shifted from approximately 350 to 300 °C. For pyrolysis with 5 K·min⁻¹, the decomposition of cellulose was completely proceeded before reaching 400 °C, while it almost reached 450 °C for that of 50 K·min⁻¹. This indicates that the pyrolysis with lower heating rate making longer reaction period required lower temperature to complete cellulose decomposition.

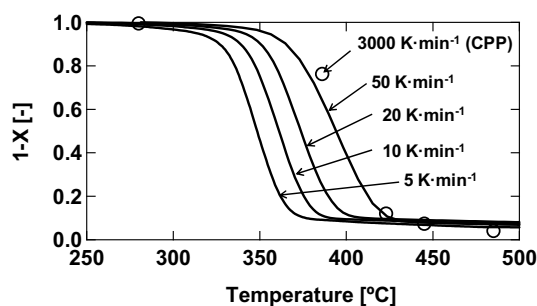


Fig. 1 TG curves of cellulose samples pyrolyzed at various heating rates.

3.2 Analysis of Biomass Structure during Pyrolysis at Low Temperature

Since TG results showed the change of pyrolysis behavior due to its decomposition reaction during low temperature region, the analyses of FTIR and XRD were conducted, which their results are given in Fig. 2 and 3, respectively in order to compare the structure of cellulose residues pyrolyzed at different low temperatures with $5 \text{ K}\cdot\text{min}^{-1}$ and $3,000 \text{ K}\cdot\text{s}^{-1}$. For FTIR spectra in Fig. 2, absorptions between 3000 and 3600 cm^{-1} are typically ascribed to hydroxyl groups (OH) or adsorbed water. The spectra of OH peak intensity gradually decreased when the samples were treated to higher temperature. The OH peak was extremely dropped from 320 to 340°C and from 445 to 485°C for the samples pyrolyzed at $5 \text{ K}\cdot\text{min}^{-1}$ and in a flash mode, respectively. However, the spectra of the residues at higher temperature then showed almost the same low intensities of the OH absorptions. This indicates that the dehydration to produce water such as cross-linking reaction was promoted during pyrolysis at low temperature region which has agreement with the results of thermogravimetric analysis.

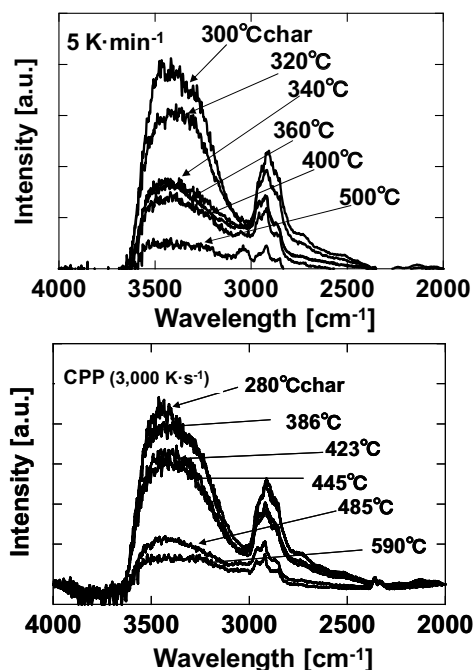


Fig. 2 FTIR spectra of cellulose samples pyrolyzed at $5 \text{ K}\cdot\text{min}^{-1}$ and $3,000 \text{ K}\cdot\text{s}^{-1}$

Through the analysis of solid crystallinity, XRD patterns of the samples treated with inert gas and air showed the peak intensities at $2\theta = 15-25^\circ$ as shown in Fig. 3. The peak intensities were continuously decreased with increasing temperature. This indicates that the crystallinity of pyrolyzed residues gradually decreased, and then the sample structure became near amorphous at 340°C and 485°C

for the samples pyrolyzed at low heating rate and in a flash mode, respectively, because the glycosidic bonds may be randomly decomposed to produce tar when heating to higher temperature.

3.3 Conclusions and Investigations of Pyrolysis Mechanism of Biomass

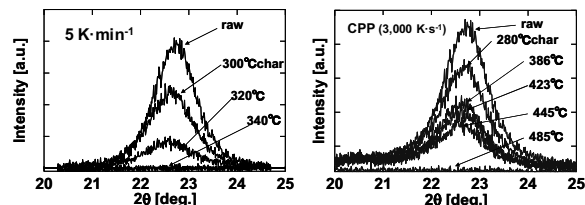


Fig. 3 XRD Patterns of cellulose samples pyrolyzed at $5 \text{ K}\cdot\text{min}^{-1}$ and $3,000 \text{ K}\cdot\text{s}^{-1}$

Through above analyses, it shows that heating rate has a significant influence on pyrolysis temperature range. Pyrolysis with low heating rate at $5 \text{ K}\cdot\text{min}^{-1}$ almost completely proceeded at 340°C , while the sample was hardly decomposed for flash pyrolysis at the same temperature. Moreover, lower heating rate at low temperature causes relatively more cross-linking reaction with a decrease in OH group. Consequently, pretreatments of biomass at low temperature may be necessary to change its structure and obtain valuable products. Finally, a simple structural model was also proposed to properly explain the mechanism of biomass pyrolysis.

4. Recommendations for Thailand

Since Thailand has abundant biomass resources, researches on mechanism and reactor technology of biomass conversion such as pyrolysis and gasification should be more focused to control obtained products as renewable energy and valuable chemicals. In conclusion, through the results in this work, the temperature profile of biomass pyrolysis is very important to effectively design reaction zones for required products distribution and reactor development.

Gasification of Cotton and Jatropha Residue Using Supercritical Water

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Among various biomass materials available in Thailand, cotton and jatropha are abundant biomass which has potential as renewable energy resources. Powdery cotton and jatropha residue has been gasified by supercritical water in a tubular flow reactor to produce fuel gas. Effects of gasification temperature in a range of 400 – 700°C and biomass loading of 0.1-0.5 wt % have been experimentally examined. The gaseous product is composed of hydrogen, carbon dioxide, carbon monoxide, methane and a small amount of ethane and ethylene. The hydrogen yield was dependent on the increasing biomass loading. Elevated temperature and catalyst addition would be required in the gasification of high concentration of feedstock.

1. Introduction

Biomass is one of the most abundant renewable energy resources. A variety of biomass resources can be used to convert to energy. Biomass conversion to energy is undertaken with two main process technologies: thermo-chemical and biological processes. Thermo-chemical gasification of biomass is likely to be a cost-effective process to produce fuel gas [1].

One method for hydrogen production is the steam reforming of biomass. The major problem in gasification by steam reforming is the formation of tars and char as the biomass does not react directly with steam at atmosphere pressure [2].

Supercritical water has an excellent extracting capability which is superior to that of liquid water. Generally, the dielectric constant of supercritical water is much lower than that of water and other solvents. As a result, supercritical water behaves like an effective solvent for many biodegradable materials. It is well known that supercritical water has the ability to dissolve biomaterials which are not normally soluble in water or steam. These properties make supercritical water a very promising reaction medium for the conversion of biomass to value-added products. The objective of this research is to produce a fuel gas from biomass, which are cotton and jatropha seed residues by gasification in supercritical water. Investigation on effects of temperature and biomass loading upon gasification yield has been conducted experimentally. Analyses of gas compositions obtained from gasification have also been carried out.

2. Experimental

All gasification has been performed within a tubular flow reactor shown schematically in Fig. 1. The tubular flow reactor had the inside diameter of 2.17 mm and the length of 12 m. Cotton or jatropha residue powder suspension was fed into the reactor by a piston pump (Toyokoatu Co.,

designed for our use). Except otherwise stated, the reactor temperature and pressure were 500°C and 25 MPa, respectively. The reactor was cooled down by the cooler before solid remaining was separated from suspension by the solid-liquid separator. Meanwhile, the exit gas flow was separated by the liquid-gas separator. The gas generation rate was measured by the gas meter (W-NK0.5A, Shinagawa). The gas and liquid samples were analyzed with gas chromatograph (GC-14B, Shimadzu) and TOC (TOC-V_{CPH}, Shimadzu), respectively. In this work, the reaction temperature was varied from 400 to 700 °C and residence time in the range of 80 – 222 s.

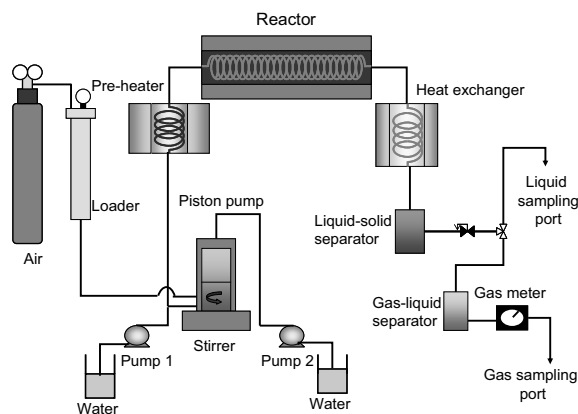


Fig. 1 Schematic experimental set-up

3. Results and Discussion

Effect of biomass loading (0.1-0.3 wt %) in the reactor on gasification product by supercritical water was studied at 500°C, 25 MPa. Figure 2 shows that with an increase in the biomass loading from 0.1 to 0.2 %wt, relative yield of methane, ethylene, ethane and carbon monoxide concentration was reduced while that of carbon dioxide and hydrogen was increased. As the biomass loading was further increased from 0.2 to 0.3 %wt, the hydrogen fraction was reduced while carbon monoxide

and was increased slightly. Based on these results, it would be implied that the gasification of high solid loading of biomass feedstock would be preferable to gaseous product with small molecular size.

Meanwhile, effect of temperature (500-600°C) on gasification of cotton and jatropha residue is shown in Figure 3. When temperature was increased from 500 to 600°C, the yield of hydrogen and methane were increased while the fraction of carbon monoxide and carbon dioxide were reduced. These would be attributable that the selective formation of hydrogen and methane would be more enhanced under higher supercritical conditions.

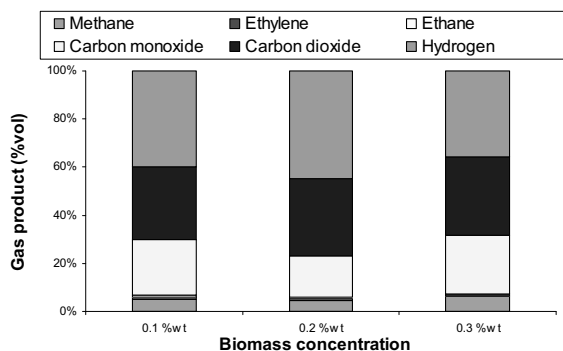


Fig. 2 Effect of loading on gaseous product synthesized from cotton gasification in supercritical water (500°C and 25 MPa.)

4. Conclusion and Recommendations for Thailand

Cotton and jatropha residue could be gasified by supercritical water to produce fuel gas which contained hydrogen, methane, carbon monoxide, carbon dioxide and small amount of ethylene and ethane. Hydrogen production was influenced by operating parameters which were biomass loading, temperature and residence time. With a high solid loading, hydrogen fraction was decreased. Systematic investigation on gasification of both biomass materials would be beneficial to Thailand and Southeastern Asian countries because of their abundance in this region.

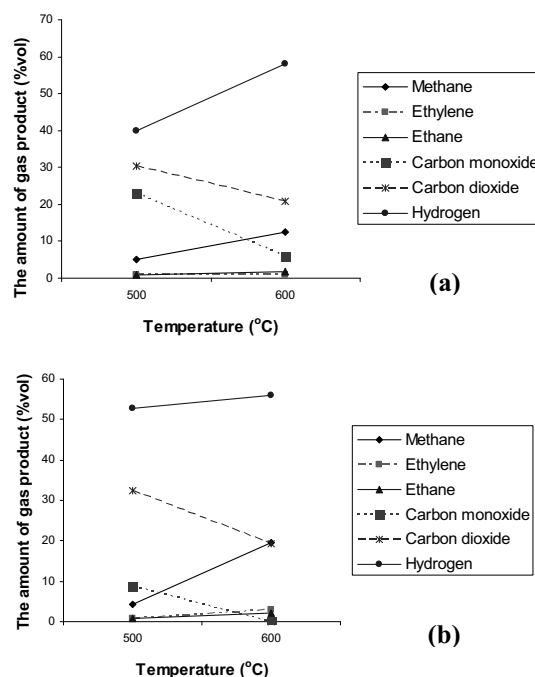


Fig. 3 Gaseous products synthesized from gasification of biomass in supercritical water (P= 25 MPa.); (a)Cotton (b)Jatropha residue

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Acknowledgement

This research is partially supported by the Centennial Fund of Chulalongkorn University. TS also gratefully acknowledges the support of HUMAP of Hiroshima University.

Liquid Phase Deposition of Anatase Titanium dioxide Nanotubes Arrays and their Performances of Hybrid Solar Cells

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Titanium dioxide (TiO_2) nanotube arrays were deposited on the fluorine-doped SnO_2 (FTO) transparent conducting glass oxide by a liquid phase deposition method using ZnO template. Characterizations of the TiO_2 nanotube arrays were performed. TiO_2 arrays on the substrate are suitable for fabricating hybrid solar cells based on the nanotube arrays FTO/ TiO_2 /N719/P3HT:PCBM/Au structure. Before cell fabrication, the surface modification of the metal oxide surface enhanced the electron injection of the solar cells performance. The power conversion efficiency of the device is determined to be 0.656% under AM 1.5 solar illuminations.

1. Introduction

Over the past decade organic based solar cell are attracting enormous as a low cost, lightweight, and scalable source of renewable energy. The high power conversion efficiency has been reported 4-5% which focused of conjugated bulk heterojunction polymer [1-3]. Hybrid solar cell is an alternative type of the promising devices which combined the donor organic semiconductor together with acceptor inorganic semiconductor. TiO_2 is an attractive oxide because of its electron accepting and conducting ability. It has been reported the application of TiO_2 for photovoltaic dye sensitized solar cell and hybrid solar cells as an electron acceptor and transport. In the structure of nanorod/nanotube vertical arrays of the metal oxide, the large interface between the metal oxide materials and straight carrier paths to the electrode can be achieved due to the very short length of diffusion excitons[4].

2. Methodology

ZnO nanorod array on the ITO substrate was prepared by hydrolysis with solution method.. ZnO nanorod arrays were grown by immersing the zinc nanocrystal seeded sample into the solution of zinc nitrate hydrate and sodium hydroxide at 80 °C. After the deposition, substrate were rinsed by distilled water and dried in the air. TiO_2 nanotube arrays were synthesis by using ZnO template for deposition (LPD). The template of ZnO nanorod arrays on was immersed into aqueous solution including, ammonium hexafluorotitanate and boric acid. After immersion, the surface modified FTO was washed by deionized water and calcined at 450 °C. Prior to use, FTO coated with TiO_2 nanotube arrays was immersed overnight in N719 dye. After the rising with acetonitrile out the extra

amount of dye, mixture of P3HT and PCBM in chlorobenzene was spin-coated on the top of the N719/ TiO_2 -coated FTO substrate. Subsequently, the sample was immediately annealed at 140 °C. All the device preparations were prepared in the glove box under Ar atmosphere. Finally, gold electrodes were then evaporated under high vacuum in the ULVAC evaporation system.

3. Results and Discussion

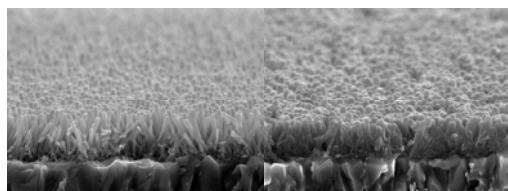


Fig. 1 SEM images cross-sectional views of ZnO nanorods arrays (a) and TiO_2 nanotube arrays (b) grown on FTO substrate (inset shows the top view of the tube structure, scale bar 500 nm.).

Fig. 1(a) show the images in cross-sectional view ZnO template on FTO substrate. These nanorods have uniform lengths of ~750 nm and diameters of ~80 nm were observed. After the heat treatment XRD patterns shows the predominant anatase phase. The current density-voltage of TiO_2 hybrid solar cells with and without surface modification under simulation of the light at AM 1.5. Modifying the TiO_2 nanotube arrays with N719 ruthenium dye attained V_{oc} of 0.48V, J_{sc} of 5.7 mW/cm^2 , FF of 24 %, and η of 0.656%. On the contrary, unmodified cell demonstrated the V_{oc} of 0.08V, J_{sc} of 1.1 mW/cm^2 , FF of 25 %, and η of 0.02%. Such improvement of the interfacial contact between the organic layer and the electron transporting layer may improve the efficiency of electron transfer because the wettability of the

surface after surface modification of TiO₂ nanotubes with dye molecule by the polymer resulting in enlargement of the contact area where the charge separations occur

4. Conclusions and Recommendations for Thailand

We have successfully synthesized the TiO₂ nanotube arrays through one step liquid phase deposition technique on ZnO template perpendicularly on the substrate. TiO₂ nanotube arrays on the substrate are suitable for fabricating hybrid solar cells based on the nanotube arrays TiO₂/N719/P3HT:PCBM/Au structure. The solar cell performance was improved in terms of the enhancement of the electron injection through the surface modification of the metal oxide surface by using N719 dye. Finally, this method for fabricating the 1-D aligned TiO₂ nanorod/nanotube arrays can provide us for the other application in electronic devices.

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Electrospun Conductive Polymer Nanofibers for Organic Photovoltaic Cells

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Organic photovoltaic device is one of the promising alternatives to conventional silicon-based solar cells. A new method for preparation of active layers of conductive polymer-based organic solar cells by electrospinning without any thermal post-treatment to obtain optimal performance is presented. A conductive polymer, poly[2-methoxy-5-(2'-ethyl hexyloxy)-1,4-phenylenevinylene] (MEH-PPV), and its blends with an easily spinnable polyvinylpyrrolidone (PVP) were dissolved and electrospun. Electrospinning was carried out under an applied electrical potential of 15 kV over a collection distance of 15 cm. Electrospun MEH-PPV nanofibers were obtained as a ribbon-like structure aligned with wrinkled surface in fiber direction after the Soxhlet extraction. Crystallinity and electrical conductivity of the obtained fibers is higher than that of the spin cast film. By combination of these electrospun MEH-PPV nanofibers with the fullerene (C_{60}) or its derivative {[6,6]-phenyl- C_{61} -butyric acid methyl ester (PCBM)}, it is possible to fabricate bulk-heterojunction organic photovoltaic cells with relatively high efficiency as compared with that of conventional organic photovoltaic devices. The preliminary power conversion efficiency of ca. 0.2% with detail will be reported.

1. Introduction

Organic photovoltaic device is one of the promising alternatives to conventional silicon-based solar cells. In this sense, bulk heterojunction devices, which are based on the spontaneous phase separation between donor and acceptor materials, have become popular. However, high conversion efficiencies require a thermal annealing during the fabrication of cells.

One of promising materials for organic photovoltaic devices is conductive polymer because of a combination of specific properties from optical and electronic points of views with easy processing. From various forms of the conductive polymers; nanowires and nanofibers are growing broad interest in recent year. In particular, diameters of the polymeric materials can be shrunk to sub-micro or nanometers, bringing several specific characteristics such as improved mechanical performance, relatively large surface area to volume ratio, and flexibility in some surface functionality [1]. Among various kinds of processing techniques, we adopted electrospinning, which has become one of the versatile tools for fabrication of ultrafine fibers. In this context, a new method for preparation of active layers of conductive polymer-based solar cells in wide area, by electrospinning, without any thermal post-treatment to obtain optimal performance is presented.

2. Experimental

A conductive polymer, poly[2-methoxy-5-(2'-ethyl hexyloxy)-1,4-phenylenevinylene]

(MEH-PPV), and its blends with an easily spinnable polyvinylpyrrolidone (PVP) were dissolved. As-prepared solutions were electrospun under an applied electrical potential of 15 kV over a fixed collection distance of 15 cm at room temperature. The flow rate and the collection time were fixed for all experiments at $1 \text{ ml} \cdot \text{h}^{-1}$ and 1 min, respectively. In order to remove PVP out from as-spun MEH-PPV/PVP fibers, the Soxhlet extraction was carried out. Methanol was used as a solvent at the extraction temperature of 75°C . The extraction time was fixed for 12 h. The samples were then dried overnight at 60°C in vacua. Morphological appearance of the as-spun fiber mats was observed by a scanning electron microscope (SEM), operating at an acceleration voltage of 10 kV. Crystallinity of the as-spun fibers was measured by an X-ray diffractometer (XRD). Ultraviolet-visible (UV-Vis) absorption and photoluminescence (PL) of the as-spun fibers were also investigated. The excited wavelength was 385 nm. The photovoltaic properties of obtained devices [Fig. 1(a)] were investigated.

3. Results and Discussion

As-spun fibers from solutions of MEH-PPV/PVP in mixed chlorobenzene/methanol with various concentrations showed beaded or uniform characteristic with relatively small diameter ($625 \text{ nm} - 1.7 \mu\text{m}$). In order to study the effects of solution properties and spinning conditions, electrospinning of solutions of MEH-PPV/PVP in chlorobenzene/methanol was carried out at various conditions. The average diameter of fibers was found to

decrease with the increase in the applied electrical potential in the range of 5 to 15 kV and a minimum size was ca. 625 nm when the applied electrical potential was ca. 15-20 kV (MEH-PPV:PVP = 1:3). Further increase of the applied electrical potential led to the increase of the size of as-spun fibers. Moreover, this periodic trend was also observed in the study in effects of content of MEH-PPV in the blended solution, which the minimum size of as-spun fibers was observed at the ratio of MEH-PPV/PVP of 1.5:6. While the average diameter was found to decrease monotonously with increasing the collection distance up to a far enough distance (ca. 20 cm) [1]. Moreover, the average diameter of the as-spun fibers was found to decrease into nanometer scale (smallest diameter was ca. 43 nm in the form of beaded fibers) with decreasing the concentration of PVP and/or addition of a volatile organic salt [2].

Electrospun MEH-PPV nanofibers were obtained as a ribbon-like structure aligned with wrinkled surface in fiber direction after the Soxhlet extraction as shown in Fig. 1(b). Crystallinity of the obtained fibers is higher than that of the spin cast film [3]. By combination of these electrospun MEH-PPV nanofibers with the fullerene (C_{60}) or its derivative {[6,6]-phenyl- C_{61} -butyric acid methyl ester (PCBM)}, it is possible to fabricate bulk-heterojunction organic photovoltaic cells [structure: ITO / PEDOT:PSS / MEH-PPV nanofibers:fullerene / Al] with relatively high efficiency as compared with that of conventional organic photovoltaic devices. The preliminary power conversion efficiency of ca. 0.2% with detail will be reported.

4. Conclusions and Recommendations for Thailand

Thailand is a tropical country which has sunshine in several months a year, which makes it as an ideal location for the development of renewable energies, especially solar cells. Therefore, this work is quite new and interesting to study in Thailand. The fabrication of nanofibers by electrospinning with above reported conditions seems to be able to carry out in Thailand. However, the preliminary power conversion efficiency reported here is only 0.2%. Therefore, it still needs to undergo further research and development to enhance the efficiency of organic solar cells and the potential to use organic solar cells in a commercial level.

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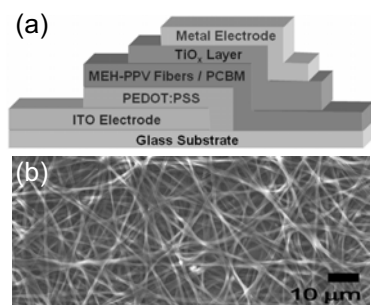


Fig. 1 Cell structure (a) and SEM image (b) of fibers-based photovoltaic cell

Experimental Study on the Performance of a Single-cell SOFC Prepared by Screen Printing and Co-firing Process

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A single-cell SOFC (solid oxide fuel cell) was successfully prepared by screen printing with co-firing technique and its electrochemical performance both impedance spectra and I-V test was investigated. In this experiment, nickel oxide and yttria stabilized zirconia (NiO/YSZ) have been prepared as the anode and $\text{La}_{0.6}\text{Sr}_{0.4}\text{MnO}_3$ (abbreviated as LSM) as the cathode in contacted with YSZ electrolyte on either side. The preliminary experimental results showed that the fabricated SOFC unit cell provided acceptable performance, which both cathode and anode side were prepared by screen printing technique. However, this experimental study just provides preliminary information of the fabricated SOFC which conducted in the initial step of the prospective future study that will be deliberately conducted by emphasizing on both materials development (i.e., materials with high activity) and also the fabrication methodologies; especially for the anode electrode side, in order to obtain high performance SOFC. The objective of this prospective future work includes obtaining high performance SOFC with effective availability for applying in the industrial applications. As this consequence, the further information and development are strongly required.

1. Introduction

Nowadays it is commonly well known that the energy crisis is seemed to be the major problem which dramatically affected the widening attention of many researchers. Many alternative energy sources are still in their different stages of development. Among the alternative energy sources, ceramic fuel cells, commonly known as solid oxide fuel cells (SOFCs), have been extensively developed for electric power generation applications. The most attractive feature of SOFCs is its clean and efficient production of electricity from a wide variety of fuels. Moreover, the SOFCs has potential to be manufactured and operated cost effectively and, thus, promises to be an important alternative source for generating complementary electric power in the future. However, many various parameters such as operating temperature, cathode, anode and electrolytic characteristics can strongly effect on the efficiency of SOFCs. Among these constituents in the SOFCs, its electrical and physical characteristics greatly affect power generation characteristics of the cell [1]. The performance of an anode is critically dependent on its microstructure [2], which in tune closely dependent on the initial powder preparation and anode forming process [1, 2]. It is usually agreed that the slurry-coating method resulted in single-cell with good reproducibility and reasonable performance, suggesting that this method can be considered for SOFCs fabrication [3].

2. Experimental

With the simple approach of screen printing, both anode and cathode pasting materials need to be previously prepared. For anode substrate preparation, NiO and YSZ were mixed with 4:1 molar ratio and ball-milled for 24 h, respectively. Then the well-dispersed powders were sintered at 1400 °C for 12 h. After cooling down to the room temperature, the as-prepared anode powders were mixed with organic binder in an alumina mortar and applying mechanical grinding to enhance the separation of the particles in order to form the well-dispersed anode pasting materials. In this experiment, a 0.5 mm thick YSZ electrolyte support cell was painted by the as-prepared anode pasting materials through screen printing procedure. After pasting the anode material on the center of YSZ electrolyte, then it was sintered instantly again at 1400 °C for 5 h in order to obtain perfect attachment with the support electrolyte. The similar procedure is applied to fabricate cathode electrode; however, for cathode material, $\text{La}_{0.6}\text{Sr}_{0.4}\text{MnO}_3$ (abbreviated as LSM), 5 g of $\text{La}(\text{CH}_3\text{COO})_3 \cdot 1.5\text{H}_2\text{O}$ with $\text{Sr}(\text{CH}_3\text{COO})_2 \cdot 0.5\text{H}_2\text{O}$ and $\text{Mn}(\text{CH}_3\text{COO})_2 \cdot 4\text{H}_2\text{O}$ were mixed with 300 ml distilled water. The mixture was suddenly heated by hot plate assisted with mind magnetic stirring to vaporize redundant water and other light organic compounds. After complete vaporizing, the cathode powders were suddenly generated, and then sintering process was applied at 900 °C for 5 h. After cooling down to the room temperature, then glycol was

used as solvent for the as-prepared cathode powder to form the well-dispersed cathode pasting materials. Screen printing procedure was also applied to cathode side and after sintering the cell at 900 °C; thus, the unit cell was completely prepared.

In order to test this fabricated unit cell, hydrogen saturated with water at room temperature was used as a fuel at the anode side and ambient air was used as oxidant at the cathode side and the cell performance was investigated.

3. Results and Discussion

The anode and cathode pasting material which obtained from previously mentioned methodology are illustrated in Fig. 1a and b, respectively. These materials provide well-dispersed powders of both initial components with the appropriate viscosity for pasting on the electrolyte layer (YSZ). However, some agglomerated particles could be observed which can be controlled during the powder preparation procedure. After performance's test was applied to this fabricated cell, the result was illustrated in the Fig 2.

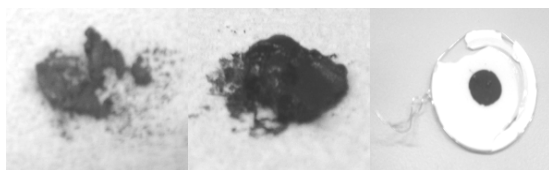


Fig 1 (a) Anode pasting material; (b) Cathode pasting material; (c) Planar unit cell after applying performance test.

This I-V result shows acceptable performance of obtained cell compared to other literatures reviews [2, 3]. It can be preliminary accepted that screen-printing can be applied to produce unit cell with good performance. Although, the maximum power density was only 0.008 W·cm⁻²; however the prospective study on fuel

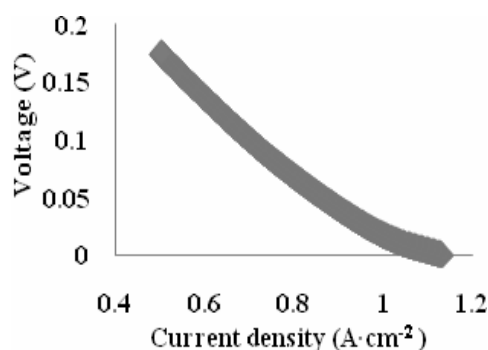


Fig 2 I-V of curve of cell measured at 1000 °C using H₂/O₂ as the operating gas

4. Conclusions and Recommendations for Thailand

Screen printing methodology can be applied technically to fabricate the SOFC with reproductively easy for transferring to an industrial scale. The cell shows the acceptable performance. Due to this conducted experiment was in the initiate research procedure; however, the development of the anode materials to obtain the higher activity and performance is still continuously required.

As previously mentioned, SOFCs are promising alternative energy sources which can be applied directly to various industrial applications. For Thailand, my mother land is still a developing country; hence, many useful technologies and research on both commercial and industrial developments are strongly required.

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Synthesis of Carbon Nanoparticles by Arc Discharge under Reduced Pressure Air

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NS-P06

Carbon nanostructures including multiwalled carbon nanotubes (MWCNTs) and multishelled carbon nanospheres (MSCNSs) were formed by DC arc discharge in reduced pressure air within a spherical chamber. The effects of arc current and pressure on the yield and morphology of carbon nanostructures were experimentally investigated. TEM and XRD analyses were performed to characterize the synthesized products. It was found that MWCNTs with relatively small diameter (less than 20 nm) could be found as deposit on the cathode tip. Based on XRD analysis, it was found that MWCNTs synthesized with the arcing current of 35 A had notably high crystallinity. Meanwhile, at higher arcing current of 55 A MSCNSs were obtained as the solid deposit scattering and sticking on the chamber wall. The percent yield of as-synthesized carbon nanoparticles increased with an increase in arcing current and a slight increase in reduced pressure of air. Based on our experimental results, the reduced pressure for the highest yield of MWCNTs was 190 Torr.

1. Introduction

Among several methods for preparing carbon nanoparticles (CNPs), arc discharge is one of the most practical means to yield highly graphitized nanotubes due to the high process temperature. Gas atmosphere under which the arc discharge is generated is one of the most important key factors affecting the yield and morphology of the CNPs. We expected that CNPs could also be produced in an air atmosphere though Cui et al. prepared MWNTs under a nitrogen atmosphere [1]. Because of the ultimate safety and convenience for tooling, dry air can be the most profitable process gas, but there have been few reports related to the preparation of CNTs in an air atmosphere.

2. Experimental

Direct current arc discharge between two pure graphite rods with vertical alignment had been carried out within a spherical chamber. After the chamber was evacuated to a designated vacuum level ranged from 190 to 760 Torr, the direct electrical current of 35 to 75 A was applied to the two graphite rods which were 1-2 mm apart for generating stable arc plasma, in turn vaporizing the anode to generate carbon nanoparticles. Those generated products could be observed as black soot depositing on the cathode tip and the chamber wall. TEM and XRD analyses were performed to characterize the fabricated products.

3. Results and Discussion

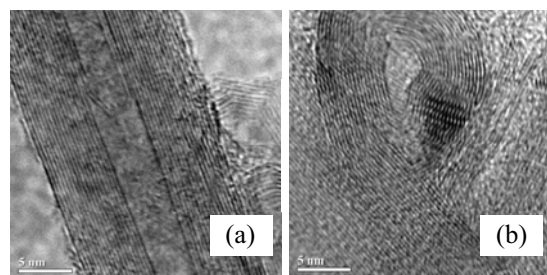


Fig. 1 TEM images of (a) MWCNTs and (b) MSCNSs synthesized at 190 Torr, 75 A and 600 Torr, 55 A, respectively.

After the arc process without using any catalyst, we found that the quantity of product was remarkably reduced. In the case of using nitrogen as the accommodating gas, the yield of product was acceptably high [1]. But there was lower yield when air was employed. The quantity of as-synthesized product was dependent upon the process conditions such as current and pressure. At high current and air pressure the quantity of product increased but still much lower than that in nitrogen gas. This might be attributed to the efficient oxidation reaction in the air.

Fig. 1(a) shows MWCNTs with small diameter (less than 20 nm) could be fabricated with the arcing current of 75 A in the vacuum of 190 Torr. Meanwhile, fine quasi-spherical multishelled carbon nanoparticles were mainly

collected from the chamber wall deposit when a higher arcing current of 55 A in the vacuum of 600 Torr was employed (Fig 1(b)).

Based on XRD analysis shown in Fig. 2, it could be confirmed that the as-synthesized product, which was obtained when the arcing current of 35 A was employed, exhibit markedly high crystallinity. Moreover, the quality of the CNTs increases with a decrease in the reduced pressure air. In this work, the effects of gas pressure which provide high yield of MWCNT production was examined. Ebbesen et al. reported the optimized pressure to yield the highest amount of MWCNTs was 500 Torr [2]. Furthermore, Waldorff et al. also showed the effective pressure for CNP synthesis was about 200-300 Torr [3]. Based on our

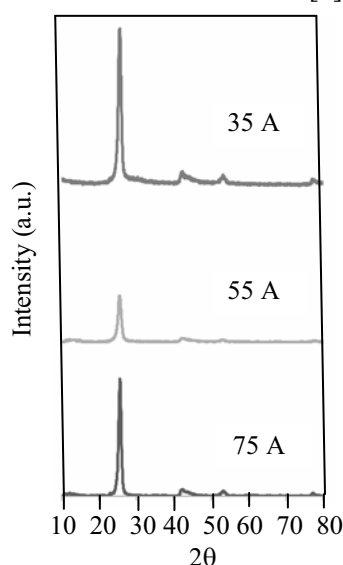


Fig. 2 XRD patterns of CNTs synthesized at different arcing current.

experimental results, the air pressure for the highest yield of MWCNTs was 190 Torr. It has been believed that accommodating air acts as “quenching media” for carbon vapor, which could attain at supersaturation of carbon clusters, leading to nucleation and growth of carbon nanoparticles [4].

It should be noted that with the sufficient low vacuum level and the special configuration of the chamber used in this work, radial flow of carbon clusters emerging from the vaporizing anode would be beneficial for fabrication MWCNTs. This phenomenon would accompany with the convective and radiation heat transport mechanism [5]. It should be experimentally observed that with an increase in arcing current the higher irradiation was generated from the arc. A higher gas flow could also be visually observed during the experiment. The anode consumption rate was drastically increased with the arcing current while the production yield was increased. Arc discharge could vaporize the graphitic anode, resulting in formation of numerous carbon clusters emerging from the arcing zone. Then higher amounts of carbon clusters would flow in all radial direction due to the convective flow mechanism [4]. Therefore, higher amount of MWCNTs could be fabricated.

4. Conclusions and Recommendations for Thailand

With high aspect ratio, MWCNTs would form a percolating network within the non-conductive matrix at much lower loading than traditional fillers. They would be more beneficial to composite applications. Besides composite application, MWCNTs have a broad range of potential applications including nanoelectronics or chemical sensors.

MWCNTs and MSCNSs could be synthesized by a DC arc discharge under reduced pressure of air without using any catalyst. The structure and amount of each type of nanoparticles could be controlled by arc current and the air pressure inside the chamber. Based on XRD analysis, carbon nanoparticles with high crystallinity could be prepared at the low arcing current of 35 A. There are possibilities to make use of such carbon nanoparticles, in particular MWCNTs for developing VOC gas sensors, which would be beneficial to Thailand.

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Improvement of Thermo-mechanical and UV Absorption of PMMA with ZnO Nanoparticles

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In this present work, poly (methyl methacrylate)/ZnO nanocomposite has been successfully fabricated by melt mixing method. The concentration of ZnO nanoparticles in PMMA has been varied for examining its effect on the properties of PMMA/ZnO composite by dynamic mechanical analysis (DMA) and ultraviolet-visible (UV-vis) spectrophotometry. The results indicated that the thermal stability of the prepared PMMA/ZnO composite could be significantly improved. The composite glass transition temperature shifted to a higher temperature with the increasing ZnO loading. Furthermore, UV absorption of ZnO PMMA composite was higher when ZnO concentration was increased and the composite with 0.5 wt% of 20-nm ZnO was sufficient for shielding UV irradiation.

1. Introduction

Because of the wide band gap (3.37 eV), high exciton binding energy (60 meV) at room temperature and high mechanical and thermal stabilities, zinc oxide (ZnO) is used as not only semiconductor but also functional filler for polymer composites [1]. Poly (methyl methacrylate) (PMMA) is an optically clear thermoplastic material. It is widely used as an artificial glass because it shows higher impact strength as well as resistant to weak acid, alkaline solutions, non-polar solvents, oils and water. Therefore, PMMA is commonly used for alternative constructing interior instead of glass. It is well recognized that PMMA is excellent host material for nanoparticles of metal and semiconductors. ZnO can absorb a wide range of UV light ($\lambda < 400$ nm) which could convert photonic energy to excitation energy [2]. Therefore, ZnO could especially be used in shielding UV irradiation, which is beneficial to applications of buildings or automobiles protection. The objective of present work is to improve optical and mechanical properties of PMMA film with ZnO nanoparticles. The effect of concentration of ZnO particles on UV absorption and dynamic mechanical properties was experimentally studied and analyzed.

2. Experimental

In order to prepare composite of PMMA/ZnO, commercial ZnO particles with average size of 20 nm purchased from Wako Pure Chemical Industries and PMMA by Kuraray Co. LTD., were employed.

ZnO nanoparticles with designated loading were mixed with PMMA using a two-roll mill at 200°C for 10 min. The mixed materials were subject to compression molding to prepare 0.5 mm thick sheets. The operating condition of the compression molding machine was 200 °C and 100 MPa. Then the specimen was immersed in 0°C water for cooling down.

The optical properties of prepared specimens were studied by UV-vis-NIR spectrometer (Jasco V570). The scanning speed was 400 nm/min in the wavelength range of 200-800 nm. The nanocomposite film samples were cut into rectangular shapes of 20mm×5mm×0.20mm. Dynamic mechanical analysis of the specimens was performed using a DVE-V4 FT with a heating rate of 1 °C/min and frequency 10 Hz.

3. Results and Discussion

Figure 1(a) shows the absorption spectra of composite with ZnO concentrations of 0.5, 1, 3 and 5 wt%. The intensity of UV absorbance peak increases with ZnO concentration. Although there were some noises in the absorbance curves at a high ZnO concentration, the peak absorption existed at the wavelength of 367 nm, which is smaller than 378 nm (the theoretical wavelength of bulk ZnO corresponding to band-gap of 3.3 eV). The blue-shift phenomenon for 20-nm ZnO particles is attributed to the quantum effect of nanoparticles. Kanemitsu et al.[3] claim that semiconductive nanoparticles would play a role in the electronic interaction due to the

confinement of excitons and electrons in nanoparticles which would lead to efficient energy transfer.

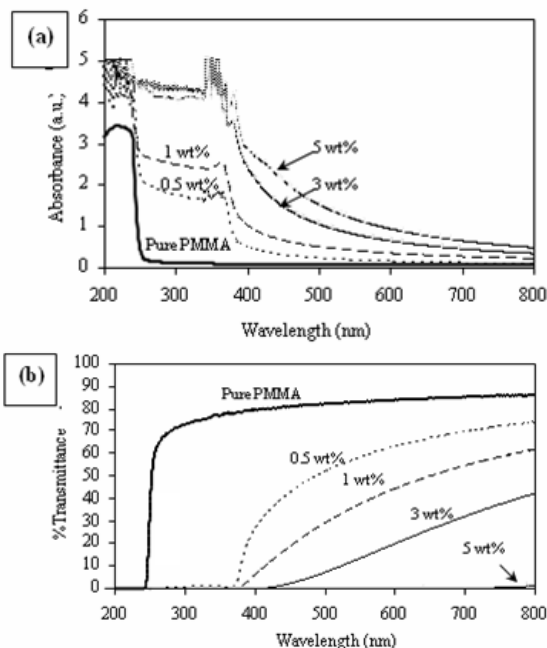


Fig. 1 Optical characteristics of PMMA/ZnO nanocomposite films (a) UV absorbance, (b) UV transmittance

Fig.1 (b) shows specific transmission of UV light. It could be clearly observed that only 0.5 wt% of 20-nm ZnO compounded with PMMA could significantly shield UV irradiation, resulting in a remarked decrease in % transmission. Xiong et al. also reported that 7 wt% of 60-nm ZnO particles added into poly(styrenebutylacrylate) completely shields UV irradiation [4]. As a result, it is reasonable to imply that the nanocomposite prepared in this study would probably exhibit UV protection. Thereby ZnO nanoparticles could improve the UV durability of the PMMA film.

Meanwhile, the loss modulus (E'') of the composites was characterized by a dynamic mechanical analyzer (DMA). The loss modulus relates to the energy loss due to polymer chain movement and the E'' peak corresponds to the glass transition temperature (T_g). Figure 2 indicates that the T_g of PMMA/ZnO nanocomposites was shifted with the increment of ZnO content and exceeded that of pure PMMA. This would be attributed to the mobility restriction of PMMA chain due to the entangling ZnO particles within PMMA matrix.

4. Conclusions and Recommendations for Thailand

PMMA/ZnO nanocomposite films have been successfully prepared by a two-roll mill. When concentration of ZnO in the composite

was increased, UV absorption of the composite became higher. Based on thermo-mechanical test, the PMMA/ZnO nanocomposite films with higher ZnO content exhibited higher glass transition temperature compared with that of pure PMMA. These results would exhibit possibility to apply PMMA/ZnO composite for UV-cut window, which would be beneficial to many countries including Thailand. However, capability of producing ZnO nanoparticles would be required for Thai manufacturers. Moreover process of manufacturing of UV shielding material should be further studied for finding the most effective route.

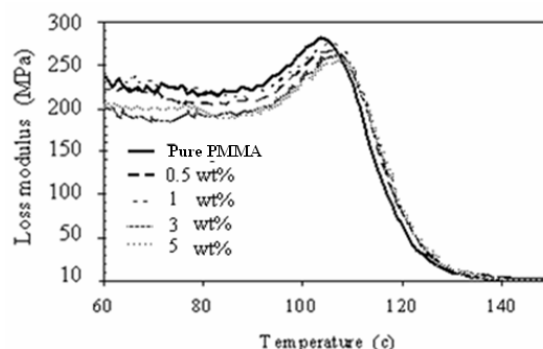


Fig. 2 Effect of ZnO loading on loss modulus of PMMA/ZnO nanocomposite

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Acknowledgement

This work is partially supported by the Centennial Fund of Chulalongkorn University and KUSEP of Kanazawa University.

Synthesis and Characterization of SiC/SiO₂ Core-Shell Nanowires

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SiC/SiO₂ core-shell nanowires were synthesized through a simple thermal evaporation of silicon powders during decomposition of methane (CH₄) gas. The influence of two parameters, reaction temperature (1300, 1350 and 1400 °C), and soaking time (1, 3 and 6 h), were investigated. X-ray diffractometry, field-emission scanning electron microscopy, transmission electron microscopy, scanning TEM, and high-resolution TEM were used to characterize the as-grown products. The typical synthesized nanowires at different conditions possess the diameter of was not more than 100 nm with several tens micrometers in length. It can be reported that using higher temperature and longer soaking time lead to more complete reaction to attain high yield nanowires. Base on the results, it was also found that the typical nanowires should be grown via the oxide-assisted growth (OAG) mechanism.

1. Introduction

In recent years, one-dimensional (1D) nanoscale structures such as wires, rods, tubes, springs, belts, and etc. have attracted much attention due to their remarkable properties and potential applications as interconnects or functional components in nanoscale electronics, nanocomposites and nanodevices including field-effect transistors [1]. Among these materials, silicon carbide nanowires (SiCNWs) are the leading material, because of its excellent thermal and mechanical properties and large band gap [2].

Various methods have been addressed for preparation SiC nanostructures, including chemical vapor deposition (CVD) [3], laser ablation [4], arc discharge [5], and so on. However, synthesis of SiC/SiO₂ core-shell nanowires by means of simple evaporation of Si have not reported yet.

In this work, we present a simple way to fabricate the β -SiC/SiO₂ core-shell nanowires without adding metal catalysts from outside through thermal evaporation of Si powders among flowing CH₄ gas. The effect of reaction temperature and soaking time on growth of nanowires were studies.

2. Experimental Procedure

Silicon powder, SN (average particle size $\approx$ 50 nm, 99% nominal purity) was used as raw powder. The experiment was conducted in a horizontal mullite tube furnace. First, silicon raw powder was put in the mullite boat which was then covered by a thin sheet of alumina fiber net. After placing the whole set into the center of the furnace, the chamber was initially evacuated to a pressure below 1.33 Pa. Ar gas was then applied at a flow rate of 0.6 l/min into the tube. The furnace was first ramped to 1200 °C at 10°C/min and then continued to heat but

5°C/min to preset target temperatures of 1300, 1350 and 1400 °C. At maximum temperature, H₂ at a flow rate 20 sccm was introduced for 2 min before flowing of CH₄ gas at a flow rate 10 sccm for 30, 90 and 180 min in batch for soaking time of 1, 3 and 6 h, respectively. The furnace was allowed to cool down to room temperature in Ar atmosphere and then the mullite boat containing as-grown SiC nanowires was moved out from the chamber.

After reaction at different conditions, the products were obtained in the boat. X-ray diffractometry (XRD, CuK α , PW 1700, Philips, Holland), field-emission scanning electron microscopy (FE-SEM, S-4800, Hitachi, Japan), transmission electron microscopy (TEM, H-9000, Hitachi, Japan), and scanning TEM (STEM) were used to characterize the synthesized products.

3. Results and Discussion

3.1 Effect of reaction temperature

The yield of white-blue wool-like products in the boat increased with temperature. The XRD analysis indicated that the as-synthesized products consisted of β -SiC. FE-SEM observation confirmed that the wool-like product from every specimen was wire-like nanostructures. Lengths of the nanowires were up to several tens micrometers and diameter ranging from 5-60 nm. Fig. 1 shows typical FE-SEM image of product synthesized at 1400 °C. The upper right inset of Fig. 1 is a high magnification TEM of a typical nanowire, clearly revealing that the nanowire consists of a dark-contrasted inner core and a light-contrasted outer shell. The result of STEM-EDX and selected-area electron diffraction (SAD) patterns altogether of core and shell indicated that the core part could be indexed with the β -SiC crystal with twins and

the fiber axis direction was found to be {111} of β -SiC, while only diffused spots ($d = 0.36$ nm) sited along the fiber direction was detected from the un-completed crystallinity shell layer.

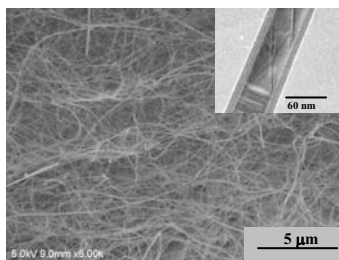


Fig. 1 typical FE-SEM image of product synthesized at 1400 °C, it composed of large amount of straight, curved, haphazard distributed nanowires.

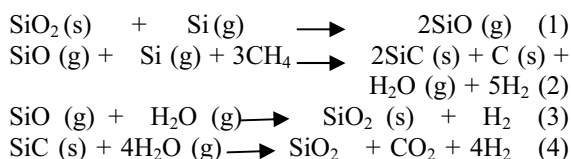
The typical thick SiC/SiO₂ core-shell nanowires were observed by TEM. The result shows that higher reaction temperature is, thicker cores are, and clearly to observe thickness of wires increased when using reaction temperature at 1400 °C K. The thickness of core/shell of nanowires synthesized at 1300, 1350 and 1400 °C are 15/5, 20/5 and 40/10 nm, respectively.

3.2 Effect of soaking time

As-synthesized products of SiC nanowires were fabricated at 1350 °C with soaking times of 1, 3 and 6 h. It seems increasing the soaking time increased amount of product.

FE-SEM observation indicated that the all as-grown products consisted of large quantities of randomly distributed wire-like shape products. Lengths of the nanowires are up to several tens of micrometers and diameter less than 100 nm. TEM images of typical thick coaxial structure nanowires under soaking time at 1, 3 and 6 h indicated that only thickness of shell layer increased after change in soaking time from 1 h to 3 h. After synthesized for 6 h, both thickness of core and shell became larger than those synthesized for 3 and 1 h. The thickness of core/shell of typical nanowires synthesized at 1, 3 and 6 h are 20/5, 20/10 and 30/12.5 nm, respectively.

Although the detailed growth mechanism of β -SiC/SiO₂ coaxial nanowires is not still completely understood yet, we infer that the overall reactions of nanowires formation can be written as following reactions (1)-(4).



According to above, the SiC/SiO₂ core-shell nanowires were formed through the reaction of SiO and methane. It seems the SiO is important factor on nanowires growth. Thereby, this mechanism can be classified into the oxide-assisted growth (OAG) mechanism.

4. Conclusion and Recommendations for Thailand

Based on the experimental results of the current work, the conclusions can be written as follows. The high yield of very long SiC/SiO₂ core-shell nanowires with diameter not more than 100 nm are fabricated by the simple evaporation method through the OAG mechanism. The yield of as-synthesized products increased with synthesis under using higher reaction temperature, and longer soaking time. The synthesized nanowires at higher reaction temperature and longer soaking time possessed larger core and thicker shell than those nanowires prepared at lower reaction temperature and shorter soaking time.

This research can be applied for many fields in Thailand such as electronic components, nanocomposites, including solar cell because SiC nanowires have very high surface area and the elasticity and strength of an individual SiC nanowire is much higher than that of bulk SiC.

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Production of Non-firing Ceramic from Paper Sludge Ash

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Non-firing ceramic of paper sludge ash have been successfully fabricated by combination of surface activation of the powder and chemical solidification. Surfaces of paper sludge ash powder were mechanochemically activated using a planetary ball-milling, and the mixture of activated powders with 15 wt.% KOH aqueous solution was cast into a mould and keep at 25°C for 7 days under relative humidity of 90%. All the compositions can be solidified at ambient temperature. This proposed process is an attractive route for shaping waste materials into ceramics without using the conventional sintering step.

1. Introduction

Nowadays, paper sludge has become one of the most serious environmental problems. Because the paper sludge dumped on land has increased, environmental burden. The paper sludge is usually landfilled or burned to produce paper sludge ash, which is composed of more mineral such as SiO_2 and Al_2O_3 [1] as starting material of ceramic. Mechanochemical (MC) treatment is considered as potential candidate for initial material pretreatment because of it involves the formation of product phase at the interface of the reactants. The mechanochemical treatment initiated by intensive of milling in high-energy ball mills could be good choice for the ceramic powder preparation [2]. On the other hand, it is well known that alkaline solution as a binder between ceramic particles, which is responsible for solidification to form a strong green body at room temperature [3]. It is possible to convert waste materials into valuable ceramics by using chemical solidification assisted by surface activation of the powder by planetary ball milling under ambient temperature condition. The objective of this work is to fabricate ceramic without firing using the activated particles from paper sludge ash as raw material to reduce industrial waste.

2. Experimental Procedure

The paper sludge ash powder was used as a raw material. Planetary ball-milling was used for mechanochemical treatment of powder. The mill was rotated between 100 to 300 rpm at 60 min of milling time. The products were prepared by mechanical mixing an amount of paper sludge ash and alkaline solution (KOH) to form homogeneous slurry throughout the series of compositions. After being mixed at 2,000 rpm for 5 min with an electric mixer, the

slurry was poured to Teflon mold and kept at room temperature until solidification. After demolding, the specimens were dried at 25°C (RH 90%) for 7 days in the steam oven. X-ray diffraction was used for the qualitative determination of the crystal phases present in paper sludge ash and microstructural examination of surfaces were carried out using a SEM [4-5]

3. Results and Discussion

Fig. 1 shows the XRD pattern of raw material treated for 0 to 300 rpm at 60 minutes. From this figure, the raw material is mainly composed of wollastonite (CaSiO_3), gehlenite ($\text{Ca}_2\text{Al}_2\text{SiO}_7$) and calcium aluminate ($\text{Ca}_5\text{Al}_6\text{O}_{14}$). Peak intensity of crystalline decreases with increasing rotation speeds. This is because that the particles were involving in miniaturization and amorphilization with influence of high energy action of ball milling. Fig. 2 shows the microstructure of raw material without and

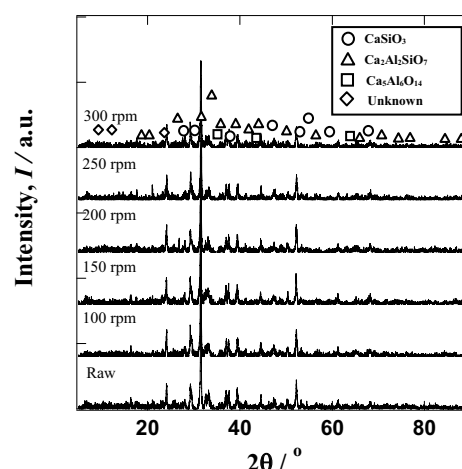


Fig.1 XRD patterns of the initial material treated by planetary ball-milling at 0-300rpm

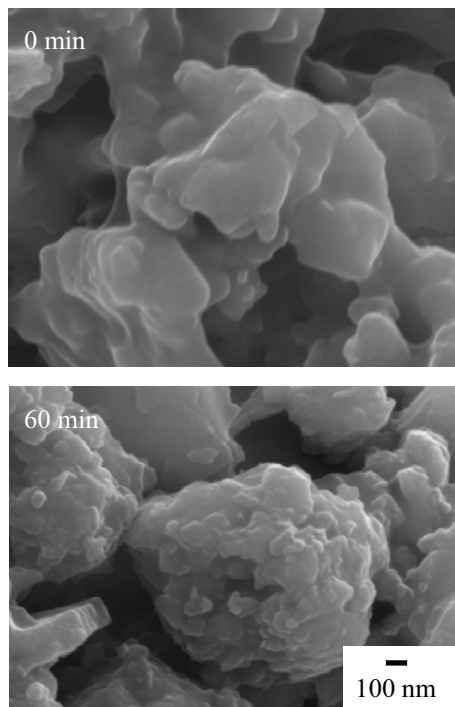


Fig.2 SEM images of initial material treated by planetary ball-milling at different time

with treatment for 300 rpm, 60 minute by planetary ball-milling. This study examined the microstructures of samples to understand developments on how MC treatment influences the raw material structure. The treated sample consists of the fine particles having decreasing size with an increasing of milling time.

4. Conclusions and Recommendations for Thailand

Non-firing ceramic was successfully fabricated from paper sludge ash. This method was done by combination of the both mechanochemical and chemical reaction of ceramic particles converting waste material into valuable ceramics without using the conventional sintering step. The benefit of this research which contributes to Thailand is to reduce industrial waste such as paper sludge and change it into valuable ceramics. Because Thailand have many industrial wastes such as, paper sludge ash, rice husk ash and palm oil fuel ash, which become the most seriously environmental problem. On the other hand, all the waste material on mentioned above, are composed of mineral of Al_2O_3 and SiO_2 as starting material of ceramic. Therefore, it is possible to reduce waste material from industry by fabricating to valuable ceramics.

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Characterization of Short Glass Fiber-Reinforced PC/ABS Blends

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Polycarbonate (PC) and acrylonitrile-butadiene-styrene (ABS) blends of a high melt flow index formulation are reinforced with short glass fibers at 0 to 30 wt% using a fixed fiber length of 3 mm. From rheological studies, the viscosity of the filled systems increases with an increasing content of the short glass fiber. The viscosity of the compound at 30 wt% fiber content exhibits a value about one order of magnitude higher than that of the neat PC/ABS. Shear thinning behavior was also observed in those filled and unfilled polymers. From thermogravimetric analysis, the degradation temperature of the composite specimen was found to be negligibly affected by the presence of the glass fiber. The technique was also used to confirm good fiber dispersion in this PC/ABS composites. Scanning electron micrographs reveal that the glass fiber adhered relatively well to the PC/ABS matrix which is crucial to the effective reinforcement of the fiber.

1. Introduction

Polycarbonate (PC) is used in specialty applications from its high toughness, higher continuous working temperature, high modulus and good transparency. The drawbacks of PC, however, are high melt viscosity (poor processability) and notch sensitivity. The disadvantages of PC can be effectively overcome by blending with various thermoplastics or thermoplastic elastomers of which ABS is the most popular candidate. The addition of ABS not only minimizes the drawbacks of PC but also retains the other superior mechanical properties and also generates other useful properties such as glossiness and low-temperature toughness [1, 2].

For some specific applications that require substantially high mechanical properties (such as a case of notebook etc.), one effective method to improve the properties and to maintain its processability using traditional extrusion or injection is by reinforcing with short glass fiber. Therefore, the major purpose of this study is to investigate the effect of short glass fiber on properties of the resulting PC/ABS composites. The composites are useful for applications in the electronic and electrical appliance industries in Thailand.

2. Experimental

2.1 Materials

PC and ABS pellets used were a commercial product. The short glass fiber was purchased from Chongqing Polycomp. International Corp., China.

2.2 Preparation of PC/ABS Composites

Both PC and ABS pellets were dried to constant weight at 105°C for at least 4 hr in an

air-circulated oven to remove some moisture, which could cause PC degradation and defects [3].

Compounding of PC, ABS and glass fiber was carried out by a twin screw extruder (Thermo Haake Rheomex, Haake PolyLab Co., Ltd., Germany). The fiber contents were varied from 0 to 30 wt%. The extruded strands were cut into pellets (lengths of > 3 mm.) and dried before use.

2.3 Experimental Procedures

2.3.1 Rheological Property Measurement

The melt viscosities of PC/ABS blends having glass fiber loadings of 0 to 30 wt% at a constant shear rate (1 sec⁻¹) were determined using a parallel plate rheometer, Haake Rheo Stress 600, from Thermoelectron Cooperation. The diameter of each plate is 20 mm and the gap between the plates was fixed at 1 mm.

2.3.2 Thermogravimetric Analysis

The degradation temperature (T_d) and residual weight of the PC/ABS blends at various glass fiber contents were studied using a Perkin Elmer Instrument Technology (SII Diamond TGA/DTA) thermo gravimetric analyzer at a heating rate of 20°C/min. The temperature was scanned from 50 to 700°C under air atmosphere. The purge air flow rate was 50 ml/min.

3. Results and Discussion

3.1 Rheological Properties

From Figure 1, the viscosity of PC/ABS blend reinforced with short glass fibers was increased with increasing the content of the glass fiber. The plots also indicate the decrease in viscosity with increasing shear-rate, the characteristic of shear thinning fluid. The

viscosity value of 30wt% glass fiber filled compound was about one order of magnitude higher than that of the neat PC/ABS used.

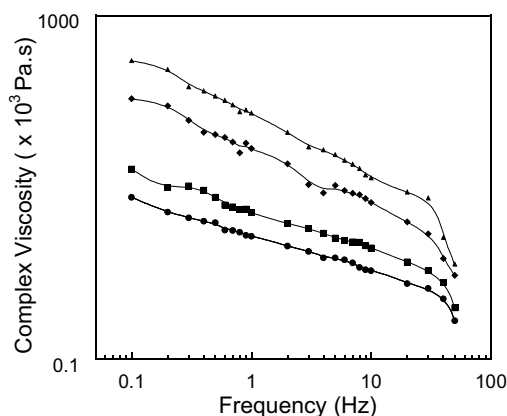


Fig. 1 Viscosity of PC/ABS blend at various glass fiber contents (●) 0%, (■) 10%, (◆) 20% and (▲) 30%

3.2 Fiber Dispersion and Composite Interface from Microscopy

The SEM micrographs of the fracture surface of PC/ABS blend filled with 10 wt% of short glass fiber are shown in Figure 2a and 2b. Figure 2a reveals the relatively good dispersion of the short glass fiber in the PC/ABS matrix. The uniform dispersion is one key feature to yield a good composite property. Figure 2b illustrates also the glass fibers to substantially adhere to the PC/ABS matrix which is essential for its mechanical property enhancement by the reinforcing fiber.

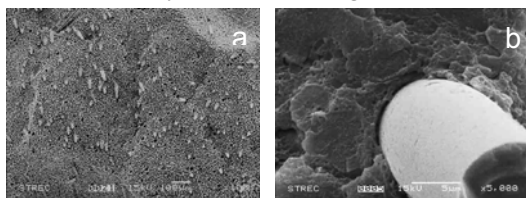


Fig.2 SEM micrographs of fracture surface of PC/ABS/GF (a) (×1000), (b) (×5000)

3.3 Thermogravimetric Analysis

The thermal degradation of glass fiber-reinforced PC/ABS blend is presented in Figure 3. The TGA thermograms of all composites were found to decrease in two steps. The first step was between 360 and 460°C and the second step was approximately 520°C. From the figure, it can be seen that the degradation temperature at 5% weight loss was ranging from 371 to 380°C. Moreover, the residual solid of all composites were found to be consistent with the composition in the molding compounds suggesting good dispersion of the fiber in the PC/ABS matrix.

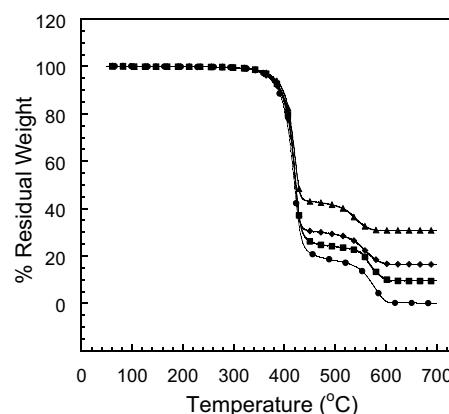


Fig. 3 TGA thermograms of PC/ABS blend at various glass fiber contents (●) 0%, (■) 10%, (◆) 20% and (▲) 30%

4. Conclusions

Short glass fiber-reinforced PC/ABS blends has been widely exploited by the industry in Thailand especially in automotive and electronic applications due to its good processability and thermal properties.

The viscosity of PC/ABS reinforced with short glass fiber increased with increasing the glass fiber content whereas substantial bonding between the glass fiber and the PC/ABS was observed. The processing condition used can provide a specimen with relatively uniform fiber dispersion.

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Thermomechanical Properties of TPP-Filled Polycarbonate/Acrylonitrile-Butadiene-Styrene Blends

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Effect of triphenyl phosphate (TPP) on thermophysical properties of polycarbonate/acrylonitrile-butadiene-styrene (PC/ABS) blends for flame resistant application was investigated. From dynamic mechanical analysis, two glass transition temperatures (T_g 's) for PC and ABS phases at 158 and 125 °C, respectively, of the blend clearly suggested the immiscible nature of the two polymers though with some degree of mixing. The amount of the TPP additive was systematically varied. The results revealed that the value of the glass transition temperature (T_g) from Tan δ of the PC/ABS blend decreased with increasing the content of TPP. In contrast, with increasing the contents of TPP, the storage moduli of the blend specimens at room temperature systematically increased. The V-0 category of UL-94 standard of flammability test can also be achieved using the TPP system.

1. Introduction

In recent years, PC/ABS blends have become one of the most frequently used engineering plastics. Their commercial success is due to an appropriate properties combination of the two components: high thermal stability and good impact behavior of PC and easy processability and economy of ABS. Furthermore, the PC notch sensitivity is improved by the more reliable notch impact ABS resistance. The flammability of PC/ABS blends strongly depends on the mass ratio of PC and ABS. PC by itself exhibits a V-2 rating in the UL-94 test, whereas ABS has a rather flammable rubber component so it is more combustible and tends to produce heavy black smoke. Furthermore, due to a recent environmental concern, there has been a demand for non-halogenated flame retardant plastics. Phosphorus-base flame retardants are believed to be effective both in gas phase and in condensed phase although a specific flame retardant works dominantly in either of two phases. TPP is the most widely used flame retardants and is reported to exhibit relatively good fire-retarding performances [1]. The additive has been reported to be compatible with both PC phase and ABS phase [1-2].

2. Experimental

2.1 Materials

The polymeric materials used in this investigation were commercialized PC and ABS. The commercial TPP flame retardant was purchased from Fluka Co., Ltd., with 99.98% purity, melting point of 48°C and boiling point of 245°C.

2.2 Preparation of PC/ABS blends

Melt mixing of PC, ABS, and TPP was carried out by a single screw extruder. PC and ABS pellets were dried for several hours to a constant weight in an air-circulated oven, in order to remove any moisture. PC was mixed with ABS as the high impact formula [1], and the blend was compounded with TPP at various weight percentages. The PC/ABS blend was cooled in air and then cut by a pelletizer.

2.3 Dynamic mechanical analysis (DMA) of the blends

DMA was used to characterize the viscoelastic properties of the studied PC/ABS blends. The tests were carried out at a frequency of 1 Hz in the three-point bending mode using NETZSCH DMA242 equipment under N₂ atmosphere. The thermograms were obtained in a temperature range of 30 to 180 °C at 2 °C /min.

3. Results and discussion

Storage modulus curves of the pure PC/ABS in Figure 1 exhibit two step changes corresponding to the positions of T_g 's of the PC and ABS phases at about 155°C and 122°C, respectively. The presence of two step changes clearly suggested the immiscible nature of the two polymers. This behavior is in good agreement with that reported elsewhere [3-4]. In the case of PC/ABS modified with TPP, the flame retardant was found to systematically enhance the room temperature storage modulus of the PC/ABS blend. The positions of the step changes shifted to lower temperature with the TPP addition. The storage modulus of the system with TPP was found to be higher than that without TPP.

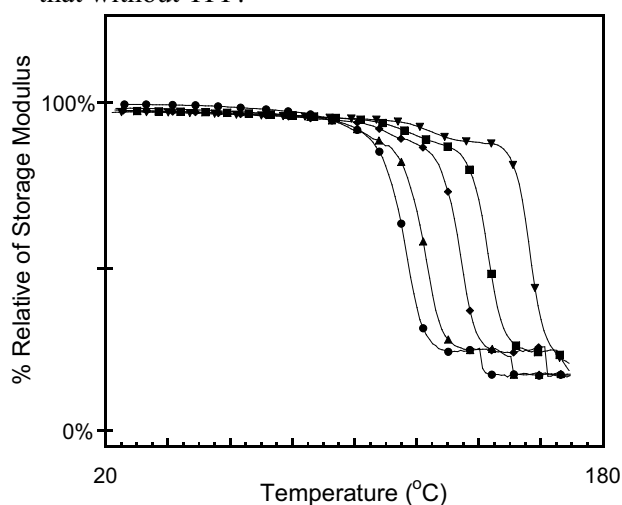


Fig. 1 % Relative of Storage modulus of PC/ABS blends at various TPP compositions.

(▼) TPP1, (■)TPP2, (♦)TPP3, (▲)TPP4, (●)TPP5

Glass transition temperatures of PC/ABS/TPP blends were also observed in the DMA thermograms based on the α -relaxation peak of $\tan \delta$. Figure 2 shows $\tan \delta$ of PC/ABS and PC/ABS/TPP systems at varied compositions. It can be seen that all of PC/ABS/TPP blend samples exhibited two relaxation peaks of the $\tan \delta$ which were designated as the T_g 's of the PC-rich and ABS-rich phases of the blends. The one at higher temperature is of the PC phase, whereas that at lower temperature belongs to the ABS phase. In the case of PC/ABS filled TPP, the flame retardant was observed to cause the lowering of the T_g 's of both phases. With adding TPP, T_g values of the PC phase were lower at a larger degree compared to those of the ABS phase (see inset of Figure 2). The behavior suggested that TPP flame retardant might preferably compatible with the PC phase to the ABS phase thus causing the greater reduction in their T_g values with an addition of TPP.

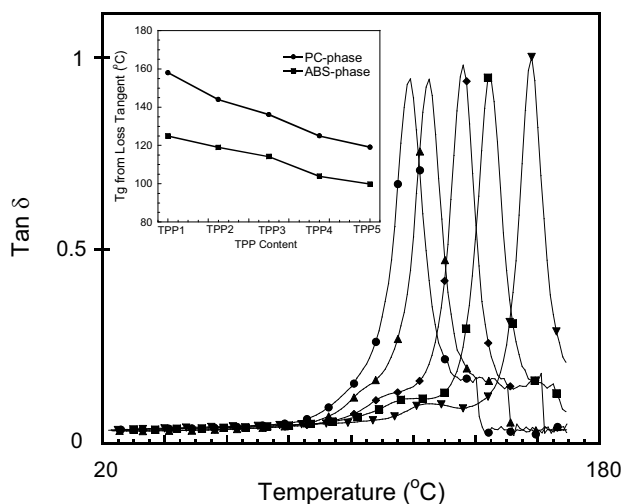


Fig. 2 $\tan \delta$ of PC/ABS blends at various TPP compositions.

(▼) TPP1, (■)TPP2, (♦)TPP3, (▲)TPP4, (●)TPP5

4. Conclusions and Recommendations for Thailand

The improvement in PC/ABS blends with flame retardant has been widely exploited by the industry in Thailand especially in automotive and electronic applications. Therefore, this research has been conducted. PC/ABS blend exhibited two T_g 's of the PC-rich and ABS-rich phases as indicated by the existence of two step changes in their storage moduli and the appearance of the corresponding two $\tan \delta$ peaks. TPP flame retardant was found to enhance the storage modulus at room temperature but systematically reduce the two glass transitions of the PC/ABS blend.

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Acid Sulfate Soil-landform Relationships in the Lower Central Plain, Thailand

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The morphology of acid sulfate soils (ASSs) and their relation to landforms of the Lower Central Plain of Thailand were studied. Characteristics of ASSs are categorized into three groups. Group I is ASSs with very strongly to extremely acid conditions throughout profiles. It extends in the area of upper boundary of deltaic plain. Group II is ASSs with reducing C horizons which contain high sulfidic material, after air-dried their reactions are decreased to ultra to extremely acid. It occupies in the lower boundary of deltaic plain. Group III represents non ASSs with reducing C horizons which contain low sulfidic material. Most of them extend across in the area of deltaic tidal to tidal plain. ASS is located in the area of recent deltaic plain which considered as developed in condition closely related to the Holocene paleo-environment, especially to the intertidal to deltaic condition at the middle Holocene transgression as mangrove forest and shallow marine environments. In contrast to non ASS, it is distributed in area of embayment during the time of middle Holocene transgression. This indicated sediment of the environment has low sulfidic material content, therefore, ASSs do not develop in the area. However, ASSs are developing in the suitable environment of sulfidic material forming as the eastern active tidal flat of the Gulf of Thailand.

1. Introduction

ASS is one of the serious problem soils. Since the soil contains iron sulfides which produce sulfuric acid when exposed to air [1]. It is especially formed in the estuaries, mangrove swamps, and tidal plains. ASS distributes widely in the Southeast Asia such as Indonesia, Vietnam, and Thailand [2]. The ASS occupies in Thailand around 881,000 ha, and the largest region of distribution is the Lower Central Plain [3], one of the best areas for economic crop of Thailand. However, the occurrence of ASS probably causes of low productivity in the area. Sustainable development requires integrated soil, water and cropping system management over whole landscapes. In the absence of specific information, land use evolves by trial and error, due to insufficient knowledge to conserve and develop land in accurate aspect. For agricultural activities, the wrong is not only causing of decreased yield but also deteriorate capability of soil and impact environment seriously. This paper is aimed to determine the morphology of ASS in the Lower Central Plain of Thailand in relation with the pattern of the paleo-environment of the plain. The recognition of those is importance for soil survey, land use planning, soil database, and environment assessment.

2. Methodology

There are 15 soil profiles were examined in the Lower Central Plain, both the area of ASS and non ASS in southernmost of the plain as deltaic, deltaic tidal and tidal plains landform units. Mainly, the pits were

excavated as deep as 2 m. Some profiles can be observed deeper in the case of the bottom of profiles could be opened continuously and they were not collapsed. On the contrary, some were investigated shallower than 2 m due to high level of groundwater of the sites. The study included soil morphology, field pH [4], [5], and 1:1 in H₂O pH [6] were also measured. At each site, sedimentary succession and electric conductivity [7] were determined for better understanding of the depositional environment.

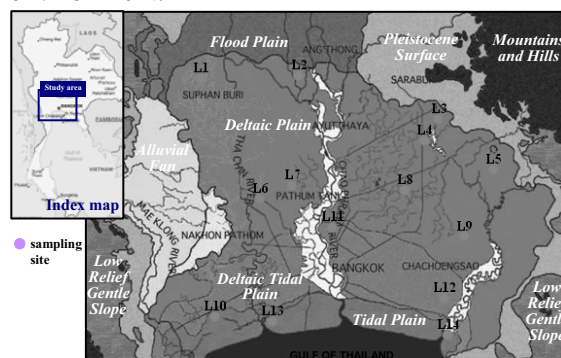


Fig. 1 Landforms classification map of the Lower Central Plain of Thailand [8] and sampling sites.

3. Results and Discussion

Characteristics of ASS are categorized into 3 groups. Group I is ripe ASSs with very strongly to extremely acid condition, including L1-L5. The soils are characterized by various shades of red, brown and yellow mottles which occur as separate zones in profiles, red and brown mottles usually occur at the top whereas yellow mottles of jarosite occur at lower of B horizons. The C horizons commonly contain iron pipes, dead roots, and plant fragments.

Their morphology show oxidation already occurred entire the profiles. Group II is ASSs with reducing C horizons which contain high sulfidic material, including L6-L9 and L14. Reaction of these horizons is neutral to moderately alkaline but becomes extremely acid on oxidation due to the high sulfidic material content. The soils also have red, brown and yellow mottles but occur in the same zone of upper B horizon. A few plant fragments were observed in the C horizons. Group III is non ASSs with reducing C horizons which contain low sulfidic material, including L10-13. Reaction of soils is slightly acid to strongly alkaline and does not become extremely acid on oxidation. Concretions of marl, shell fragments, iron pipes and dead roots could be observed in B and C horizons.

Group I distribute in the upper boundary of deltaic plain, Group II distributes in the lower boundary of deltaic plain and eastern active tidal flat of the Gulf of Thailand. L14 locates in recent environment of ASS development. Group III distributes in the deltaic tidal to tidal plain area.

4. Conclusions and Recommendations for Thailand

ASSs is considered to be developed in condition closely related the Holocene paleo-environment, especially to the intertidal to deltaic condition during the middle Holocene transgression as mangrove forest and shallow marine environments. Sulfidic material strongly accumulated in intertidal mangrove forest environment to which it was suitable for ASS formation. In contrast to non ASS, it is distributed in the embayment during the time of sea level transgression, then developed to be tidal flat in the period of rapid regression and the southernmost is being tidal flat until the present. At the time of sedimentation, any plant may not grow well in the area and condition was unsuitable for sulfidic material accumulation. Therefore, ASSs did not develop in the area of group III.

Land use planning in area of ASS in the Lower Central Plain should considering types of plant to cultivate, select plant which has root system shallower than sulfuric horizon (sulfuric horizons of ASS samplings are begin 0-90 cm from surfaces) due to extremely acid condition is inappropriate for general plant growing. Also improvement of plant nutrients of the soil should be finished before cropping. Moreover, excavation in the area of ASS with reduced subsoil should be done and managed carefully,

do not opened the land as deep as horizon containing sulfidic material (upper boundaries of the horizons are 128-170 cm). Due to the material possibly generate serious acid condition on oxidation. Consequently, the land will difficult to apply in any objective.

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Effect of Intermediate Principal Stress on Bangkok Clay Behavior under Quasi Simple Shear Condition

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This paper presents an experimental investigation of the effect of the intermediate principal stress (σ_2). A series of tests was performed on the undisturbed samples of Bangkok Clay by means of a torsional shear hollow cylinder apparatus. The magnitudes of b values were fixed at 0, 0.5 and 1 in each test. The direction of the major principal stress (σ_1) is also fixed at 45° against the vertical axis of the specimens in the entire tests. The results show that when α values were fixed at 45° , significant difference in undrained shear strength is observed at different values of b .

1. Introduction

A lot of experiments proposed that the undrained shear strength measured in the compression mode ($\alpha = 0^\circ, b = 0$) can be significantly higher than that in the extension mode ($\alpha = 90^\circ, b = 1$). This difference can be suggested that the stress conditions, such as the direction of the principal stress and the condition of the intermediate principal stress, have some effects on the soil behavior [1, 2].

Although, several researchers have widely investigated the effects of the principal stress direction and the condition of the intermediate principal stress on many soils, the condition of the intermediate principal stress on the behavior of Bangkok Clay is not available. The objective of this study is to investigate the undisturbed Bangkok Clay behavior with particular attention to the intermediate principal stress effect.

2. Experiments

To clarify these effects, the torsional shear hollow cylinder apparatus was used. Four stress components on the specimen ($\sigma_z, \sigma_r, \sigma_\theta, \tau_{\theta z}$) can be adjusted by controlling the torque (M_T), the axial force (W), the outer cell pressure (p_o) and the inner cell pressure (p_i). The average stress components in hollow cylindrical specimen were calculated with reference to the work by Hight et al. (1983) [3]. Undisturbed samples were taken by piston sampler from Ladprao area, Bangkok between the depths of 10.0-12.5 m. The index properties are liquid limit = 85.2-85.8 %, plastic limits = 27.4-33.0 %, plastic index = 52.2-58.4 %, natural water content = 49.3-54.3 % and total unit weight = 17 kN/m³. The hollow cylindrical specimens (inner diameter,

$D_i = 30$ mm, outer diameter, $D_o = 70$ mm, height, $H = 120$ mm) used in this study were prepared by using successive drill and enlarged by a wire saw. Three torsional shear tests on hollow cylindrical Bangkok Clay samples were carried out each with a different b values at 0, 0.5 and 1 in undrained condition. The α values were fixed at 45° . The back pressure of 200 kPa was applied to ensure the specimen saturation. After the saturation, with Skempton's B value greater than 0.95, all specimens were isotropically consolidated to the pressure which is same as the in-situ vertical stress and then undrained sheared. The undrained shear stage is terminated when the rotation angle of the top part of the specimen reaches 30° . The termination of the isotropic consolidation stage is judged by the dissipation of the excess pore water pressure ($\Delta u < 1$ kPa).

3. Results and discussion

Normalised undrained effective stress paths with α values were fixed at 45° (Fig. 1), whereas b values were varied from 0 to 1. Obviously, the normalised undrained effective stress paths are almost same, irrespective of the values of b when the effective stress path is plot on the q/p_o' versus p'/p_o' . The deviatoric stress is $q = \sigma_1 - \sigma_3$. It can imply that the excess pore water pressure is a function of the principal stress difference. However, it is independent of the intermediate principal stress parameter.

The angle of shearing resistance $\phi' = \arcsin\left(\frac{\sigma'_1 - \sigma'_3}{\sigma'_1 + \sigma'_3}\right)$ at the peak shear stress

(the $\tau_{\theta z}$ becomes maximum) with respect to b is shown in Fig. 2. The main observation is that the measured variation in ϕ' increases

when b increase up to 0.5 and remains increase slightly thereafter. This contradictory result may be caused by the effects of stress and strain non-uniformity and/or the different properties of the specimens in the hollow cylinder test.

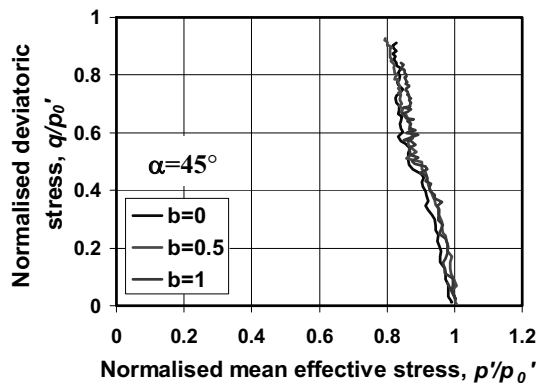


Fig. 1 Normalised undrained effective stress paths with $\alpha=45^\circ$

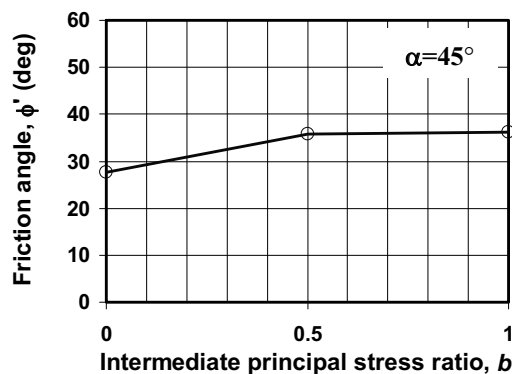


Fig. 2 Friction angle of Bangkok Clay from undrained test with $\alpha=45^\circ$

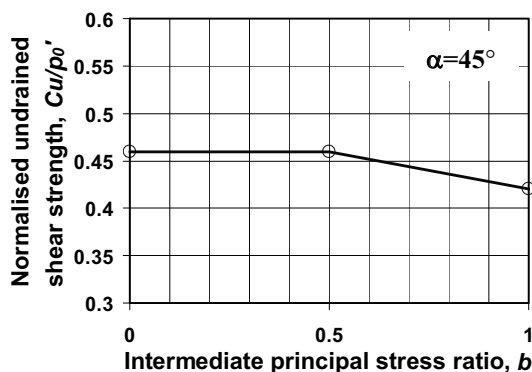


Fig. 3 Normalised undrained shear strength at peak with $\alpha=45^\circ$

Fig. 3 represents the normalized values of undrained shear strength at the peak shear stress with $\alpha=45^\circ$. A lower undrained strength is obtained when the shearing is performed with the larger value of b ($b=1$). The value of Cu/p_0' tends to exhibit constant when b value changes from 0 to 0.5 but difference in Cu/p_0' close to 10% arises at higher values of b . The same trend in behavior has been reported by other researchers [4, 5].

4. Conclusions and Recommendations for Thailand

The influence of intermediate principal stress on the behavior of Bangkok Clay is presented in this paper. When α values were fixed at 45° , the significant difference in the undrained shear strength is observed in shear behavior of Bangkok Clay at different values of b . There is negligible undrained shear strength affected by σ_2 when $b < 0.5$. However, the opposed result of ϕ' is noticed. This information is achieved accurately; they should be useful for improving the soil model to better represent the real Bangkok clay behavior.

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Stress Analysis of Granular Media Confined in Long Vertical Column

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Stress analyses of granular media stored in a long vertical axis symmetric column has attracted many interests from granular physics and mechanics. The analyses of stress distributions proposed by Janssen (1895) for corn, and by Jaky (1948) for wheat storage in silos, confirmed good agreement with experimental results, though certain assumptions are needed to improve. This study attempts to indicate the certain theoretical simplification in their assumptions and discusses on the validation aiming to generalize all related formulas. The basic assumption for deriving a well-known coefficient of earth pressure at-rest in soil mechanics proposed by Jaky is examined and clarified in this study. It is clear that Jaky assumed linear shear stress reduction in his analyses of stress distribution not only to sand heaps but also to grains in silos.

1. Introduction

In agricultural and chemical industries, crops and powders are frequently stored in tall silos. In order to design the optimum size of the containing structure with safety and economy, knowledge of storage conditions and stress distributions throughout the granular media is necessary. The study of silo problem has been initiated as early as 1985 by Janssen [1] based on the mechanics of continuous media. The approximation of vertical stress obtained by Janssen's model as well as the phenomenon of saturation pressure has been widely recognized in both physics and mechanics of granular media. However, Janssen's assumption that the vertical and horizontal stresses are principal stresses is not correct. Jaky [2] corrected this inconsistency by considering the distribution of shear stress and imposing that at-rest condition is achieved at the center line of silos. Jaky's analysis firstly introduced the coefficient of earth pressure at-rest K_o , to describe the static mechanism of granular media. From agricultural products to cohesionless soils, his simplified K_o equation later became the advantage to compute lateral pressures for geotechnical engineers in particular. The analytical method proposed in this study shortcuts the original Jaky's analysis in an attempt to emphasize that Jaky assumed linear shear stress reduction in his analyses (Pipatpongsa et al. [3]). Comparisons of the analytical formulation are made with the published experiments of corn and wheat stored in silos and the results are discussed.

2. Analytical method

The equilibrium equations of stresses in axi-symmetric cylindrical co-ordinates (r, z, θ) are given in radial and vertical directions.

$$\frac{\partial \sigma_r}{\partial r} + \frac{\sigma_r - \sigma_\theta}{r} + \frac{\partial \tau_{rz}}{\partial z} = 0 \quad (1)$$

$$\frac{\partial \sigma_z}{\partial z} + \frac{\partial \tau_{rz}}{\partial r} + \frac{\tau_{rz}}{r} = \gamma \quad (2)$$

$$\text{where } \sigma_\theta = \sigma_r, \tau_{z\theta} = \tau_{rz} \quad (3), (4)$$

$$\text{Shear stress at wall } \tau_w = \mu_w \sigma_w \quad (5)$$

where μ_w is a static coefficient of friction between granular material and silo's wall ($\mu_{w,max} = \tan \phi$), and σ_w is a radial stress exerting to the wall at a given depth.

State of stresses in granular media is assumed to be not mobilized, therefore shear stress τ_{rz} is to reduce linearly with radius r to zero at the center line of silo in Eqs.(6)-(7). Shear and radial stresses along the wall τ_w and σ_w are the boundary conditions to determine τ_{rz} and σ_r from Eqs.(1)-(2). Eq.(8) describes the assumption that vertical stress σ_z is uniform across horizontal section. According to Eq.(2), Eqs.(5)-(7), σ_w can be expressed by Eq.(11).

$$\tau_{rz} = \frac{r}{R} \tau_w, \frac{\partial \tau_{rz}}{\partial r} = \frac{\tau_w}{R}, \frac{\partial \sigma_z}{\partial z} = 0 \quad (6), (7), (8)$$

$$\tau_w = \tau_{rz}|_{r=R}, \sigma_w = \sigma_r|_{r=R} \quad (9), (10)$$

$$\sigma_w = \frac{R}{2\mu_w} \left(\gamma - \frac{\partial \sigma_z}{\partial z} \right) \quad (11)$$

According to Eq.(1), using Eqs.(3)-(7), variation of σ_r along the radius can be expressed by Eq.(12).

$$\frac{\partial \sigma_r}{\partial r} = -\mu_w \frac{r}{R} \frac{\partial \sigma_w}{\partial z} = \frac{r}{2} \frac{\partial^2 \sigma_z}{\partial z^2} \quad (12)$$

Another boundary condition is given along the center line where state of stress is assumed to be *at-rest condition*. Hence, σ_r and σ_w can be related to σ_z thru Eqs.(12)-(15).

$$\sigma_r|_{r=0} = K_o \sigma_z \quad (13)$$

$$\sigma_r = \int_0^r \frac{\partial \sigma_r}{\partial r} dr + \sigma_r|_{r=0} = \frac{r^2}{4} \frac{\partial^2 \sigma_z}{\partial z^2} + K_o \sigma_z \quad (14)$$

$$\sigma_w = \frac{R^2}{4} \frac{\partial^2 \sigma_z}{\partial z^2} + K_o \sigma_z \quad (15)$$

Elimination of σ_w from Eqs.(11) and (15), with rearrangement can form a linear homogeneous 2nd order differential equation.

$$\frac{R^2}{4} \frac{\partial^2 \sigma_z}{\partial z^2} + \frac{R}{2\mu_w} \frac{\partial \sigma_z}{\partial z} + K_o \sigma_z - \frac{\gamma R}{2\mu_w} = 0 \quad (16)$$

The solution of σ_z based on Eq.(16) are carried out by referring to standard formulations given by Eqs.(17)-(21).

$$\xi = K_o \sigma_z - \frac{\gamma R}{2\mu_w} \quad (17)$$

$$\frac{\partial^2 \xi}{\partial z^2} + \frac{2}{\mu_w R} \frac{\partial \xi}{\partial z} + \frac{4K_o}{R^2} \xi = 0 \quad (18)$$

Let m_1, m_2 be the real and distinct roots of

$$m^2 + \frac{2}{\mu_w R} m + \frac{4K_o}{R^2} = 0, \quad (19)$$

$$\text{where } \begin{Bmatrix} m_1 \\ m_2 \end{Bmatrix} = -\frac{1}{\mu_w R} \begin{Bmatrix} 1 - \sqrt{1 - 4\mu_w^2 K_o} \\ 1 + \sqrt{1 - 4\mu_w^2 K_o} \end{Bmatrix} \quad (20)$$

$$\text{hence } \xi = c_1 e^{m_1 z} + c_2 e^{m_2 z}. \quad (21)$$

σ_z shown in Eq.(22) is determined from ξ given in Eqs.(17) and (21). Constants c_1, c_2 are solved from Eqs.(23)-(24) as the initial conditions of σ_z at the top of silo where $z=0$.

$$\sigma_z = \frac{\gamma R}{2\mu_w K_o} \left(1 + \frac{2\mu_w}{\gamma R} \xi \right) \quad (22)$$

$$\sigma_z|_{z=0} = 0, \quad \frac{\partial \sigma_z}{\partial z} \Big|_{z=0} = \gamma \quad (23), (24)$$

$$\begin{Bmatrix} c_1 \\ c_2 \end{Bmatrix} = \frac{\gamma}{2\mu_w (m_1 - m_2)} \begin{Bmatrix} 2\mu_w K_o + R m_2 \\ -2\mu_w K_o - R m_1 \end{Bmatrix} \quad (25)$$

3. Results and Comparisons

The asymptotic saturation pressures at the great depth can be ascertained by imposing $z \rightarrow \infty$. Fig. 1 shows the pressures diagram normalized by the saturation pressures versus height of silo normalized by the characteristic depth z_c . It is found that the theoretical equations agreed well with experiments results reported by Janssen and Jaky. At the great depth, stress condition is clearly at-rest state.

$$\lim_{z \rightarrow \infty} \xi = 0, \quad z_c = \frac{R}{2\mu_w K_o} \quad (26), (27)$$

$$\sigma_z|_{z=\infty} = \gamma z_c, \quad \sigma_r|_{z=\infty} = K_o \gamma z_c \quad (28), (29)$$

$$\tau_w|_{z=\infty} = \frac{R}{2} \gamma, \quad \frac{\sigma_r}{\sigma_z} \Big|_{z=\infty} = K_o \quad (30), (31)$$

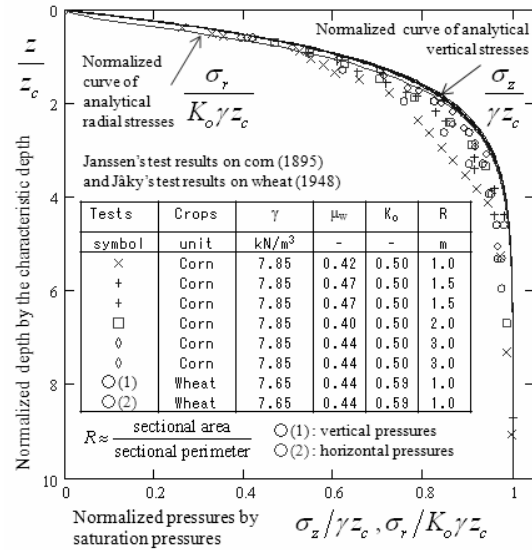


Fig. 1 Stress distributions along the wall of silos

The formula derived in this paper implied by one hand generalized the Janssen's equation of vertical pressure by associating the wall friction with internal friction angle of the material and introduce the coefficient of at-rest pressure, and other hand simplified Jaky's approach of upper and lower section of experimental curve.

4. Recommendations for Thailand

Major exports of Thailand and regional countries are agricultural products which are generally stored in silos. Understanding of storage condition and stress distribution of stored materials can contribute to the optimized design of containing structures.

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Interpretation of K_o -consolidation Processes Illustrated by Randomized Inhomogeneous Strains

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The Sekiguchi-Ohta model is one of the most fundamental constitutive equations based on critical state theory for anisotropic geomaterials. According to the domain of metastability defined for the inhomogeneous strains at the corner of Sekiguchi-Ohta model, plastic flow is limited by the inequality for generalized strains. The nature of anisotropic virgin-consolidation can be considered as a combined process compression and extension in axi-symmetric condition. This combination is supposed to produce consolidation without overall distortion. Using binary distribution, strain increments can be randomly selected in the domain of metastability. For small number of combinations, inhomogeneous internal strains are obviously seen while the more homogeneous internal strains due to an accumulation random movement can be seen for large number of combinations.

1. Introduction

The Sekiguchi-Ohta model [1] is one of the most fundamental constitutive equations based on critical state theory for anisotropic geomaterials. The yield function $f(\boldsymbol{\sigma}, \boldsymbol{\sigma}_c)$ of this model is expressed by Eq.(1) as a function of a stress tensor $\boldsymbol{\sigma}$, and anisotropic hardening stress tensor $\boldsymbol{\sigma}_c$.

$$f(\boldsymbol{\sigma}, \boldsymbol{\sigma}_c) = M \ln(p/p_c) + \bar{q}/p = 0 \quad (1)$$

where M is critical state frictional parameter, p is mean stress, p_c is isotropic hardening stress parameter and $\bar{q}$ is a relative deviatoric stress. Derivation of these stress variables are shown in Eqs.(2)-(9).

$$p = \frac{1}{3} \boldsymbol{\sigma} : \mathbf{1}, \quad p_c = \frac{1}{3} \boldsymbol{\sigma}_c : \mathbf{1} \quad (2),(3)$$

$$\mathbf{s} = \boldsymbol{\sigma} - p\mathbf{1}, \quad \mathbf{s}_c = \boldsymbol{\sigma}_c - p_c\mathbf{1} \quad (4),(5)$$

$$\boldsymbol{\eta}_c = \mathbf{s}_c / p_c, \quad \bar{\mathbf{s}} = \mathbf{s} - p\boldsymbol{\eta}_c \quad (6),(7)$$

$$\bar{\mathbf{n}} = \bar{\mathbf{s}} / \|\bar{\mathbf{s}}\|, \quad \bar{q} = \sqrt{\frac{3}{2}} \|\bar{\mathbf{s}}\| \quad (8),(9)$$

where $\mathbf{1}$ is second-order identity tensor, $\mathbf{s}$ and $\mathbf{s}_c$ are stress deviator of $\boldsymbol{\sigma}$ and $\boldsymbol{\sigma}_c$ respectively and $\boldsymbol{\eta}_c$ is deviatoric second-order tensor associated to anisotropic consolidation. Compressive stresses and strains are considered positive, effective stresses are used throughout the paper, single dot ($\cdot$), double dot ($:$) denote single and double contraction of two tensors respectively. Euclidian norm is written shortly by $\|\bullet\| = \sqrt{\bullet : \bullet}$ where $\bullet$ stands for a second-order tensor.

2. Domain of inhomogeneous strains

According to the domain of metastability defined for the inhomogeneous strains at the corner of Sekiguchi-Ohta model [2], plastic flow is limited by the inequality for generalized strains expressed by Eqs.(10)-(11) where $\boldsymbol{\varepsilon}$ is an applied strain rate, $\boldsymbol{\varepsilon}_v$ is a volumetric strain rate, $\bar{\boldsymbol{\varepsilon}}^p$ is a second-order tensor of relative plastic strain rate, η_o is a constant K_o -consolidated stress ratio, Λ is an irreversibility ratio. Provided that the stress point is continuously kept along the corner, the arbitrary strain rate can be varied within the domain of metastability. In other words, uniform possibility of plastic flows can be randomly selected in this domain.

$$\bar{\boldsymbol{\varepsilon}}^p = \boldsymbol{\varepsilon} - \boldsymbol{\varepsilon}_v \left\{ \frac{1}{3} \mathbf{1} + (1 - \Lambda) \frac{\boldsymbol{\eta}_c}{\eta_o} \right\} \quad (10)$$

$$\sqrt{\frac{2}{3}} \|\bar{\boldsymbol{\varepsilon}}^p\| - \frac{\Lambda \boldsymbol{\varepsilon}_v}{M - \sqrt{3/2} \boldsymbol{\eta}_c : \bar{\mathbf{n}}} \leq 0 \quad (11)$$

Under K_o -consolidation processes, states of stresses and strains are under axi-symmetric condition. Therefore, Eq.(11) can be deduced to Eq.(12) where $\boldsymbol{\varepsilon}_s$ is a deviatoric strain rate.

$$\boldsymbol{\varepsilon}_s \leq \frac{\Lambda \boldsymbol{\varepsilon}_v}{M \pm \eta_o} \quad (12)$$

Descriptions of rate form will be replaced by increment form in the next section by considering that the rate is constant throughout the discretized time increment.

3. Randomized plastic flows

The nature of anisotropic virgin-consolidation can be considered as a combined process compression and extension. This combination is supposed to produce consolidation without overall distortion [3]. In order to illustrate this condition for a given soil sample, we can assume that for any point of this sample, distortion $\delta\epsilon_s$ is described by either compression or extension under a constant rate of volume change $\delta\epsilon_v$. We can adopt deviatoric strain increment $\delta\epsilon_s^{(i)}$ as a probability variable where i denote step number. To satisfy consistency conditions it is required that,

$$\frac{-\Lambda}{M + \eta_o} \delta\epsilon_v \leq \delta\epsilon_s \leq \frac{\Lambda}{M - \eta_o} \delta\epsilon_v \quad (13)$$

The Eq.(13) means that distortion is controlled by compression and extension limits;

$$\delta\epsilon_s^{(i)} = \begin{cases} \frac{\Lambda}{M - \eta_o} \delta\epsilon_v & \text{compression} \\ \frac{-\Lambda}{M + \eta_o} \delta\epsilon_v & \text{extension} \end{cases} \quad (14)$$

Using binary distribution we can consider distortion due to volumetric strain increments. Stepwise volume change is obtained by dividing an accumulated volume change with a number of steps n , which represents a number of grain movements. Means of volume and distortion increments $\bar{\delta\epsilon}_s$ are calculated by,

$$\bar{\delta\epsilon}_v = \delta\epsilon_v^{(i)} = \frac{\delta\epsilon_v}{n} \quad (15)$$

$$\bar{\delta\epsilon}_s = \frac{1}{2} \left(\frac{\Lambda}{M - \eta_o} \delta\epsilon_v + \frac{-\Lambda}{M + \eta_o} \delta\epsilon_v \right) \quad (16)$$

Simple computation are made for a rectangular sample composing of 10×10 element points using parameters $M=1$, $\Lambda=0.75$ and $\eta_o=0.5$. Net change in distortion is a summation of all steps emerged from randomized processes.

$$\Delta\epsilon_s = \sum_i^n \delta\epsilon_s^{(i)} \quad (17)$$

Various steps under constant volume change are carried out. Results emanated from binary distribution are illustrated in Fig. 1. Accumulated axial and radial strain increments $\Delta\epsilon_a, \Delta\epsilon_r$ can be transformed from

accumulated volumetric and deviatoric strain increments by,

$$\begin{Bmatrix} \Delta\epsilon_a \\ \Delta\epsilon_r \end{Bmatrix} = \begin{bmatrix} 1 & 2 \\ 2/3 & -2/3 \end{bmatrix}^{-1} \cdot \begin{Bmatrix} \Delta\epsilon_v \\ \Delta\epsilon_s \end{Bmatrix} \quad (16)$$

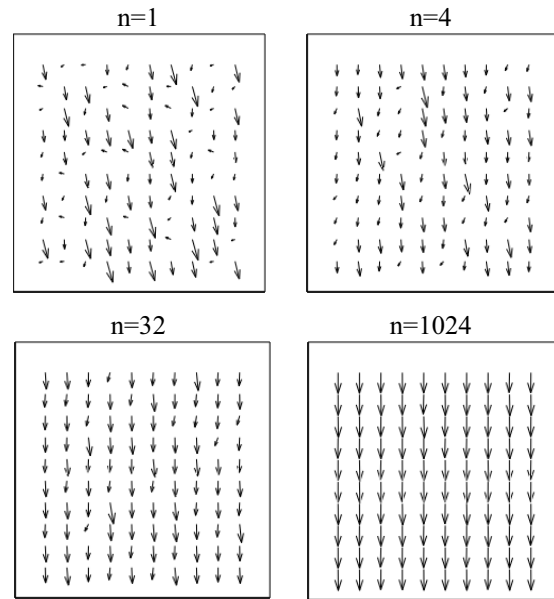


Fig. 1 Vector plots of averaged strains characterized by binomial distribution

4. Conclusions

For small number of n we can see obviously inhomogeneous internal strain due to the combination of compression and extension while increasing the number of n results in the more homogeneous internal strain due to an accumulation random movement.

5. Recommendations for Thailand

The Sekiguchi-Ohta model is the most popular soil constitutive model used in Japan. Understanding of the model benefits to academics/researches which contribute to Thailand in the field of Civil Engineering. Soil parameters should be carefully determined when applying to analyses and design.

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Program “PimThai” (Typing Thai by Romanized input)

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This article proposes “PimThai”, a program for typing Thai words by Romanized input (Romanization is the representation of word with Roman alphabet). This program will make foreigners who study Thai language and also Thai people who live in foreign countries able to type Thai more effectively. Moreover, this is a good way in promotion Thai language.

1. Introduction

Nowadays, foreigners especially Japanese who are interested in Thai language have become increasing recently. Although they can use Thai, they cannot use Thai keyboard easily because of more than 90 used keys. So if they can type with only 26 keys of English keyboard, it will become more comfortable.

Moreover, if Thai language can be used in Romanization more effectively, we can promote more easily. So this is a good way to heighten Thai language status to be a more universal language. “Promotion Planning for Thai Language as a Foreign Language in Japan” was initiated by Podsatiangool [1]. This idea is an inspiration to make Program “PimThai” (Typing Thai by Romanized input).

2. Methodology

In this project, “タイ文字読み書きの基礎” [2] was use as the reference in Romanization. At present, there are 2 methods, [manual typing method] and [automatic method], in 2 separate versions of program.

The manual typing method, after finishing every syllable and pressing “space bar” button, the program will separate the input word for alphabet and vowel and select Thai alphabet and vowel that match the input and assemble them. Then it show all of the possible words for the input, including all tone marks (wannayuk) that can be chosen whether meaningful or not. For example, when type “KIN” the program will separate K for front-alphabet, I for vowel, and N for back-alphabet. Possible front-alphabet that matches for K is “ก”. The possible vowel for I is “ิ”. And the possible last-alphabets for N are “น”, “ญ”, “ล” and “ร” (the order of words shown in list is according to frequently of normally used of each alphabet). Therefore the possible words shown in list box for choose are “กิน”, “กิญ”,

“กิล”, and “กิร”, although some words are meaningless. Moreover, each word can change into different tone marks, for example, “กิน”, “กึ้น”, “กิ้น”, etc.

The automatic method (in the other separate version), using a Thai dictionary for the reference of Thai words. Although it does not cover for the entire of Thai words, it is enough for all usually using words. Then convert from Thai to Romanized word and keep it into database. When text is input by user, the program will search from the database for the 20 nearest words. More texts is input, nearer word will be shown. For example, when type K, the first 20 nearest words such as “ก”, “กึ”, “กก”,... will shown in list. When type I (become KI), words in list will change to the new nearest words such as “เกียกกาย”, “เกียขง”, “เกียขงอน”. User can select the required word if it is found in the list.

3. How to use

For the manual version, to input Romanized each syllable one by one and then press “Space bar” button, the possible words will be shown in the list box. Select the word from list by pressing “Space bar” continually. If you require tone marks, click “Tab” and Tone marks will be shown. Choose it by click “Space bar”. Then press “enter” to select.

For the automatic version, input Thai word by Romanized input. Typing one by one, the nearest word will be shown in list. When the required word is found then press “space bar” button to select the required word. Press the “enter” button to select the required word and Romanized input will be replaced by Thai word. After finish typing, then copy and paste to the require place.



Fig. 1 Using “PimpThai” in automatic mode

4. Next Step for This Project

- Combine 2 versions of program together for users can choose both manual and automatic typing.

- Improve the word's database more effectively, such as arranging order of words by frequently of using.

- Patch the program into Microsoft Windows for typing in the require programs such as MS-Office, E-mail, and chatting programs directly

5. Conclusions and Recommendations for Thailand

This application will have an effect on both Thai people and foreigners.

In case of Thai people, they can type in Thai more comfortably because English keyboard has less used keys than Thai. For Thai people in foreign countries, they also Thai easily without remembering positions of each keys.

In case of foreigner, this program will certainly solve the problem of finding keys for each Thai alphabet. And also heighten Thai language status to be a more universal language.

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Workplace Environment and Personal Exposure of PM and PAHs to Workers in Natural Rubber Sheet Factories Contaminated by Wood Burning Smoke

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Workplace environment in factories producing Ribbed Rubber Smoke Sheet (RSS), inside of which are heavily contaminated by wood burning smoke, has been evaluated focusing on concentrations of particulate matter and particle bound PAHs as well as their exposure to workers during January, 2006 – February, 2008 in Thailand. Seasonal changes in the particulates and PAHs concentrations were related to the production amount of RSS and weather conditions. Based on the measurement in four different factories, which have different types of ventilation facilities, influences of ventilation were also discussed. The concentration of total suspended particulates (TSP) in workplace increased linearly with RSS production although it showed a slight dependency on the wind direction to a factory building probably because of the configuration of open sides of the building. TSP concentration in the workplace and at the worker's breathing zone ranged 0.02 to 0.28 and 0.14 to 0.56 mg/m³, respectively. Those are still less than the working environmental standard but rather high PAHs concentrations (94.6 ~ 131 ng/m³ in workplace and 153 ng/m³ at breathing zone) were observed. Ventilation by roof turbines as well as a ridge vent roof may not be efficient enough to remove smoke particles. The workers in the RSS factory were found to have a risk of exposure to rather high concentration of PAHs, which may be both from wood burning and a diesel engine operated inside.

1. Introduction

Ribbed Rubber Smoke Sheet (RSS) is a main product from rubber latex. In the southern provinces of Thailand, there are currently 444 small-scale manufacturers operating, which are commonly called 'RSS cooperatives'. Since a management system is carried out in a cooperative function [1]. The main process of RSS production is drying the latex sheets by smoke and heat in the drying rooms. This requires the burning of solid fuel, which is mainly rubber wood. Therefore, wood combustion is considered the major emission source of smoke in RSS factories. During incomplete combustion, polycyclic aromatic hydrocarbons (PAHs) are formed, especially a major group of carcinogens [2]. Exposure to particulate matter and chemical components such as PAH is reported the potential harm to health damage [3]. Hence, this study will investigate the worker's exposure level to particle and PAH concentration over 12 months. The influences of particulate matter dilution by the current ventilators will be clarified.

2. Location and general characteristics of Ribbed Rubber Smoked Sheet (RSS) factories

Four RSS factories were selected to represent the general characteristics of RSS factories. Three of them are located in Songkhla and another one is in Phattalung Province. In the study area, the main interest was a new model without (w/o) ventilation. This RSS factory was

built in the 'new' design with 4 drying rooms in a dimension of 4 x 5 m. The total diameter is 18 x 25 m, which was the same as the 'old' design. The 'old' design has 7 drying rooms with a dimension 3 x 7 m. The ventilation systems (vent.) in the study areas are 2 kinds that consist of a turbine and a ridge vent on the roof. Around 4-8 workers were employed to produce RSS.

3. Air sampling and chemical analyses

Air sampling was done at the worker's breathing zone (BZ) and workplace area (PS) using personal sampling pumps (Gilair-5, Sensidyne Inc; SKC Universal PCXR8, SKC Inc, flow rate 2 lpm) with quartz fiber filter (ADVANTEC, QR-100). Workplace area sampling was done continuously during August 2006 to February 2008 which sampling points comprised three points. All samples were weighted to determine the particulate matter with a 5-digit balance (in mg), and then were wrapped in aluminum foil and stored at -20°C until chemical analysis. Fifteen – sixteen PAH components were analyzed using a high performance liquid chromatograph (HITACHI, L-2130/2200/2300/2485).

4. Results and discussion

4.1 Rubber production

The RSS production in the new model w/o vent is varied depending on the amount of natural latex, weather, season, and the price of RSS on the central RSS market. Therefore, the production figures over 12 months were not constant.

4.2 Particulate matter concentration

The 50th percentile of the particle size distribution in the new model w/o vent was at 1 micron, which is consistent with smoke characteristics [4]. The particulate matter concentrations of PS and HV were 0.09 ± 0.07 and 0.16 ± 0.08 mg/m³, respectively. The different concentrations might be influenced by location and height, as the HV was located near the opening area of the drying room.

The particulate matter concentration at the worker's breathing zone was 0.17 ± 0.1 mg/m³, which was higher than the concentration at the PS and HV sites. This might be influenced by the job characteristics; for example, a worker has to check the RSS quality in the drying room. In addition, the exposure to particulate matter is related to the increase of the amount of RSS production. Therefore, the worker might be exposed to higher concentrations during higher production season.

4.3 Total PAH concentration

The average total PAH concentration at PS and HV point were 94.6 ± 7.2 and 131 ± 120 ng/m³, respectively, whereas at the worker's breathing zone it was 153 ± 10.6 ng/m³. The higher total PAH value at BZ might be the worker's exposure to PAH from two sources. The main source of PAH were the drying rooms and another source was the diesel engine of the squeezing machine which was the total PAHs concentration at 0.5 m. was 365 ng/m³. In addition, the total PAH gas-phase concentration in workplace was 3.6 ± 5.3 µg/m³.

Table 1 Concentration of total dust (mg/m³) and PAH (ng/m³) in 4 RSS factories

		RSS cooperation type			
		Hybrid model w/t vent	Old model w/t vent	New model w/o vent	New model w/t vent
Particle conc. (mg/m ³)	PS	0.13 ± 0.05 (n=12)	0.11 ± 0.03 (n=7)	0.09 ± 0.07 (n=47)	0.13 ± 0.04 (n=7)
	BZ	0.29 ± 0.2 (n=7)	0.14 ± 0.1 (n=4)	0.17 ± 0.1 (n=30)	0.24 ± 0.1 (n=6)
	HV	-	-	0.16 ± 0.1 (n=47)	-
	AN	0.12 (n=1)	0.15 (n=1)	0.22 (n=1)	0.21 (n=1)
Total PAH (ng/m ³)	PS	255 ± 190 (n=6)	113 ± 61 (n=7)	94.6 ± 7.2 (n=35)	517 ± 380 (n=7)
	BZ	932 ± 101 (n=3)	95.2 ± 74 (n=3)	153 ± 10.6 (n=29)	147 ± 120 (n=4)
	HV	-	-	131 ± 120 (n=31)	-
	AN	83.01 (n=1)	224 (n=1)	790 (n=1)	1408 (n=1)

These total PAH particle-phase concentrations, showed at the middle range of the study in the sinter plant and carbon black manufacturing, were found 42 ± 23 to 365 ± 203 ng/m³ [5] and $4.95 - 612$ ng/m³ [6], respectively. All particle concentrations were less than the recommend airborne concentrations [7], which should be less than 10 mg/m³. However, the total PAH concentrations of the RSS factories were in a serious situation.

4.4 Geometric of plantation and ventilation

According to the plant design, all of the RSS factories were semi-open small scale enterprises. The open site of the new model w/o vent was in the W to SEE direction and the close sites were the other directions. During sampling period, 33.33% of the wind directions were through the open site, whereas through the close site was 66.67%. This had an effect on the particle concentrations, as the concentrations at the open site (0.08 ± 0.02 mg/m³) were lower than at the close sites (0.12 ± 0.08 mg/m³).

Table 1 showed that the particle concentration both at PS and BZ were in various ranged. This may be some ventilators, roof turbine ventilators, and ridge vents on the roof were installed. During a high production period, the RSS cooperative w/t ridge vent of roof showed no turbulences air flow in the workplace, while RSS factories w/o vent showed several times of turbulences air flow.

5. Conclusion

The 50th percentile of particle distribution in RSS factories was 1 micron. The total dust concentrations in all RSS factories were lower than occupational exposure limit values. However, the total PAH concentrations were relatively high and close to the range of PAHs in medium and heavy manufacturing. According to RSS cooperative plant's design, rain and wind directions might influence the particle concentrations. The general ventilation is not appropriate to dilute PAHs and smoke from the workplace. The workers in the RSS factories were exposed to PAHs from smoke particles from the drying room and the diesel engine.

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An Integer Programming-Based Method of Predicting RNA Secondary Structure with Pseudoknots and Its Relation to Simple Linear Tree Adjoining Grammar

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RNA secondary structure prediction is one of the major tasks in bioinformatics because it helps to understand the function of RNA molecules. Various prediction methods have been proposed so far. Pseudoknot is one of the substructures appearing in several RNAs, and plays an important role in some biological processes. Prediction of RNA secondary structure with pseudoknots is still challenging since the problem is NP-hard when arbitrary pseudoknots are taken into consideration. We proposed a new method of predicting RNA secondary structure with pseudoknots based on integer programming. In our formulation, we aimed at minimizing the value of the objective function that reflects free energy of a folding structure of an input RNA sequence. We also conjectured that our integer programming formulation has a one to one relationship with simple linear tree adjoining grammar, which can describe a subclass of RNA pseudoknots. We compared the experimental results of our method for a set of real RNA sequences with an existing method. For a set of sequences of small length, our approach achieved good performance in both sensitivity and specificity. We successfully employed the flexibility of integer programming to model the problem of RNA structure prediction. This research could be helpful to studies related to biomedicine and agriculture, and important for the promotion of science in Thailand.

1. Introduction

An RNA molecule plays many important roles in cells. For example, it serves as messenger (mRNA) carrying genetic information from DNA in order to translate into proteins. However, many RNAs are not translated into proteins, called non-coding RNAs (ncRNAs). Functions of some ncRNAs are known such as RNA splicing, processing and editing; but some are yet unknown. Secondary structure analysis helps to understand the function of RNA. The laboratory process to determine RNA structure is costly. Therefore, secondary structure prediction of RNA is important.

We can represent a secondary structure of RNA by drawing a sequence of bases as a horizontal line and arcs over or under the sequence connecting two bases to represent the base pairs. If there are some crossing arcs, the secondary structure is said to contain a *pseudoknot* (Fig. 1 (c) and (d)).

An often-used thermodynamic hypothesis states that RNA always forms a secondary structure with the lowest free energy. Hence, the problem of RNA secondary structure prediction is modeled as an energy minimization problem. Many algorithms have been developed to solve this problem. Existing algorithms can predict a secondary structure with pseudoknots in $O(n^4)$, $O(n^5)$ or $O(n^6)$ time, where n is the length of an input sequence. Moreover, prediction of an arbitrary planar secondary structure including pseudoknots is proven to be NP-hard [1].

We proposed an integer programming-based method of predicting RNA secondary structure with pseudoknots. Despite the theoretical drawbacks in computational complexity, it is practical and reasonable to model the prediction of pseudoknotted structure by integer programming.

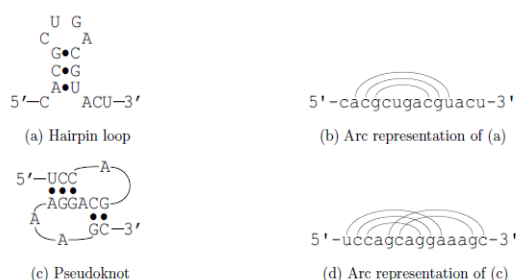


Fig.1 An example of RNA secondary structures.

A molecule of RNA can be viewed as a single strand of the nucleotides (bases) adenine (A), guanine (G), cytosine (C) and uracil (U). A-U, C-G and G-U can form a base pair via hydrogen bonding. Due to this property, an RNA strand can fold back on itself to form a secondary structure (Fig. 1).

2. Methodology

Integer programming (IP) is an optimization problem, which optimizes a linear function subject to linear equality and/or inequality constraints. An IP problem is

composed of decision variables whose values are to be decided in some optimal fashion and required to be integer, an objective function to be maximized or minimized, and a set of constraints, in the form of linear equalities and/or inequalities with respect to the decision variables.

We developed an IP-based method for RNA secondary structure prediction [4]. In the present abstract, we extended the method in order to cover a wider class of pseudoknots. Precisely, we extended the method so that all types of planar pseudoknots can be covered (see [3] for details). We also conjectured that secondary structure that can be described by simple linear tree adjoining grammar (SLTAG) [7] has a one to one correspondence with another IP formulation.

We used ILOG CPLEX 10.1, an IP solver software, to solve the IP model. Our IP-based method was intended to solve the energy minimization problem. We employed the stacking energy parameters for RNA folding at 37 °C as given in Mfold 3.0 [8].

3. Results and Discussion

The IP-based model was tested with the set of sequences with known structure from PseudoBase. We selected 34 sequences in different families (viral 3UTR, mRNA, rRNA, ribozymes and tRNA-like) and of various lengths (21-137 bases).

We evaluated the prediction results by sensitivity and specificity. We also compared our prediction accuracy with that of another algorithm called PKNOTS [5]. Although the overall average accuracy of the IP-based method is inferior to that of PKNOTS, we found that the average accuracy for the short sequences (length less than 37 bases) is comparable to that of PKNOTS. Specifically, average sensitivity of the IP-based method is 92.13%, while average sensitivity of PKNOTS is 79.80%. Average specificity of the IP-based method is 82.59%, whereas PKNOTS yields 91.77%. The results for short sequences show that our IP-based method is more sensitive than PKNOTS.

4. Conclusions and Recommendations for Thailand

RNA secondary structure prediction is helpful in RNA structure analysis because it help to reduce cost and time in laboratory process. For example, the research on AIDS, which is one of the major health problems in Thailand, revealed that mRNA secondary structure is generally believed to have roles in

the frameshift site of various HIV type 1 viruses. Therefore, mRNA secondary structure prediction and analysis are important for discriminating and indentifying the subtype of HIV type 1 viruses [2].

Recently, several studies concerning bioinformatics have been conducted in Thailand. Bioinformatics has been recognized as a key for technological development in biomedical and agricultural area by Thai government. Therefore, some financial support is offered to promote the research in this field [6]. This presented work provides a novel methodological contribution to bioinformatics, which would be important for the promotion of science in Thailand.

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Inhibitory Effect of Lime Powder as Natural Source of Potassium Citrate on *In Vitro* Calcium Oxalate Crystallization

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History in the past showed that the attempts to prevent stone formation have been conducted. The ability of urine to inhibit calcium oxalate (CaOx) crystallization is a prime mechanism against stone formation. Moreover, the therapeutic action of citrate salts on urolithiasis has widely been acknowledged as one of the consolidated practice. Citrus fruits, such as limes and lemons, are sources of natural citrate. These factors inspired us to study the effect of lime powder on CaOx crystallization. Sachets of Thai Lime powder were obtained and analyzed for compositions. After urinalysis, CaOx crystallization was studied using pooled 24-hour urine. The crystallization study was performed introducing various concentrations (0-2 mg/ml) of lime solution to the urine. Later, CaOx induction was done by the addition of sodium oxalate to reaction chambers. Crystals generated from the reaction were manually counted triplicate by a Neubauer counting chamber. CaOx structures were analyzed under light microscopy. The presence of lime solution decreased CaOx crystals in dose-dependent manner. Additionally, the highest inhibition ratio (37%) was observed at the highest concentration (2 mg/ml) of lime solution (8268.30 ± 2193.62 in 0 mg/ml Vs 5186.67 ± 1288.85 crystals/ml in 2 mg/ml of added lime, respectively). Under the light microscopy, CaOx crystals were found with both monohydrate and dihydrate forms. In conclusion, the presence of lime powder in urine inhibits the precipitation of CaOx crystals. The inhibiting mechanism on crystallization may due to crystal dissociation. Moreover, the lime powder may contain substances that assist in inhibiting calcium oxalate crystallization, apart from citrate. We suggested that consumption of lime powder might be beneficial in protection against urinary stone and recurrence.

1. Introduction

Kidney stone is a classical clinical disease affecting up to 10-12% in various parts of the world. The disease has been related with various factors including genetic, diet, as well as environment. The majority (about 80%) of stone found in human is comprised of calcium oxalate [1]. Crystallization is the very first step of the stone forming process. The balanced concentrations of promoters and inhibitors play key roles in the formation and dissociation of crystals as well as stones. Citrate has become one of the predominant therapeutic measures against stone formation [2]. Citrus fruits, such as limes and lemons, are sources of natural citrate [3]. These factors inspired us to study the effect of lime powder on crystallization

MilliQ water (Millipore, USA) to make 0.125, 0.25, 0.50, 1, and 2 mg/ml lime solution respectively. Two milliliters of pooled normal urine tubes were prepared, pre-incubated at 37°C. Lime solution was added into each tube following with 0.1 M sodium oxalate. After 30 minutes of incubation, solution was then mixed and inspected under light microscopy at room temperature. The percentage inhibition ration was calculated for *in vitro* effect of lime powder.

3. Results and Discussion

The water soluble citrate was 37 times higher than calcium and was 15,739 times higher than oxalate respectively. The number of calcium oxalate crystals decreased by adding lime solutions in a concentration-dependent manner. The highest percentage inhibition ratio (37.3%) reached at 2 mg/ml added lime solution, $p=0.028$). In all experimental tubes, the mixture of calcium oxalate monohydrate (COM) and calcium oxalate dehydrate (COD) were observed. The abundant crystals were found in control with some aggregations. However, in the presence of lime powder extract, the amount of crystals decreased. We also found the decrease of

2. Methodology

Lime powder was manufactured by the Pilot Plant Development and Training Institute, King Mongkut's University of Technology Thonburi, Bangkok, Thailand [4]. Briefly, limes were bought from local markets in Thailand and were squeezed, lyophilized, and packed in sachets (5 grams/sachet). Chemical composition analysis was performed. The produced lime powder was reconstituted with

crystal aggregates and size in the presence of lime powder extract.

The medical management of calcium urolithiasis depends on manipulating the balance of crystal promoters versus inhibitors. The conventional preventive measure is to achieve urinary dilution by enhancing urinary output. This reduces the urinary supersaturation which is a crucial step for crystal formation. Another measure is to supplement the urinary stone inhibitors. Among all, citrate salts has been the most clinically acknowledged. Increasing studies on lemon and citrus fruits prove the beneficial effect of citrus fruits, the natural resource of citrate, in prevention against stone formation and protection against the stone recurrence. Though the pH of lime as well as other citrus fruits is acidic, recent study showed that consumption of limeade based regimen in human alkalinized urinary pH as well as acquired the citraturic effects, and the antioxidative effect [5]. Since, the stone forming process is complicated, therefore, we focused on the very first step—the crystallization. The *in vitro* calcium oxalate crystallization in human urine under the condition employed in the present study produced a mixture of COM and COD. Most of the study showed the beneficial effect of adding substances on crystallization by transforming COM to COD which is more soluble in urine. Unlike other study about crystallization *in vitro*, we found that lime powder addition did not cause the change from COM to COD but rather dissolved the calcium oxalate crystals since the number of crystals decreased significantly and the amount of aggregate also decreased. This may be the strong potency of lime powder.

Citrate is one of the most prominent physiological modifiers protecting urine from precipitation of calcium salts, the formation of pathologically large crystals or aggregates, and also binding on the calcium oxalate crystal. The complexation of citrate to calcium forms a calcium-citrate-potassium complex $[\text{CaCitPO}_4]^{4-}$ whereas the complexation to the calcium oxalate forms a $[\text{CaOxCit}]^{3-}$ complex [6]. Lime powder also expressed the similar result against calcium oxalate nucleation. The possible mechanism regarding the effect of lime against calcium oxalate crystallization may be that citrate, which is rich in lime, forms complexes with free calcium ions prior to challenging with sodium oxalate solution as described in methodology.

4. Conclusions and Recommendations for Thailand

In conclusion, we demonstrated the potential ability of lime powder to decrease the urinary calcium oxalate crystallization *in vitro*. With our results contribute to those existed evidences and studies in the past to prove the beneficial effect of citrus fruits consumption on protection against stone formation and recurrence. Since the northeastern Thailand is the endemic area for stone disease, the advice to consume lime powder or limeade purchased from local markets should be useful for protection against stone recurrence. Further process to manufacture lime powder into capsule or easier consumable package is recommended.

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Characterization of the amino acid transporter in plant plastids

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In the genome of *Arabidopsis*, we found the putative aromatic amino acid transporter (AtAroT1) encoded by At5g19500 which is a homologue of *Escherichia coli* tyrosine permease (EcTyrP). Amino acid sequence analysis of AtAroT1 showed that it has 11 putative transmembrane domains and carries the plastidic targeting signal at its N-terminus. Uptake of tyrosine significantly increased in *E. coli* cells that mAroT1 (without targeting signal) was induced, whereas uptake of arginine, asparagine, or isoleucine was very low. Moreover, inhibition of tyrosine uptake was clearly observed only when phenylalanine, or tryptophan was added. The transient expression of AtAroT1-GFP in *Arabidopsis* culture cells showed the localization in the chloroplasts. In addition, AtAroT1 can be imported into the isolated pea chloroplasts by the *in vitro* protein import assay. These results suggest that AtAroT1 is involved in transport of aromatic amino acids in the chloroplasts. Besides, we found the E-rich domain between the targeting signal and the first TMD of AtAroT1. Comparing the protein import assay between the AtAroT1 containing the E-rich domain and lacking E-rich domain, we expected that the E-rich domain maybe play an important role in targeting of protein into the chloroplasts. Currently, the import property of the E-rich domain is underway.

1. Introduction

In multicellular organism, amino acids play fundamental roles in many processes such as protein synthesis, hormone synthesis, and cell growth. To maintain the various cellular functions, amino acids are transported between cells and within a cell. However, amino acid cannot pass through the biological membranes. Therefore, amino acids have to be transported via a mediator; that is, amino acid transporter. Like other organisms, the transport of nitrogen compounds is essential for plant growth and development and mediated by amino acid transporters. In the present, about 60 putative amino acid transporters were identified from *Arabidopsis thaliana* genomic database. Some of them have been studied and characterized. However, despite of the importance of plastids on the nitrogen fixation and amino acid biosyntheses, plastidic amino acid transporter has not been well-studied.

In the previous study in my laboratory, the putative aromatic amino acid transporter (AtAroT1) encoded by At5g19500 homologous to *Escherichia coli* tyrosine permease (EcTyrP) was found in the *Arabidopsis* genome. It has been shown that uptake of tyrosine was enhanced in *E. coli* overexpressing AtAroT1. Therefore, the objective of my study is to further characterize AtAroT1 to determine the molecular mechanisms, such as the localization within the cell, the direction of transport, topology, and the mode of transport.

2. Methodology

AtAroT1-GFP fusion construct under the control of the CaMV 35S promoter was introduced into the *Arabidopsis* culture cells. Expression of prAtAroT1-GFP fused protein was monitored by the fluorescent microscopy. The import properties and topology of AtAroT1 was examined by *in vitro* chloroplast protein import assay.

3. Results and Discussion

The alignments of amino acid sequences between AtAroT1 and EcTyrP show 23.8% identity and 42.2% similarity. Amino acid sequence analysis of AtAroT1 showed that it has 11 putative transmembrane domains and carries the plastidic targeting signal at its N-terminus. Inhibition of tyrosine uptake in *E. coli* cells overexpressing AtAroT1 was observed only when phenylalanine, or tryptophan was added. On the other hand, fluorescence microscopic observation revealed that AtAroT1-GFP was exclusively localized in the chloroplasts.

To determine whether the amino-terminal extension of AtAroT1 is serving as the plastidic targeting signal, the *in vitro* chloroplastic import assay was performed with the *in vitro* transcription/translation of truncated prAroT1 (Fig.1A). After incubation of truncated prAroT1 with isolated pea chloroplasts, two different length of prAroT1 proteins (Fig.1B, lanes 5 and 9) were imported into chloroplasts and processed to the two

mature forms of AtAroT1 (mAroT1) (Fig.1B, lanes 6 and 10) that were insensitive to proteases (Fig.1B, lanes 7, 8, 11, and 12), indicating that the amino-terminal extension is the plastidic targeting signal and prAtAroT1 is double-processed during import into chloroplasts

AtAroT1 carries the E-rich domain (EEEEDEEEE) between the plastidic targeting signal and the first TM domain of AtAroT1. To determine whether E-rich domain affect the import property of prAtAroT1, truncated prAtAroT1 deleting E-rich domain (prAtAroT1 Δ E(0)) (Fig. 1A) was constructed and applied for protein import assays. After import reaction, only one processing band was observed (Fig.1B, lanes 2-4). This result indicates that E-rich domain is playing an important role for the double processing of prAtAroT1.

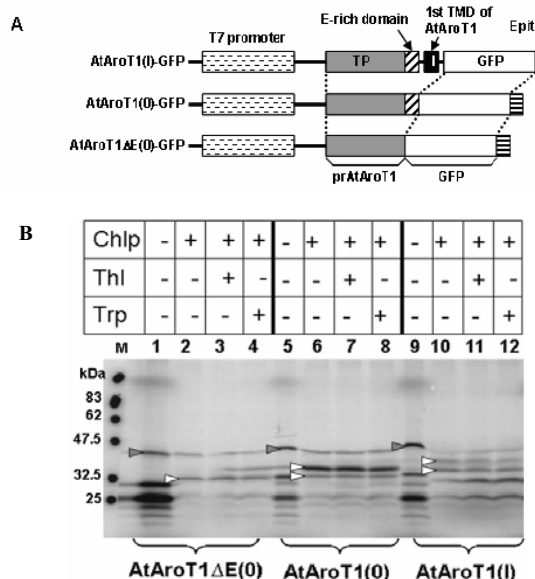


Fig.1 The *in vitro* import of AtAroT1 into chloroplasts. (A) Diagrams of GFP-fused AtAroT1 used in this study. (B) AtAroT1 Δ E(0) (lanes 1-4), AtAroT1(0) (lanes 5-8), and AtAroT1(I) (lanes 9-12) were incubated with the isolated pea chloroplasts under the import condition. Thermolysin and trypsin was added after import assay. Chl : Chloroplasts, Thl: Thermolysin, and Trp: Trypsin. Precursor proteins and imported proteins are denoted as “ $\blacktriangleright$ ” and “ $\blacktriangleleft$ ” respectively.

To further investigate the effect of E-rich domain on protein import, plastidic targeting signal (TP) of prAtAroT1(I)-GFP or prAtAroT1 Δ E(I)-GFP was replaced by TP of the precursor to the small subunit of Rubisco (prSS) which has been characterized as the plastidic protein. These constructs were applied

for protein import assays. The hybrid protein containing E-rich domain was imported into chloroplasts with the double processing. While another hybrid protein deleting E-rich domain only resulted in a single processing (data not shown). These results were the same results as the results of AtAroT1 with its own transit peptide shown in Fig.1B. These results confirmed that E-rich domain is important for the double processing. Currently, the import property of this E-rich domain has been determining in detail.

4. Conclusions and Recommendations for Thailand

At present, the amino acid industry has come to occupy an important role in world chemical industries. Thailand is an agricultural country and has a large population. Annual demand for amino acids used in feed additives and pharmaceutical products is huge. In Plants, amino acids can be biosynthesized and utilized as nitrogen transporters, nitrogen sources, precursors of secondary metabolites, and stress tolerance. Therefore, amino acids production and transport in plants are important in both physiological and biotechnological aspects. However, the information of amino acid transporter in plants is little known. As a result, I am interested in identification and characterization of amino acid transporters in plants.

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Identification of the Vacuolar Amino Acid Transporter Genes in Fission Yeast

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We have identified the *Schizosaccharomyces pombe* SPBC3E7.06c gene (*fnx2*⁺) from a homology search with the *fnx1*⁺ gene involving in G₀ arrest upon nitrogen starvation. Green fluorescent protein-fused Fnx1p and Fnx2p localized exclusively to the vacuolar membrane. Uptake of histidine or isoleucine by *S. pombe* cells was inhibited by concanamycin A, a specific inhibitor of the vacuolar H⁺-ATPase. Amino acid uptake was also defective in the vacuolar ATPase mutant, suggesting that vacuolar compartmentalization is critical for amino acid uptake by whole cells. In Δ *fnx1* and Δ *fnx2* mutant cells, uptake of lysine, isoleucine or asparagine was impaired. These results suggest that *fnx1*⁺ and *fnx2*⁺ are involved in vacuolar amino acid uptake in *S. pombe*. (Part of this article was published at the FEBS Letters)

1. Introduction

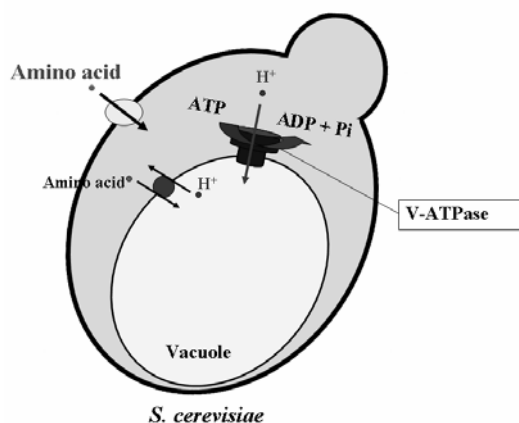


Fig.1 Schematic overview of amino acid transport into vacuole in *S. cerevisiae*

The yeast vacuole functions as a digestive compartment and also serves as the major storage compartment for amino acids, particularly basic ones. In *S. cerevisiae*, vacuolar membrane catalyzes active transport of a variety of amino acids; a process that is driven by a proton electrochemical gradient generated by the action of the proton pumping vacuolar ATPase being likely a secondary proton/amino acid antiporter (Fig.1). Recently some of the genes encoding amino acid transport were identified. AVT genes family is involved in transport of neutral amino acids [1] and VBA family of basic amino acids [2]. We focus on the *S. pombe fnx1* gene that has been discovered to play a role in G₀ arrest upon nitrogen starvation [3]. Here, we found two genes, *fnx1* and *fnx2* genes, in fission yeast, *S. pombe* that phylogenetically related to the *VBA2* gene of *S. cerevisiae*. Here we report that Fnx1p and its phylogenetic relative Fnx2p, are vacuolar membrane proteins in *S. pombe*, and are involved in vacuolar amino acid uptake. This is

the first identification of a vacuolar amino acid transporter in *S. pombe*.

2. Materials and Methods

S. pombe strains used in this study were ARC039, *fnx1*-deleted mutant, *fnx2*-deleted mutant, *fnx1/fnx2* double-deleted mutant and *vma1* deleted mutant (defective in subunit A of V₁ in V-ATPase). Localization of GFP-fused Fnx1p and Fnx2p was examined by fluorescence microscopy. Transport activity and the effect of concanamycin A were assayed by filtration method.

3. Results

The alignment of amino acid sequences of Fnx1p and Fnx2p (*S. pombe*) shows a close relationship to Vba2p (*S. cerevisiae*), which is involved in the uptake of basic amino acids into vacuoles. Fluorescence microscopic observation revealed that Fnx1p-GFP and Fnx2p-GFP located at the vacuolar membrane. Concanamycin A inhibited uptake of all these amino acids but not of 2-deoxy-D-glucose into *S. pombe* cells. The uptake activities of these amino acids decreased in the *vma1* mutant, which are nearly equal with those of concanamycin A-treated parent cells, showing that amino acid uptake by whole cells of *S. pombe* involves the transport into vacuoles. The uptake of lysine, asparagine and isoleucine was impaired in Δ *fnx1* mutant cells whereas the uptake of lysine and isoleucine impaired in Δ *fnx2* mutant (Fig.2).

In conclusion, Fnx1p and Fnx2p are involved in vacuolar transport of amino acids in *S. pombe* with a moderate specificity that Fnx1p mediates lysine, isoleucine or asparagine uptake, whereas Fnx2p mediates lysine or isoleucine uptake.

4. Discussion

The *S. pombe* proteins Fnx1p and Fnx2p are members of the multidrug permease (MDR), H⁺/drug cotransporter, family of the MFS superfamily, and are phylogenetically close to *S. cerevisiae* Vba2p. GFP-fused *fnx1*⁺ and *fnx2*⁺ products localized exclusively to the vacuolar membrane, suggesting that Fnx1p and Fnx2p are vacuolar amino acid transporters.

The question of how *fnx1*⁺ is involved in G₀ arrest remains an important one. We showed that *fnx1*⁺ and *fnx2*⁺ were involved in vacuolar amino acid uptake, especially for isoleucine and lysine. It is likely that overexpression of *fnx1*⁺ triggers a drop in cytoplasmic amino acid level, likely an inducing signal for starvation; we are now going to investigate the effect of overexpression of the *fnx1*⁺ and *fnx2*⁺ genes on G₀ arrest and the amino acid pool. In order to understand the physiological roles of the *fnx1*⁺ and *fnx2*⁺ genes, it is important to investigate changes in expression of these genes in response to nitrogen starvation. Such experiments might clarify the reason why no additional effect of the double mutation of *fnx1* and *fnx2* was observed on amino acid uptake. In any case, it is clear that vacuoles are critical for the storage of amino acids in *S. pombe*.

5. Conclusions and Recommendations for Thailand

The demand for amino acids is increasing year by year; their usage is diversified from food taste enhancer to medical uses and even to animal nutrition. The industrial production of amino acid is carried out mainly by fermentation through the use of overproducing microorganisms. All overproducing strains so far reported are manipulated in amino acid synthesis and/or its regulation. However, amino acid production in microorganisms is also balanced with transport process. I am interested in the role of amino acid transporter in amino acid production in microorganisms especially in yeast. Amino acid transport system is expected to enhance amino acid synthesis for maintaining the internal amino acid level.

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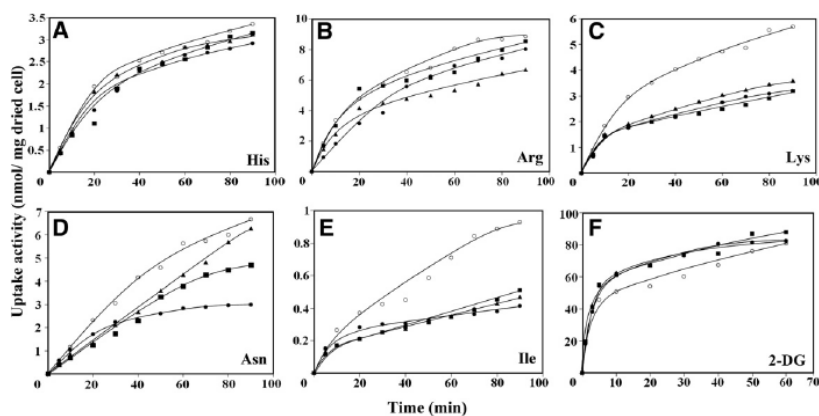


Fig. 2 Uptake of amino acids and 2-DG by *Δfnx1* and *Δfnx2* mutants. Uptake was measured in strains ARC039 (open circles), *Δfnx1* (closed squares), *Δfnx2* (closed triangles), and *Δfnx1Δfnx2* (closed circles)

Bioactive Aporphine Alkaloids from Aerial Part of *Stephania venosa* (Blume) Spreng

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Stephania venosa (Blume) Spreng is native to Thailand and commonly used for treatment of fever, asthma, diarrhea, dyspepsia, urinary complaints and other intestinal. In this study, five aporphine alkaloids, s-(-)crebanine (**1**), dehydrocrebanine (**2**), 4,5-dioxodehydro crebanine (**3**), oxostephanine (**4**), and thailandine (**5**) were isolated from the hexane and methanolic extract of the aerial parts of this plant. The structures of these compounds were elucidated by spectroscopic techniques and comparison to literature data. Biological activities including cytotoxicity (against KB and BC cell line), antimalarial (*Plasmodium falciparum*) and antimycobacterium tuberculosis H₃₇Ra were examined. Thailandine (**5**) was found to have promising cytotoxicity against KB cell lines with IC₅₀ value of 0.88 µgml⁻¹ without any cytotoxic activity against human vero cell (IC₅₀ > 50 µgml⁻¹). Moreover, thailandine (**5**) showed significant antiplasmodial activity against *Plasmodium falciparum* with IC₅₀ of 19.3 ngml⁻¹ as well as antimycobacterium tuberculosis with a MIC of 6.25 µgml⁻¹.

1. Introduction

The genus *Stephania* is a member of the Menispermaceae plants family that is a rich source of alkaloids. Some of the most extensively studied members of this family belong to the genus, *Stephania*, and are native to Africa, India, South-East Asia and the northern and eastern parts of Australia. The use of plants of the genus *Stephania* in the treatment of medical ailments is widespread in the traditional medicine of Asia and Africa. *Stephania venosa* (Blume) Spreng is native to Thailand and commonly used for treatment of various ailments under the local name “sabu leaud”. A characteristic feature of this climber is the red liquid emanating from the large tuber, the long stem and the leaves. In term of previous reports on the chemical compositions of this species, various alkaloids have been isolated with antimalarial and anti-cholinesterase activity.

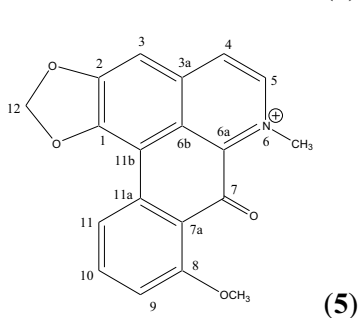
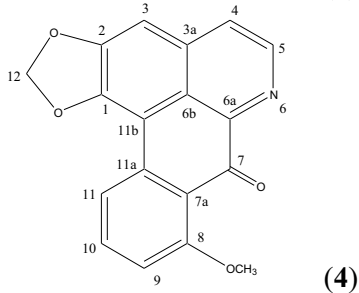
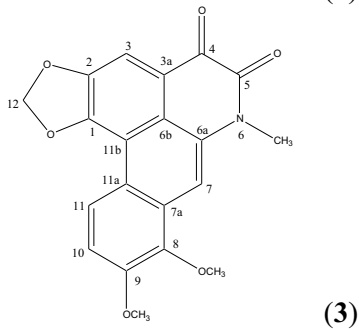
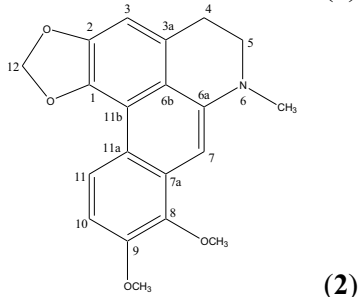
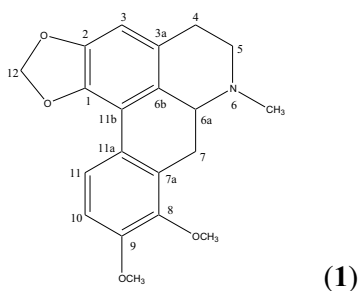
2. Methodology

Dried tuber of *Stephania venosa* (Blume) Spreng was powdered and extracted with an order of solvents n-hexane, ethyl acetate and methanol. The extracts were filtered and then concentrated using a rotary evaporator to give brown semi-solid, brown semi-solid and black semi-solid, respectively. Fresh-leaves of *Stephania venosa* (Blume) Spreng were extracted with an order of solvent ethyl acetate and methanol. The extracts were filtered and concentrated using a rotary evaporator to

brown-green semi-solid and give greenish semi-solid, respectively. Preliminary fractionations of the crude extracts were carried out using column chromatography and were further purified by flash column chromatography and/or preparative thin layer chromatography.

3. Results and Discussion

After repeated purification with column chromatography and/or PLC (Preparative thin layer chromatography), s-(-)crebanine (**1**), dehydrocrebanine (**2**), 4,5-dioxodehydro crebanine (**3**) were isolated from the hexane extract of the dried tuber whereas oxostephanine (**4**), and thailandine (**5**) were isolated from the ethyl acetate and methanol extracts of the leaves. The structures of the isolated compounds were identified by spectroscopic methods as well as comparison with the published data. Furthermore, thailandine was obtained in high yield providing a good source to explore new biological activity and/or further chemical transformation in order to enhance its activity.



4. Conclusions and Recommendations for Thailand

The medicinal plants is widely found and used in Thailand. This survey shows that the *Stephania* plants are capable of producing a wide range of interesting secondary metabolites. In reality only a comparatively small proportion of these species has been pharmacologically and biologically examined. It is certain that much novel chemistry and pharmacology is waiting to be uncovered in the future.

Acknowledgement

We are grateful to Graduate School, Kasetsart University for Thesis and Dissertation Supported fund. Grateful acknowledgements are also extended to the Chulabhorn Research Institute and Department of Chemistry, Kasetsart University for support and assistant during this work.

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Phylogenetic Relationship between Two Rust Fungi on *Allium* Species in Japan

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To study the relationship between rust fungi *Puccinia allii* and *Uromyces durus*, molecular phylogenetic analysis was carried out based on sequences of D1/D2 of 28S rDNA and ITS2 regions. Specimens used in this study were collected from various areas in Japan. The specimens were observed under light microscope and scanning electron microscope to clarify morphological characteristics of urediniospores and teliospores. As a result, specimens of both species were divided into two phylogenetic groups which were supported by high bootstrap values. However, specimens of both species were not separated into these two groups and were present in both groups. This result could not support the morphological differences between two species which were mainly classified based on the cell number of teliospore. Furthermore, phylogenetic analysis showed that the specimens on *A. fistulosum* and *A. schoenoprasum* var. *foliosum* belong to a different group from specimens on *A. tuberosum* but the specimens on *A. grayi* belong to both groups. Moreover, the morphology of urediniospores of these two groups showed high similarity in spore size; wall thickness and number of germ pore, but spine density was a slight different each other. Therefore, taxonomic revision of these two species should be required.

1. Introduction

The genus *Allium* contains a number of species that are world - wide cultivated as vegetables, medicinal plants and natural pest repellent plants. Rust fungi on *Allium* species are distributed widely in the world and cause serious damage on these cultivated plants such as *A. fistulosum* (welsh onion), *A. cepa* (onion), *A. cepa* var. *ascalonicum* (shallot), *A. sativum* (garlic), *A. schoenoprasum* (chives), *A. porrum* (leek) and *A. chinense* (rakkyo). In Japan 4 species of rust fungi on *Allium* species have been reported. There are *Uromyces japonicus*, *U. alli monanthi*, *U. durus* and *Puccinia allii*. Among them, 2 species, *U. durus* and *P. allii* are very similar to each other in host range, life cycle and morphology though they belong to different genera. Phylogenetic hypothesis among five species of *Allium* rust fungi based on life cycle and morphology was proposed. Hiratsuka and Hiratsuka (1) concern that the evolution of *U. durus* developed from *P. allii*. Therefore, these two species are closely related to each other.

2. Methodology

2.1 Material

Specimens were collected from various areas in Japan. Dry specimens borrowed from the Hiratsuka Herbarium (HH), the Mycological Herbarium of the Graduate

School of Life and Environmental Science, University of Tsukuba (TSH), the Herbarium of Systematic Mycology, Ibaraki University (IBA), the Herbarium Hirosaki University (HU) and National Museum of Nature and Science, Tsukuba (TNSF) were used for analysis.

2.2 Morphological observations

The specimens were observed under light microscope and scanning electron microscope to clarify morphological characteristics of urediniospores and teliospores. For each specimen, fifty spores were randomly chosen and five characters of urediniospores; length, width, wall thickness, number of germ pore and spine density and four characters of teliospores i.e. length, width, wall thickness and apical thickness were measured.

The specimens with teliospores were able to identify based on Hiratsuka et al (2).

2.3 Molecular phylogenetic analysis

For molecular phylogenetic analysis, DNA was extracted from about 150–200 urediniospores or teliospores. The spores were crushed between two sterile glass slides and then suspended in extraction buffer and incubated. Then, PCR amplification, sequencing, alignment and analysis were done. The DNA database of *P. allii* from the GenBank were aligned together with all specimens

3. Results and Discussion

After the identification of specimens based on Hiratsuka et al (2), only specimens with teliospore were able to identify. In this study, the teliospore were found only in 23 specimens. 13 specimens identified as *P.allii* have high % of 2- cell teliospore and 8 specimens identified as *U. durus* have only one celled teliospores. The specimens without teliospore could not be identified.

For molecular analysis, specimens of both species were divided into two phylogenetic groups (Group A and Group B) which were supported by high bootstrap values (Fig. 1). However, specimens of both species were not separated into two groups and were included in these two groups. This result could not support the morphological differences between two species which were mainly classified based on the cell number of teliospores. Furthermore, phylogenetic analysis showed that the specimens on *A. fistulosum* and *A. schoenoprasum* var. *foliosum* belong to a different group from specimens on *A. tuberosum* but the specimens on *A. grayi* belong to both groups. Moreover, the morphology of urediniospores of these two groups showed high similarity in spore size; wall thickness and number of germ pore, but spine density have a slight different each other (Fig. 2). Therefore, taxonomic revision of these two species should be required.

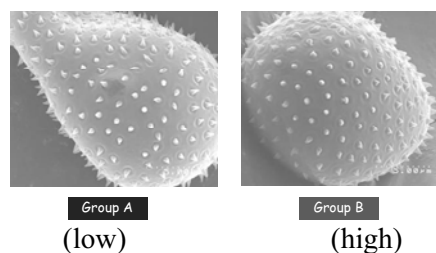


Fig. 2 Spine density of specimens

4. Conclusion and Recommendation for Thailand

Rust fungi are important pathogens of native and cultivated plants and cause serious damages of economically important plant in Thailand such as wheat, corn, coffee, soybean and onion. The molecular phylogenetic analysis is a useful tool to identify the important pathogens and study the relationship among closely related and morphologically similar rust fungi.

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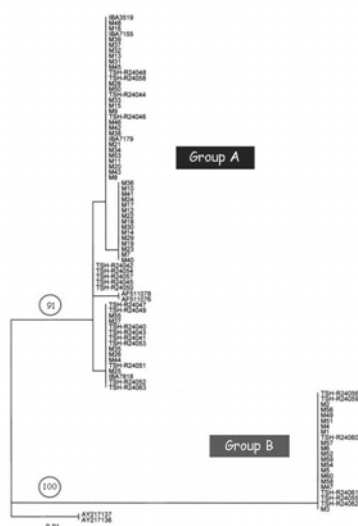


Fig. 1 A maximum-likelihood tree inferred from sequences of D1/D2 regions

Rapid Determination of Bacterial Contamination in Shredded Cabbage using Dissolved Oxygen Sensor

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The possibility of oxygen electrode for determination of bacterial contamination in shredded cabbage was investigated. The relationship between respiration rate of bacteria and its bacterial cell count was examined. Two types of extract solutions were used as samples: one was the solution containing Tryptone Glucose Extract Broth and the other was the solution without the broth. Dissolved oxygen (DO) in the extract samples were continuously measured for 2 hours at 30 °C. The decreasing rate of DO, as the oxygen consumption rate, was used to be as an index for bacterial contamination in shredded cabbage. The rate of DO decrease seemed to have weak correlation with the bacterial contamination in the extract samples without media. The samples containing media measured more than 90 minutes provided a reasonable bacterial prediction efficiency ($r \geq 0.90$). The measurement of DO with an oxygen electrode was clarified to be a rapid and simple method for prediction of bacterial contamination in shredded cabbage.

1. Introduction

Production and consumption of fresh-cut vegetables have been growing rapidly in recent years. However, one of the most crucial problems of this product is its short shelf life because of the rapid deterioration caused by micro-organisms [1, 2]. For this reason, in this study, a dissolved oxygen (DO) sensor was used for determination of bacterial contamination in shredded cabbage as a rapid and convenient method. As the Total Bacterial Count (TBC) is an important index of food safety test, the feasibility of the DO sensor on the prediction efficiency of TBC in shredded cabbage was evaluated.

2. Methodology

Sample: Head of cabbage purchased at a local supermarket was shredded into 2-mm slices using slicer and used as samples. Samples were kept in storage room at 10°C to obtain various levels of bacterial contamination.

Sample extraction: A sample weighing 10 g was combined with 60 mL of sterilized 0.85% saline solution, pummeled with a stomacher for 2 minute and drained. Then, the drained solution was divided into halves (30 mL each). For the DO measurement, two types of extract solution samples were used. The first one (called 'Extract A' hereafter) was obtained from mixing 30 mL of drained solution with 15 mL of sterilized saline solution. The second one (called 'Extract B' hereafter) was obtained from mixing the other half of drained solution with 15 mL of sterilized 5.4% Tryptone Glucose Extract Broth (Difco™ TGE Broth). Fifteen-mL of each extract sample was kept in

a sterile sample bottle [25(Ø) x 5(h)mm]. Prior to the DO measurement, 1mL of each sample was divided for microbiological test.

Conventional microbiological analysis: Serially diluted extract solution sample was inoculated onto the Petrifilm "Aerobic Count Plate" (3M™, USA) and incubated at 35°C for 48 hours. The number of bacteria was expressed as log CFU g⁻¹.

Dissolved oxygen measurement: A Galvanic type dissolved oxygen electrode (ABLE & Biott Co., Ltd.) connected to an electrochemical analyzer (Fig.1) was used to measure an electrical current which has a linear relationship with DO concentration. The analysis was done by immersing a bottle containing sample into water maintained at 30°C and measuring the current with stirring for 2 hours. All procedures were performed under sterilized condition. Prediction efficiency of bacterial determination of the measuring periods for 45, 75, 90 and 120 minutes were calculated.



Fig.1 Experimental setup.

3. Results and Discussion

Dissolved oxygen (DO) in extract solution samples were measured as the electrical current values continuously for 2 hours at temperature of 30°C. Figure 2 shows the currents changed during the analysis of Extract A and B. The current of Extract A decreased in the first hour and seemed to reach a steady-state that might be a result of the diffusion of oxygen from the solution was becoming almost equal to oxygen consumption by bacteria which did not capably grow without the additional media. However, the current output of Extract B was markedly decreasing during the analysis for 2 hours which showed the reduction of dissolved oxygen in solutions as a result of aerobic respiration and growth of contaminated bacteria. The bottom line, the fastest decreasing rate, in Figure 2B came from sample of 5.2 log(CFU/g), while the upper ones obtained from the less bacterial amount. Differences in the initial amount of bacteria caused differences in the rate of current decrease, the slope of the linear regression line, suggesting that the measured rate of current change had a potential to provide an estimate of the amount of bacterial contamination. Table 1 shows the prediction efficiency of bacterial determination of Extract A and Extract B. Using Extract A, the rate of current decrease had a weak correlation with the log TBC ($r \leq 0.30$). It might be a result of incapable growth of bacteria caused a low rate of oxygen consumption. On the other hand, the rate of current decrease measuring from Extract B seemed to have a reasonable relationship with the bacterial amount with the analysis time of more than 90 minutes ($r \geq 0.90$). The highest correlation coefficient could be obtained with the measuring time of 120 minutes ($r = 0.91$) (Fig.3). It was indicating that the additional culture media was necessary for the determination of bacteria in shredded cabbage as it could allow the bacterial growth to make a stable rate of oxygen consumptions during the DO measurement.

Table 1 Prediction efficiency of bacterial contamination by using Extract A and B.

Type of sample	Correlation coefficient (r)			
	45 min	75 min	90 min	120 min
Extract A	0.28	0.21	0.21	0.14
Extract B	0.62	0.89	0.90	0.91

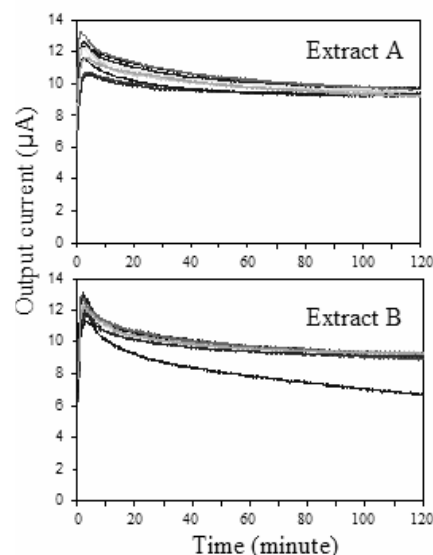


Fig.2 Changes of output current of Extract A and B during analysis for 2 hours.

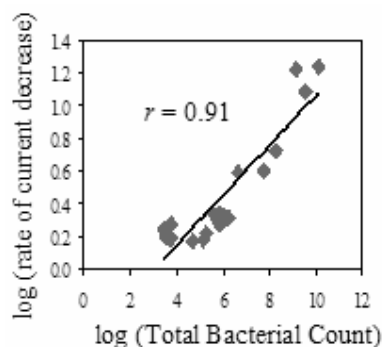


Fig.3 Prediction efficiency of bacterial determination in Extract B after measuring for 2 hours.

4. Conclusions and Recommendations for Thailand

The decreasing rate of DO; i.e. the oxygen consumption rate, measured by a DO electrode sensor serves as an index for bacterial contamination in food. The DO measurement has a potential to determine the bacterial contamination in shredded cabbage as a rapid method. This research seemed to be useful to apply for the determination of bacterial contamination in agricultural products of an agricultural country as Thailand.

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Solid Extraction Study of Antioxidants from Tamarind Seed Coat

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The antioxidant was extracted from tamarind seed coat (*Tamarindus indica* L.) cultivated in Thailand by various organic solvents and temperatures in water bath and ultrasonic bath. The antioxidant properties, including 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity, reducing power, and ferrous ion chelating ability, were evaluated and compared with trolox, water-soluble derivative of vitamin E with potent antioxidant properties. Results showed that the ultrasonic extraction of tamarind seed coat at 40°C using methanol as extracting solvent was found to possess the strongest antioxidant activities. The antioxidant activity of tamarind seed coat extracts was concentration dependent, with stronger inhibition of lipid oxidation occurring at higher concentrations of the extracts. The DPPH radical scavenging activity and reducing power of methanol extract were close to trolox and they were excellent at 0.05 and 0.5 mg/ml, respectively. The methanol and ethanol extracts showed 85.08 and 82.03% ferrous ion chelating ability at 0.5 mg/ml, while the ethyl acetate extracts barely showed any DPPH radical scavenging activity, reducing power, and ferrous ion chelating ability.

1. Introduction

The oxidative deterioration of fats and oils in foods is responsible for rancid odors and flavors, with a consequent decrease in nutritional quality and safety caused by the formation of secondary, potentially toxic compounds such as aldehyde and ketone. The addition of antioxidants is required to preserve flavor and color and to avoid vitamin destruction. Agricultural and industrial residues are attractive sources of natural antioxidants. Tsuda *et al.* [1] has attempted to extract antioxidants and studied some functional properties of the extracted antioxidants. Antioxidant activity of tamarind seed extract was investigated. There was no activity in the extract prepared from germ. The seed coat extract was powerful antioxidants owing mainly to methyl 3,4-dihydroxybenzoate, (-)epicatechin, 2-hydroxy-3',4'-dihydroxyacetophenone and 3,4-dihydroxyphenyl acetate. Pumthong [2] found that the polyphenolic antioxidant isolated from tamarind seed coat had the chemical characteristics and absorption spectra, which were similar to oligomeric proanthocyanidin (OPC). However, data from scientific angle is still lacking and there is a need for better utilization than as a mere by product of little value or as a waste material.

2. Methodology

The extraction was performed with a 0.5 g of tamarind seed coat powder (*Tamarindus indica* L.) and 5 ml of solvent in a tube. Methanol, ethanol and ethyl acetate were used as extracting solvents. The tubes were

conducted for 1 hour in ultrasonic bath or water bath, in which mechanical shaker was used during the extraction. At the same time the temperature of the water bath and ultrasonic bath could be set according to the experimental design at 30, 35, 40 and 45°C. The extracts were filtered and tested for antioxidant properties including 1,1-diphenyl-2-picrylhydrazyl (DPPH) radical scavenging activity [3], reducing power [4] and ferrous ion chelating ability [5].

3. Results and Discussion

The ultrasonic extraction at 40°C using methanol as extracting solvent was found to possess the strongest antioxidant activities (Fig.1). The antioxidant activity of tamarind seed coat extracts was concentration dependent, with stronger inhibition of lipid oxidation occurring at higher concentrations of the extracts. The DPPH radical scavenging activity and reducing power of methanol extract were close to trolox and they were excellent at 0.05 and 0.5 mg/ml, respectively. (Fig.2 and 3) The methanol and ethanol extracts showed 85.08 and 82.03% ferrous ion chelating ability at 0.5 mg/ml, while trolox hardly carried the ferrous ion chelating ability due to its chemical structure property. The ethyl acetate extracts barely showed any DPPH radical scavenging activity, reducing power and ferrous ion chelating ability. (Fig.1, 3 and 4)

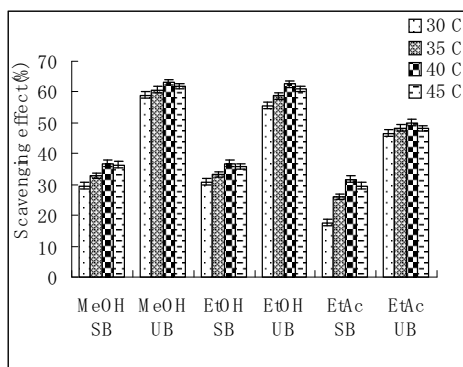


Fig. 1 Comparison of water bath and ultrasonic bath extraction efficiency of tamarind seed coat extract (MeOH-Methanol extract 0.025 mg/ml, EtOH-Ethanol extract 0.025 mg/ml, EtAc-Ethyl Acetate extract 2 mg/ml, SB-Water Bath, UB-Ultrasonic bath)

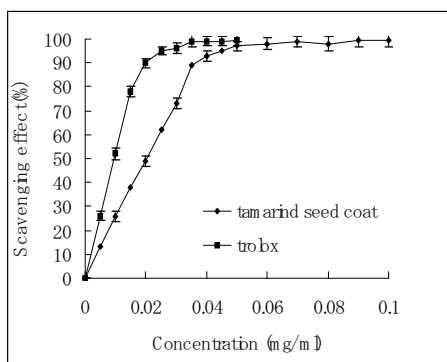


Fig. 2 Scavenging effect of methanol extract from tamarind seed coat on DPPH radicals

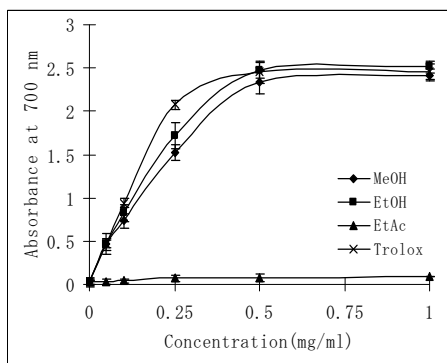


Fig. 3 Reducing power of the extracts using various solvents in comparison with trolox

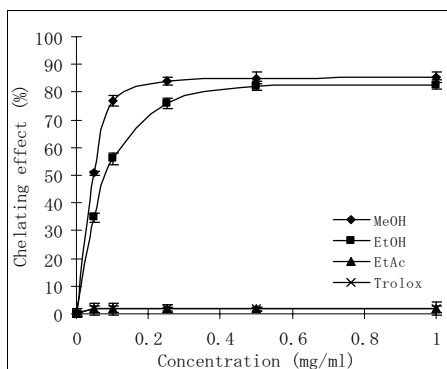


Fig. 4 Ferrous ion chelating power of the extracts using various solvents in comparison with trolox

4. Conclusions and Recommendations for Thailand

It is clearly that tamarind seed coat has significant antioxidant activity against various lipid oxidation systems *in vitro*. The antioxidants can be extracted by ultrasonic extraction at 40°C using methanol as solvent. The antioxidant activity of tamarind seed coat extracts was concentration dependent, with stronger inhibition of lipid oxidation occurring at higher concentrations of the extracts. The possible antioxidant mechanisms of the extract include scavenging of free radicals, reducing power and ferrous ion chelating activity.

Having established the antioxidant activity in these tamarind seed coat extracts, the chemical characteristics of the antioxidative components in the extracts, *in vivo* evidence, and the antioxidant potential in food systems will be further investigated.

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Educational Drive of Tokyo Tech towards Human Resource Development in Thailand

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Industrial demands for human resource development are seen to initiate transnational higher education in Thailand. The international programs of co-operated graduate school, TAIST Tokyo Tech is the outcome of decades of academic exchange/research cooperation under mutual benefit between Tokyo Tech and Thai universities/institutions. It is an opportunity of Thailand to learn from Tokyo Tech in pursuing a world-class university. Expectedly, TAIST will attract more supports by becoming a marketable hub of technology-based human resources with skilled international communication.

1. Background

Initiation of Thailand Advanced Institute of Science and Technology (TAIST) is an attempt of National Science and Technology Development Agency (NSTDA) to commence a virtual graduate school where advanced technological capabilities are locally fostered to support sustainable competitiveness of Thailand. TAIST provides the unique gateway bridging state-of-the-art facilities of NSTDA to graduate students of domestic universities under qualified instruction and transnational supervision supplemented from the renowned overseas universities. With the cooperation of Tokyo Institute of Technology (Tokyo Tech), TAIST Tokyo Tech remarks the first kind of the international cooperation undertaken by NSTDA and network institutes on the platform of the Thailand National Science, Technology and Innovation Act recently enacted in 2008. This perspective of multi-lateral collaboration highlights the outcome of long-standing ties between Tokyo Tech, NSTDA and Thai universities/institutions. Tokyo Tech' expertise in research oriented education is seen to reinforce Thailand's academic strengths and growing international educations in vital strategic fields which particularly focused on Automotive Engineering, Information and Communication Technology, Environmental Engineering, and Biotechnology. This article aims to report the active roles of Tokyo Tech which has contributed to Thailand toward the enhancement of scientific and technological human resource development.

2. Portfolios of past collaborations

Establishment of strong partnerships with leading Thai universities and research institutions can be dated back from 1985 to dates via Academic Cooperation Agreements as listed in Table 1. With NSTDA, agreement on lecture provision and office set-up was achieved in March 2002. Since the inauguration of Tokyo Tech Office (Thailand) established in Thailand Science Park, various and diversified collaborations between Tokyo Tech and Thai partners have been prosperously initiated. Tokyo Tech's drive toward educational collaboration to Thailand has gradually been gaining well-known. Frequent visits from Thai universities, organizations and government delegates are remarkably observed.

Table 1 List of Academic Cooperation Agreements with universities and institutions in Thailand

Universities/ Institutions	Date
Chulalongkorn University (CU)	Oct. 1985
King Mongkut's Institute of Technology Ladkrabang (KMITL)	Nov. 1992
Thammasat University (TU), Sirindhorn International Institute of Technology (SIIT)	Mar. 1996 Jun. 2000
Kasetsart University (KU)	Nov. 1996
National Science and Technology Development Agency (NSTDA)	Sep. 2001
King Mongkut's Institute of Technology North Bangkok (KMITNB)	Jan. 2005
Asian Institute of Technology (AIT)	Dec. 2005
King Mongkut's University of Technology Thonburi (KMUTT)	Oct. 2007

The official visit of Her Royal Highness Princess Maha Chakri Sirindhorn to see the rescued robot demonstration on October 21st, 2006 at Tokyo Tech is our highest honor. Also, the outstanding robotic technology was showcased at the Science and Technology week in Thailand. Tokyo Tech exhibits poster panels and technical demonstrations in the Science and Technology week every year since 2002. Tokyo Tech played an important role to co-organize IDC-ROBOCON'07 in Bangkok during August 6-18, 2007 as well (see Fig. 1).



Fig. 1 Posters exhibited in Thailand Science and Technology Week 2007 (left: TAIST Tokyo Tech, middle: IDC ROBOCON, right: Robotics)

Table 2 List of technical workshops and symposia held between Tokyo Tech and NSTDA

Workshops/Symposia	Date & Venue
Thailand-Japan's new frontier on advanced R&D in science and technology symposium	2004/4/17 Tokyo Tech
The 1 st automotive engineering conference	2006/8/21-22 NSTDA
Tokyo Tech-NSTDA forum	2006/11/20-21 Tokyo Tech
Tokyo Tech seminar in Bangkok on partnership with industry	2007/12/14 NSTDA
Environmental engineering forum	2008/6/13 NSTDA

3. Achievements toward TAIST Tokyo Tech

Tokyo Tech Office (Thailand) is emerged as a focal point of educational collaboration across two nations. Series of technical workshops and symposia have been held between Tokyo Tech and NSTDA since 2004 (see Table 2) along with several meetings to exchange dialogues on possibility of educational cooperation. Sub-agreement of MOU on a joint graduate program between KMITL, SIIT, NSTDA and Tokyo Tech was successfully concluded in 2006 (see Photo 1). In the consecutive year, the inaugural of TAIST Tokyo Tech was realized (see Photo 2). Master of Engineering in Automotive Engineering was firstly launched in June 4, 2007 following by Master of Engineering in Information and Communication Technology for Embedded Systems (ICTES) in June 13, 2008 (see Photo 3).



Photo 1 Signing ceremony of MOU on the cooperation in the first phase of a joint graduate institute (2006/12/26)



Photo 2 Grand Opening Ceremony of TAIST Tokyo Tech (2007/9/3)



Photo 3 Opening ceremony of ICTES program of TAIST Tokyo Tech (2008/6/13)

4. Conclusions and recommendations

Development of TAIST Tokyo Tech is introduced as the new collaborative disciplines to educate talented graduates with developing creativity. Still, the significant barriers are lack of long-term financial supports with can weaken the attractiveness of the programs. To attract more funds from authorities and private sectors, it is a challenge of TAIST to show potentials by feeding high quality of young generations to meet industrial demands.

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Outlooks of Tokyo Tech Educational Field Trip in Thailand

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Japan's education has served as a driving force behind the success of industrial development. To foster robust human resources who will serve vitality growth of Japan, Tokyo Tech is conducting the particular program under the perspectives of MEXT. Educational field trips to overseas are provided to the targeted students. 7 students visited to 3 universities, 3 research and development organizations, 4 manufacturing plants, 2 government authority and state enterprise, 2 cultural and historical sites as well as 1 program of student exchange activity in Thailand during August 27 – September 3, 2008. It is expected students can learn various things and gain a better understanding about international community.

1. Objectives

With an aim to strengthen Science and Mathematics ability of young talents under the project sponsored by MEXT (Ministry of Education, Culture, Sports, Science and Technology), Tokyo Tech has innovated the particular academic programs to promote students' creativity and leadership. Visiting to overseas universities and organizations is one of the activities to reach the targets. Educational field trips are provided during summer vacation to Bachelor students who joined the program and were successfully selected by the university. 23 students from the 1st year of Bachelor program accompanied by 8 doctoral students and 5 professors have already visited to 5 countries in 2007; Philippines (19-27 Sep.), China (13-18 Sep.), England (23-30 Sep.), Korea (2-7 Sep.), New Zealand (8-14 Sep.). Despite of short period, it was found that students realized the importance of international communication using English and raised their motivation in studying Science and Engineering. Moreover, the field trip can raise student's aspiration to further study in overseas and join international exchange programs. To continue the activities from last year, a schedule to visit Thailand was initiated as one of visiting countries in 2008. The schedule is planned to provide students with knowledge about Thailand on higher education at universities, various fields of industries, local research and development, roles of government authorities as well as cultural and historical backgrounds. The objectives of this article are to report our activities which are seen to more or less reach the targets of the program.

2. Schedules in Thailand

7 students from various departments ranging from Civil Eng., Mechanical Eng., Material Science, Biotechnology and Physics

participated to the field trip. 4 are from the 1st year, 2 are from the 2nd year of Bachelor program. One student from the 2nd year of Doctoral program is an assistant. Most students have never been in Thailand or foreign countries thus being enthusiastic. The schedule is listed in Table 1. Photos 1-14 show their activities during 27 Aug.-3 Sep. 2008.

Table 1 Schedules of field trip in Thailand 2008

Date	Programs
8/27	Bangpakong Power Plant, Electricity Generating Authority of Thailand (EGAT)
	JAYSES (Japan-Asia Young Scientist and Engineer Study Visit) forum at Kasetsart University with Thai and Indonesian
8/28	Chulabhorn Research Institute
	Laboratory Classes at Sirindhorn International Institute of Technology (SIIT)
8/29	Plant of Boonrawd Brewery Co., Ltd.
	National Science and Technology Development Agency (NSTDA), Tokyo Tech Office (Thailand)
	Plant of Thai Industrial Gases Co., Ltd.
8/30	Cultural tour: Rattanakosin Area
8/31	Historical tour: Ayutthaya World Heritage
9/1	Bangkok Metropolitan Authority (BMA)
	Energy drink plant of Osotspa Co., Ltd.
9/2	Software Park Thailand
	Foundation English Class at KU
9/3	Plant of Summit Auto Body Co., Ltd.
	Laboratories of Department of Civil Engineering, Chulalongkorn University
	Advanced Structural Engineering Class at Kasetsart University

3. Consequences of Field Trip

3.1 Power Plant: Students visited Bangpakong plant which is the biggest thermal/combined cycle power generating system in Thailand

3.2 JAYSES Forum: Students shared their ideas to discuss with international students in JAYSES forum which is the international exchange program organized by Tokyo Tech.

3.3 Chulabhorn Research Institute: Students observed the most advanced research facilities in toxicology and bio-chemistry in Thailand.

3.4 SIIT: Students joined two computer laboratory classes at SIIT's Bankadi campus.

3.5 Boonrawd Brewery: Students perceived brewery processes of Singha beer which obtains the largest market share in Thailand.

3.6 NSTDA: Students visited Tokyo Tech Office and recognized the role of NSTDA.

3.7 Thai Industrial Gases: Students learned gas mixing processes and quality control of TIG which is the biggest plant in Southeast Asia.

3.8 Rattanakosin and Ayutthaya: Students enjoyed Thailand's richness of cultural heritage while learning the history of Thailand.

3.9 Environment Office, BMA: Students were lectured about environment policies and functions of BMA on water, air and waste.

3.10 Osotspa: Students saw manufacturing processes of an energy drink M-150 which gains the largest market share in Thailand.

3.11 Software Park Thailand: Student understood the role of incubator for software industry development in Thailand.

3.12 SAB: Students observed one of Thailand's biggest automotive parts manufacturers.

3.13 CU: Students listened to a presentation about research collaborations with Tokyo Tech and visited to laboratories in Dept. Civil Eng.

3.14 KU: Students presented the introduction of Tokyo Tech while doctor student presented his research outcome in Advanced Structural Engineering Class of Dept. Civil Eng. Students also attended to Foundation English Class taught in the Faculty of Humanities.

4. Recommendations for Thailand

This field trip may be benefit to Thailand as a showcase to attract Tokyo Tech students to join the inter-university student exchanged program because Tokyo Tech have been concluded Academic Cooperation Agreements with 8 universities and institutes in Thailand.



EGAT's Power Plant



JAYSES Forum



Chulabhorn Res. Inst.



SIIT



Boonrawd Brewery



NSTDA



Thai Industrial Gases



Ayutthaya



BMA



Osotspa



Software Park Thailand



Summit Auto Body



Chulalongkorn Univ.



Kasetsart Univ.

Photos 1-14 Activities of students during field trip

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Reverse Brain Drain Project (RBD) Under National Science and Technology Development Agency (NSTDA)

Mission

To promote collaboration between NSTDA and overseas partners; through joint R&D projects, technology transfer and other joint activities through focused clusters and research programs (Strategic Planning Alliance - SPA), by having cooperation with overseas Thai professionals and their networks.

RBD alliance and Network

- Disseminate and exchange information about Thailand's needs to NSTDA's alliance and networks both inside and outside Thailand
- Work closely with RBD's partners especially Commission on Higher Education and Ministry of Science and Technology to strengthen the activities of overseas Thai professionals/ students that benefit all concerned parties
- Form joint R&D programs, exchange and education program

The RBD Office under NSTDA has been developing ways to make it possible and beneficial for Thai professional living and working overseas to participate in the RBD program. Below are the main activities of RBD that Thai professional from overseas can participate to help our homeland.

1. Special Projects Program: You can propose or suggest new joint projects (team up with Thai counterpart) and send them to RBD Office (email: rbd@nstda.or.th). RBD will coordinate and send the proposals to CPMO (Cluster & Program Management Office) of NSTDA. CPMO will review the proposals and inform RBD of the granting decision.

To qualify as a special project, the project should conform to CPMO's proposal guideline and having the following 4 characteristics

- Be pioneering and innovative for Thailand
- Have great potential to help Thailand improve its competitiveness
- Lead to commercializable/usable outcome or products: and
- Use knowledge and expertise of Thai Professionals overseas and their colleagues

2. Technology Transfer / Short-Term Visit Program: RBD will support short term visits for Thai professionals from overseas to Thailand to give lectures / workshops or seminars on topics of special interest. Issues relating to NSTDA's clusters and research programs will be given high priority. The Thai counterparts (universities and government agencies) who have connection with overseas Thai professionals and want to organize workshops / lectures can also send a request for partial granting to RBD.

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The Thailand Research Fund

Vision

The ninth National Social and Economic Development Plan (2002-2006) set a research investment goal at 0.40% of the gross domestic product. Forecasts for 2006 predict the GDP will reach 6 trillion baht. In order for such investment to be beneficial for the country as a whole, there should be research investment of at least 24 billion baht, there should be at least 240 research administrators, and there must be a high-quality research infrastructure, including both research institutions and research funding organizations.

TRF's intentions are to help construct a strong Thai research infrastructure. Policy, budgeting, expenses, research institutions, researchers, and research culture are areas identified by TRF as needing focus. Development requires improving research investment in terms of quality and amount. This fiscal year there is an investment of about 9 billion baht. For maximum benefit of the country, five times this amount should be invested. Additionally, ten times the present number of researchers are needed, and the number of strong research institutions must be increased. Finally, strategies must be set up for attracting more talent into the research career. In this regard, systems for the establishment of professional research and research administrator should be introduced in Thailand.

Objectives

1. To build up professional researchers and strengthen the research community.
2. To support research that is significant to national development, both for basic research and research where results can be used directly.
3. To promote the dissemination and use of research findings.
4. To raise funds for the national research and development system.

The Thailand Research Fund

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Bioplastics and organic agriculture are new wave industries that Thailand is gearing up for. The Thai government has already placed both bioplastics and organic agriculture as part of the nation's strategic development plan and allocated the total budget of 1.8 billion Baht and 4.3 billion Baht respectively for strengthening these industries. The National Innovation Agency plays a major role in these new developments and stands ready to facilitate further growth and expansion.



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ATPIJ, the Association of Thai Professionals in Japan, is a group of Thai "knowledge workers" and graduate students in Japan. It was originally organized in 1991 as a club of Thai engineers and scientists who were working in Japan after their graduation. The founding of ATPIJ was initially inspired by the Ministry of Science, Technology and Environment of Thailand.

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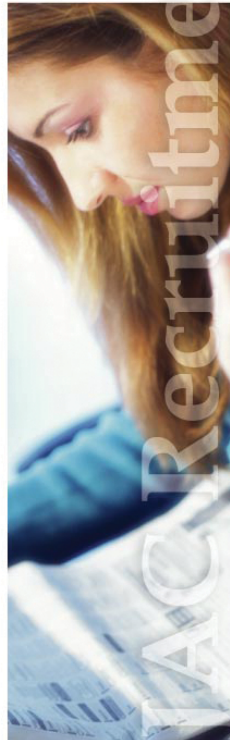
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JAC Recruitment was originally founded in London in 1975 as a recruitment consultancy for Japanese companies setting up business in the UK. After only ten years we started expanding abroad with the first overseas office opening in Singapore in 1987, closely followed by Tokyo, Japan in 1988. The key global expansion of the JAC Recruitment network has continued over the past ten years with the addition of JAC Recruitment Malaysia, JAC Recruitment Indonesia, JAC Recruitment Thailand and JAC Recruitment China. Today JAC Recruitment is one of the most successful and well-established Japanese recruitment consultancies in the world.

JAC Recruitment Japan, the largest operation within the group, continues its rapid expansion with its current network of offices in Tokyo, Osaka, Yokohama, Kyoto, Nagoya, Kobe and Fukuoka. In 2006 JAC Recruitment Japan was floated on the JASDAQ market in Tokyo.

JAC Recruitment Thailand was established in 2004. With our expertise and experience from the group, JAC Recruitment Thailand serves the recruitment needs of local Japanese as well as multinational corporate companies. With our company's philosophy to **combine the right person to the right company**, we endeavor to achieve the same leading and established status that our operations in other countries have achieved.

At JAC Recruitment Thailand, we are committed to assisting your company in hiring needs. With its network of offices in seven countries, JAC Recruitment provides quality permanent for a wide range of positions and business sectors.



Philosophy & Policy

JAC Recruitment has a corporate mission statement which is essential to the success of the company. This philosophy defines the values JAC Recruitment seeks to advocate in all its business practices.

Freedom & Discipline

The spirit of "freedom and discipline" allows our employees to clearly define their goals and objectives and to carry these out with a good sense of moral judgement, responsibility and self discipline. JAC Recruitment is defined by excellence, dedication, the ability to work freely and strives to be an environment where motivated people can pursue their ambitions.

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We encourage a culture of fairness, of being unconstrained by fixed notions of gender, age, nationality, past accomplishments, and other factors.

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Speed is an indispensable element for building relationships of trust with candidates and clients. Dealing with all requests in an efficient and professional manner enables us to provide a high-quality service.

Sincerity

JAC Recruitment seeks to provide an honest and sincere service supported by professionally trained consultants. We move beyond the matching service that many consultancies provide, to support both candidate and client from their perspective.

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We give high importance to maintaining a positive and constructive attitude. This manifests itself not only in the manner in which consultants present themselves, but also in their willingness to speak to customers and go "that extra mile" in terms of professional support.

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Vision of SCG

Our vision is that by the year 2015, SCG will be well recognized as an innovative workplace of choice, and a role model in corporate governance as well as sustainable development.

By 2015, we see SCG as a regional market leader, contributing to the sustainable progress of ASEAN and the local communities where SCG operates. Through SCG's world-class business practices, we are committed to creating value for our customers, employees, and all stakeholders. We will constantly ensure that our operational excellence, technology development and innovation will allow us to provide quality products and services in order to enhance the quality of life for all.

Growth Strategies for Sustainable Development

- **Go Regional: Striding towards becoming a leader in the ASEAN region**

SCG has a policy of expanding its investment in core businesses overseas. The emphasis is on the ASEAN region, which has a vast potential for long-term economic growth.

With the goal of becoming a leading ASEAN conglomerate, SCG continues to invest in key projects within the region to further enhance its competitiveness. SCG has taken clear and careful steps in expanding its business overseas. The Group has also implemented a rigorous systematic risk management to handle operational and financial risks that conform to the laws and regulations of the country.



- **High Value-Added Products and Services: Crating innovations to add value to products and services**



SCG has made it a policy that all business units place a strong emphasis on the R&D of products, services, processes, and business models by means of R&D activities through R&D Centers in 4 business units; **Product and Technology Development Center - Paper Business**, **SCI Research and Innovation Co., Ltd. (SRI) - Cement Business**, **Research and Technology Office - Chemicals Business**, and **Innovation and Technology Office - Building Materials Business**, and 1 **Corporate Technology Office**

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Employees are keys to success

Our people have always been the driving force behind the business success of SCG. We considers our employee an integral art of business that deserves proper caring, competitive compensation, development as well as challenging jobs and career opportunity. SCG also boosts exchanging and sharing of knowledge among employees to create mutual relationship and networking of knowledge and professionalism for benefit of the business. As one of SCG core values "Belief in Values of the Individual", we firmly believes that leveraging the employees' capabilities, raising their quality of life, and creating a strong bond of engagement will develop our employees to be the driving force that strengthen our stature. This will result in the sustainable growth of SCG and our people.

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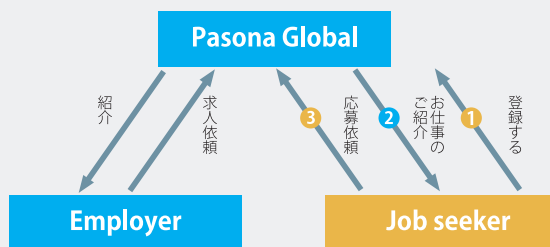
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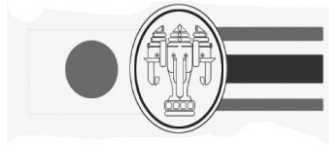
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The History of Thai Students' Association in Japan under Royal Patronage (TSAJ)



Thai Students' Association in Japan under Royal Patronage (TSAJ) was initiated in 1897 when the first batch of Thai students arrived Japan. They were supported by the scholarship from the King of Thailand, which was later known as the King's scholarship. After that, the number increased until it was possible to form the Association in 1939. On April 4, 1939, we received the name "under Royal Patronage" from H.M.'s kindness.



During World War II, the Thai Embassy building was severely damaged. Most of the documents were burnt. Our activities had to stop temporarily. After World War II was over, a meeting was held at the Kokusai Gakuyuukai. At the meeting, it was decided that the Association should continue its activities and the rules of the Association should be reconsidered and changed to suit the situation.

Therefore, on December 10, 1954, a group of committee was appointed at Thai Embassy to restart and continue the Association. From then until today, the Association has been working actively and this year (2008-2009) is the 69th batch of the committee and members.

TSAJ Tokyo welcome party 2008



24 May 2008, Komaba

The 69th TSAJ Committees

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Thai Students' Society in Hiroshima

By Seksak Chouichom

On 13th April of every year, Songkran Festival is held in every part of Thailand. Songkran is known as Thai New Year which is based on Thai's traditional calendar system. Since on this day the Thai people will sprinkle water on others to wish them good luck, it is also known as "The Water Festival" in many Asian countries such as Japan and China.



Every year, both Thai students who are studying in Hiroshima University and members of Thai-Hiroshima Fellowship Association join a lot of activities including Songkran Festival as well. Thai people and Thai students here usually congregate at the temple to celebrate this festival one time a year. We pour the water mixed with Thai fragrance on the Buddha statues to clean them once a year. We believe that doing this will bring good luck and prosperity for the New Year. During this time, younger people like us ask blessings from the elders by pouring water from silver bowls on their hands to show the respect, and then the elders sprinkle it on our hands. It is like refreshing the New Year and washing away bad luck



Besides, we also enjoy throwing water. We are very happy to do all activities together with friends and present Thai culture to let foreigners in Hiroshima know more about Thailand.

Thai Students' Society in Kanazawa

By Prapong Prechaprapranwong

Kanazawa, the capital of Ishikawa Prefecture, is the biggest city in the Hukuriku region. Kanazawa is surrounded by the Japan Alps, Hakusan National Park and Noto Peninsula National Park, and is also the home of Kanazawa castle and Kenroku-En, one of the three most beautiful gardens in Japan. Kanazawa has a long history with its own tradition and lifestyle derived from the Kaga Clan. Nowadays, Kanazawa is flourishing as the hub of political, economic, educational, and cultural activities in the Hokuriku District.



Kanazawa University is a national university of Kanazawa city. It is made up of 3 colleges, 16 schools and 7 graduate schools. Each year, more than 350 international students from over 40 countries are admitted. There are about 20 Thai students, as graduate students, research students, and exchange students (KUSEP). Most of them are studying in the Graduate School of Natural Science and Technology, the Graduate School of Education and the Graduate School of Medical Science. Kanazawa University Student Exchange Program

(KUSEP) students come from many partner universities in Thailand such as Chulalongkorn University, Thammasat University, King Mongkut's University of Technology Thonburi, Kasertsart University and Chiangmai University, to study in Kanazawa for 1 or 1.5 years.

We appreciate the opportunity to live in Japanese society and participate in its cultural activities. We are also encouraged by the Ishikawa Prefectural-Kingdom of Thailand Amity Association (Ishikawa - Thailand association) who provides a place and some budget for teaching Thai language and Thai's traditional dance every Saturday afternoon. Moreover, in summer, ! through cooperation between Ishikawa-Thailand association and Thai students, we open a booth selling Thai food once in the Japan Tent festival and again in the City's festival.



On Christmas and New Year, Thai students and Ishikawa-Thailand association members gather up with the purpose of cultural exchange with each other. We have dinner and enjoy New Year's celebration together. Winter in Kanazawa brings heavy snowfall, thus we often have chances to go skiing. Not to mention other activities throughout the year. Having dinner together every week and organizing trip every vacation, we are a small but closely bounded group of Thai students who live in Kanazawa with a simple and friendly lifestyle.

Thai Students' Society in Kyoto

**Written by Mutarika Pruksapong; translated by Yuwa Chompoobutrgool;
approved by Weerawut Chaiwat and Surawut Chuangchote**



Sakura at Kiyomizu-Dera and momiji at Kinkakuji

blossom) and in October for 'momiji' (maple). Unlike any other cities, Kyoto has an excellent-integrated culture between modern and old traditional times. That is why it is not surprising to see hundred thousands of people coming to Kyoto each and every year.

At present, there are approximately 70-80 Thai students living and studying in Kyoto City. Many of them are pursuing their degrees in Bachelor, Master or Doctoral, as well as research studies at well-known universities in Kyoto, for example, Kyoto University, Kyoto Institute of Technology, Doshisha University, Ritsumeikan University, Kyoto Prefectural University, Kyoto University of Education, etc. Moreover, there are also Thai students attending various language schools for Japanese Language studies. The university in Kyoto which has the largest number of Thai students is Kyoto University, also known as 'Kyodai' (京大), the second university found in Japan which was established on 18th June, 1897. Each year, approximately 13,200 undergraduate students and 9,400 graduate students enter Kyoto University, and among them including 45-50 Thai students.

For activities in Kyoto, every year, there are two welcome parties held for newcomers; once in April and another in October. We, Thai students in Kyoto, have been organizing these parties for years, as it is our tradition. Instead of going to a restaurant, the 'senpai' (seniors or those who have stayed in Kyoto) will bring their own professional-class cooking and enjoy it with the newcomers at our city's most famous river, 'Kamogawa'. There, by the river, it is not only the place for parties but where we can enjoy a nice breeze, the pleasant nature, and view of ducks floating in the river.

Important activities of Thai students in Kyoto are related to activities of Thai Students' Association in Japan under Royal Patronage (TSAJ) and the Royal Thai Consulate General, Osaka, such as pick up new comers from the airport, academic meeting, sport days, ski trip, travel, and so on. In daily life, after school or during weekends, many of us always gather and do activities together; for example, eating at someone's place or dining out, shopping in town, or going karaoke. Other activities include photo-taking, doing sports such as football, basketball, badminton, jogging by the river as well as cycling.



Kyoto Ski Trip 2008

Kyoto is located in the west of Japan's Honshu Island. It was an old capital of Japan in Heian period, the last division of classical Japanese history, running from 794 to 1185. Kyoto has always drawn tourists from all over the place to appreciate its beauty, especially in April for the infamous 'sakura' (cherry

blossom) and in October for 'momiji' (maple). Unlike any other cities, Kyoto has an excellent-integrated culture between modern and old traditional times. That is why it is not surprising to see hundred thousands of people coming to Kyoto each and every year.

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Thai Student Welcome Party in Kyoto (April, 2008)

The relationship among Thai students in Kyoto is very friendly and tight-knitted. We are like a big family always helping each other regardless it being academic or non-academic. Moreover, not only do we have a friendly relationship among ourselves, we also arrange activities with other students from other cities, like Kansai area, to strengthen our friendships among Thai students in Japan.

Thai Students' Society in Nagano

By Varumpa Dulayanurak

Nagano prefecture is located in the center of Japan. It is surrounded by 8 prefectures; Niigata, Toyama, Aichi, Gifu, Shizuoka, Yamanashi, Gunma and Saitama. Nagano was the site of the Olympic Winter Games 1998. Prefectural capital is Nagano City. There are many mountains called "Alps of Japan".



Shinshu University is the only one of Government University in Nagano prefecture. The university was established in May, 1949. Nowadays, Shinshu University consists of 8 faculties; Arts, Education, Economics, Science, Medicine, Engineering, Agriculture, and Textile Science and Technology. There are 5 campuses in 4 cities; Matsumoto Campus in Matsumoto City, Nagano-Education Campus and Nagano-Engineering Campus in Nagano City, Minami-minowa Campus in Kami-Ina City and Ueda Campus in Ueda City.

There are 10 Thai students (exchange student, undergraduate student, graduate students, and research student) at Shinshu University in different campuses and 1 Thai student at Nagano National College of Technology. We have few activities because we live in different areas and are a little bit far from each other. We usually take the train for transportation. This way is convenient and takes about 1 hour. For example, going to see Sakura (Hanami) at Matsumoto Castle in Matsumoto City, riding bicycle for rice field and Wasabi field sightseeing at Hotaka in Azumino City, going to see fireworks at Suwa Lake in summer, skiing at Norikura Mountain in winter, one day trip at Kamikochi, and hiking at Utsukushigaharakogen. We sometimes cook dinner together and have party. We all love nature very much and always welcome everyone who comes to visit us.



Thai Students' Society in Nagoya

By Arthit Makarasen, Thanyaporn Rithiwathanapong and
Thai Students in Nagoya

Nagoya (名古屋) is the fourth-largest city in Japan. Located on the Pacific coast in the Chubu region on central Honshu, one of Honshu's three large plains and industrial centers, it is the capital of Aichi Prefecture and is one of Japan's major ports along with those of Tokyo, Osaka, Kobe, Yokohama, Chiba, and Hakata. It is also the center of Japan's third largest metropolitan region, known as the Chukyo Metropolitan Area. With over two million inhabitants, Nagoya is Japan's fourth most populated city. Two most famous sightseeing spots are Nagoya Castle and Atsuta Shrine. Nagoya Castle was built in 1612. Although a large part of it burned down in the fires of World War II, the castle was restored in 1959. Atsuta Shrine is known as the second-most venerable shrine in Japan, after Ise Shrine. It is said to enshrine the Kusanagi sword, one of the three imperial regalia of Japan.

There are more than 50 Thai students living in Nagoya, as graduate students, research students, exchange students, etc. During each year, we have a lot of activities such as welcome parties, farewell parties, BBQ parties in spring and autumn, Songkran festival, Thai student's sport day, New Year party, etc. Regarding these stated activities, they have the same objectives, to build good relationship among Thai students. In addition, 'Meidaisai', food and bazaar festival of Nagoya University is held every year in June. Thai students in Nagoya University also participate in the festival, for example, by having Thai cultural performances and selling Thai foods. For all of the students here, even though we are from various parts of Thailand, we have unity in diversity.



Area 326.45 km² (126.04 sq mi)

Population (as of September 1, 2007)

Total 2,236,000

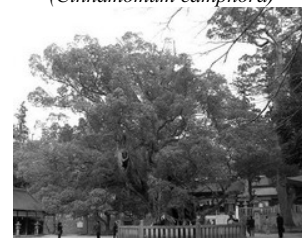
Density 6,849.4 /km² (17,740 /sq mi)

Location 35°11'N 136°54'E

Symbols

Camphor laurel
(*Cinnamomum camphora*)

Tree



Lilium

Flower



Emblem of Nagoya



Thai Students' Society in Okinawa

By Anucha Promkamnerd and Kwantree Sangprachathanarak

Most of Thai students studying in The University of the Ryukyus. They came here to study either the graduate or the undergraduate courses offered by the university. Some Thai students are also signing up for the short-term exchange program with the university.

During our time of studying in Okinawa, we have organized annual events such as the Songkran Festival, Loy Kratong Festival, the International Student Festival and the University Festival in order to promote our culture among the university students. Let us share what we did on one of the events – Songkran Festival.

We started to organize Songkran Festival in The University of the Ryukyus since the year 2000. At that time, almost 400 people from all over Okinawa came to the university to witness this event and the number is increasing every year. We showed the traditional New Year ceremony followed by Thai dances and kickboxing. We also prepared many Thai dishes for the guests, which were all free! At the end of the festival, we drenched one another with water just like in Thailand. Many Japanese and other international students came to join the celebration of the festival. This year, we donated a part of our earnings from all of the events to the schools in the rural areas of Thailand. Besides being active in the university, we also participated in the organization of Thai Festival in Okinawa.

Okinawa lifestyle is very similar to Thailand considering the subtropical climate. Their way of thinking is also similar with us. For example, the word, “Nankarunaisa”, a famous word in their dialect has a very close meaning to “Maipenrai” of our Thai language. We are able to get used with the life here easily because of these similarities. Although most of the Thai students live in the university’s dormitory, we often have gathering together. We also meet up with the Japanese and other international students in Okinawa to foster good relationship.

Last but not least, we would like to extend our gratitude and appreciation to the Monbukagakusho (MEXT), The University of the Ryukyus, Thai Honorary Consulate in Naha, The Tourism Authority of Thailand (TAT Fukuoka), Okinawa Thailand Friendship Association, the Thai restaurants and the companies in Okinawa as well as the people of Okinawa for their support and encouragement to us. Without them, we are unable to achieve our dreams to study and to organize the activities in Okinawa.



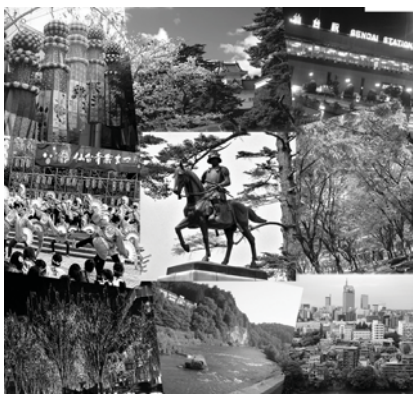
Thai Students' Society in Osaka

By Chalida Piyathamrongchai



Thai Students' Society in Sendai

By Krit Manator and Sendai Thai Students



With the unique crescent on his helmet, a courageous warlord, Date Masamune, established the city of Sendai, the capital city of Miyagi Prefecture, which is currently considered the largest one in the North Eastern region of the Honshu Island. Sendai is also known as the City of Trees as a number of Zelkova Trees, the city tree, are lushly lined along the Aoba street and the Jozenji street, making such beautiful and breezing boulevards. A few number of aesthetic sculptures laid on the Jozenji street also magnify the glamour of the promenade where both merry contemporary gatherings and famous traditional fiestas are annually held. Not only do the symbolic trees make Sendai fascinating, but the clear Hirose river rippling through the city and also attractively put in a reputed city song, Aobajo Koi Uta or the Aoba Castle Love Song, also makes this blissful city far more enchanting. In addition to cutting-edge technology commonly found in Japan, Sendai enhances both traditional property and natural beauty.

With regard to the academic aspect, Sendai upholds the advancement in education since there is Tohoku University as one of the nine Imperial Universities of Japan, being the third one erected in order that higher educational opportunity could be farther expanded to rural locales in the region. Conferring degrees to male, female, and foreign academics to maintain unbiased education, the university has been greatly boosted for its open-door policy, for it is the pioneer who provides people with equal education regardless of their sexes and nationalities. The university focally dedicates to research principle as it holds the perspective that good research leads to good education, producing graduates contributing to social development under this emphasis. Presently, the university extensively offers students a variety of studying fields.



As a part of international students in Tohoku University, there are a countable number of Thai students - undergraduates, graduates, and doctorates, pursuing their study in the establishment. From time to time, Thai students are given opportunity to greet Thai researchers, short-term exchange students, and observers from their familiarization trips. No matter why they visit Tohoku University or other universities in Sendai or its vicinity, they will be warmly welcomed by the tiny but cozy community of Thai students in Sendai. The community regularly arranges a plenty of fraternity-tightening activities in both Thai and Japanese styles; Thai cultural performance, Thai food stall, Hanami or cherry blossom appreciating, and Imoni or cassava boiling alfresco, for instance. The community also celebrates

members' birthdays, welcome party, and farewell party and always gives members a hand when they are in adversity. Recently, the community has been honorably entitled Thai Students' Association in Japan under the Royal Patronage Sendai Division.

Life in Sendai is enjoyable and valuable. Such a compatible combination of precious culture, fresh greenery, material civilization, educational opportunity, and dignified and friendly association is blended harmoniously in the city of Sendai.

Thai Students' Society in Shikoku

By Soracom Chardwiriyaapreecha

Shikoku is the smallest island of the four main islands in Japan. Shikoku region consists of 4 prefectures: Ehime, Kagawa, Tokushima, and Kochi. Matsuyama, which is known for the oldest hot spring (Dogo Onsen) in Japan, is the capital city of Ehime and also the largest city in Shikoku. Mount Ishizuchi in Ehime is the highest mountain in the west of Japan. The famous Sanuki Udon made from the good quality wheat in Kagawa is the most delicious Udon in Japan. There are 42 Thai students in Shikoku: 12 students in Ehime; 25 students in Kagawa; and 5 students in Kochi.



international events, including holding our own along the year. And we are willing to take part and support any activities organized by TSAJ.

As for Thai student community in Kagawa, we are quite similar to other communities in other parts of Japan. By taking good care of each other, we live in Ehime like a family with a simple lifestyle. We normally have dinner together every week, as well as gather up on particular occasions, for example, on birthdays or New Year's celebration. Sightseeing trip is also planed each year.

All of Thai students in Ehime are studying in Ehime University as graduate students, research students, and exchange students. Most of all students study in the United Graduate School of Agricultural Science, which is a collaboration of three universities in Shikoku (Ehime, Kagawa, and Kochi University). Thai students in Ehime usually participate in every activity such as food festival and open campus organized by the University. We also promote Thai culture to Japanese and foreigners in many



experiences, not only within Kagawa, but also with other Thai students all over Japan. Thus we appreciate your visit to Shikoku, and you will always be guaranteed a warm welcome.

In addition, we share any necessary information and pass on some belongings and appliances needed for the living in Japan. Since the majority of the students are in the field of Agricultural Science, we grow some Thai vegetables then distribute them to each other.

We have a great time and good memories that are hard to forget during our stay here and would like to share those great

Thai Students' Society in Tokyo

By Supasit Monpratarnchai and Kajeeporn Techataveekijkul

As most of Thai students studying in Japan are living in Tokyo, the capital city of Japan, Thai students' society in Tokyo is much bigger than other parts of the country. Thai students are actually separated into groups as they are studying in different universities across Tokyo. However, as Thai Students Association in Japan (TSAJ) holds many interesting activities throughout a year, Thai students have chances to come and join those activities together; for instance, ski trip in January, Sakura festival (Hanami) in April, Thai festival and new students welcome party in May, fireworks festival (Hanabi) and Mount Fuji climbing during summertime, sport days, academic conference, Loy Krathong festival and cultural festival (Bunkasai) in November. Moreover, as the Royal Thai Embassy is situated in Tokyo, most of the time Thai students join activities and ceremonies hosted by the embassy; for example, Songkran festival in April and The King's Birthday in December.



Every year in May, Thai festival which is hosted by the Royal Thai Embassy is held in order to promote Thai beautiful culture. This year, Thai students in Tokyo and Thai students in Tsukuba had a chance to present Thai traditional costumes on stage which not only showed Thai gorgeous culture to Japanese people who came to the festival, but also created friendship among Thai students.

As living alone in foreign country may sometimes cause troubles to students, Thai-Tokyo welcome party is also another activity created by TSAJ in order that old and new Thai students have a chance to get to know more people.



Apart from activities which are hosted by TSAJ, Thai students in each university also meet and do sports together; for example, Thai students in Tokyo University usually play basketball together, also Thai students in Tokyo Institution of Technology plays badminton every week. Moreover, during weekend, in order to reduce stress from studying, students in different universities frequently join some drinking, Bar-B-Q party, singing karaoke and etc. Those enjoyable activities created wonderful friendship and made Thai students' society in Tokyo become closer and tighter than it was before.

Thai Students' Society in Tsukuba

By Supatida Sirisawat and Tanapat Raruaisong

Tsukuba is the city in Ibaraki Prefecture located in the Kanto region, Japan. It is known as the location of the Tsukuba Science City, a planned city developed in the 1960s. As a new city with high population density and is close to Tokyo, Tsukuba is sometimes considered part of the Greater Tokyo Area. In addition, Mount Tsukuba is one of the top 100 famous mountains in Japan which is particularly well-known for its sacred Shinto shrine.

The University of Tsukuba was established in October 1973 in response to a new educational and research framework launched by the Japanese government. Taking advantages from its unique character as well as being located in the "Science City", the university could thereby seek to raise the level of academic activities and the degree of internationalization through several exchanges and collaborations with surrounding research institutions and academics from overseas. Having three Nobel Laureates has well demonstrated the potential of the university in producing quality students and outstanding research works.



The association of Thai students in Tsukuba has been established in 1984, which has initiated various activities that are beneficial to both Thai members and Japanese people. One of the activities that have been fruitful is the participation of Thai booth in the university's annual festival. In a restaurant style booth, varieties of original Thai food are introduced to Japanese people as well as traditional performances by both Thai members and Japanese students who are interested in Thai culture. Similar activity is also carried out in the Tsukuba International Exchange Fair organized by the Tsukuba city. A large portion of the profit from the two events is donated to poor students in remote areas of Thailand. In addition, some members who are fluent in Japanese also voluntarily offer Thai language courses to general Japanese and, sometime, Japanese students. Through these activities, the association has been successful in promoting Thai culture and establishing a good relationship with Japanese people in Tsukuba and nearby vicinities.



Nowadays, the number of Thai students in the University of Tsukuba including graduate, undergraduate, and short-term exchange students is over 40 people. Apart from the above mentioned, other events are also arranged regularly all year round to strengthen brotherhood among members, e.g., occasional parties, sport day and ski trip. A website and journals have been launched as a means to share the necessary information for living in Japan. It is customary for members to give a good care, help and guidance to newcomers in both academic and daily life concerns. Anyone who has been in the University of Tsukuba would find that their study and staying in Japan are memorable ones.



Acknowledgements

The TJIA organizing committee would like to take this opportunity to express our sincere gratitude to all parties involved and attendees as being further illustrated.

For the Thailand-Japan International Academic Conference firstly established on the basis of global level this year, the conference committee is deeply grateful to The Royal Thai Embassy in Japan for their substantial support in all significant aspects. Furthermore, financial support and participation from many generous corporations as well as organizations are hereby acknowledged.

Our deep sense of gratitude is also to the keynote speakers for their kindness to give speech on this conference. The honorable committee, the advisory committee and the academic committee play a very important role in providing invaluable suggestions on the conference arrangement. The conference committee ensures their contribution is well recognized.

The committee is also indebted to Tokyo Institute of Technology for providing the conference venue and various facilities accommodated in this conference. Without their encouragement, this conference would not have been successful.

Finally, special thanks are given to all TJIA's staff. Their valuable assistance and generosity in helping to organize this conference are greatly appreciated.

The TJIA Organizing Committee



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