

**I0001-WET DEPOSITION IN THE WESTERN REGION OF THAILAND**Mallika Panyakapo<sup>1</sup>, Dirakrit Buavait<sup>2</sup> and Pongsri Paopurce<sup>3</sup>

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**Abstract :** The study on acid deposition in the western region of Thailand is a part of "The Acid Deposition Monitoring Network in Thailand", organized by Pollution Control Department. The monitoring period is between April 1, 2003 to March 31, 2004. Wet and dry depositions are included in this project, however, wet deposition is presented in this paper. Sampling site was located at Nakhon Pathom meteorological station. Precipitation samples were collected on a daily basis using a wet-only collector. Samples were analyzed for pH, electrical conductivity,  $\text{NH}_4^+$ ,  $\text{Na}^+$ ,  $\text{K}^+$ ,  $\text{Ca}^{2+}$ ,  $\text{Mg}^{2+}$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_3^-$  and  $\text{Cl}^-$ . The total precipitation is 918.8 mm/year. pH and electrical conductivity are in the range of 4.61-6.52 and 0.45-9.07 mS/m, respectively. The annual weighted average concentrations of  $\text{SO}_4^{2-}$ , nss- $\text{SO}_4^{2-}$  and  $\text{NO}_3^-$  are 22.40, 21.20 and 11.04  $\mu\text{eq/L}$ , respectively. Wet depositions of the important acid species:  $\text{SO}_4^{2-}$  and  $\text{NO}_3^-$  are 19.03 and 9.38  $\mu\text{eq/m}^2\text{-year}$ , respectively. The ratio of  $\text{NH}_4^+ + \text{Ca}^{2+} + \text{Mg}^{2+}$  / nss- $\text{SO}_4^{2-} + \text{NO}_3^-$  which indicates a neutralizing capacity, are in the range of 0.91-4.48. The ratio of  $\text{NO}_3^-$  / nss- $\text{SO}_4^{2-}$  is in the range of 0.27-3.60, which shows that the concentrations of both ions fluctuate along the year. Therefore, the emission sources of both ions have to be carefully monitored.

**I0002-ACUTE TOXICITY AND EFFECT OF ENDOSULFAN ON GLUTATHIONE-S-TRANSFERASE ACTIVITY IN *Macrobrachium lanchesteri***

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**Abstract:** Endosulfan is an organochlorine pesticide often used in paddy fields by Thai farmers for snail eradication. The 96-h LC<sub>50</sub> of ricefield shrimp, *Macrobrachium lanchesteri* was 2.00  $\mu\text{g/L}$ . Study on the glutathione-s-transferase activity (GST) in whole body of ricefield shrimp showed that the activity of GST significantly increased after exposure to 0.35, 0.7 and 1.4  $\mu\text{g/L}$  endosulfan; and the activities increased up to 96 h and were positively related to the endosulfan concentrations. Furthermore, bioaccumulations of endosulfan by *M. lanchesteri* from surrounding freshwater were 1.34 and 1.31 ng/g-wet weight in those exposed to 0.7 and 1.4  $\mu\text{g/L}$  endosulfan for 24 h. The results suggested that the GST level in Ricefield shrimp can be used as indicator for organochlorine insecticide contamination.

**I0003-STUDY OF FINE PARTICULATE MATTER IN PHITSANULOK HOMES**

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Abstract Particulate Matter with an aerodynamic diameter less than 10 microns (PM10) was collected from six living rooms in three roadside and three non-roadside homes located in central Phitsanulok. The samples were analyzed using Energy Dispersive X-ray (EDX) for 10 elements and Scanning Electron Microscopy (SEM) for morphology. The PM10 from roadside samples were mostly higher than the standard of 150  $\mu\text{g/m}^3$  and were also higher than PM10 from non-roadside home samples. The roadside samples were found to be from diesel and gasoline engine emissions, spongy and non geometric in shape, and contained primarily the elements, C and O. The non-roadside samples were found to be from soil and construction dust, sharp-edged and dense, and contained primarily the element, Si. Questionnaires were used to obtain data on the conditions, location and background of the homes and activities of occupants.

**I0004-TREATMENT OF WASTE COOLANT EMULSIONS BY COAGULATION AND FLOCCULATION**Pakawan Kamonechaivanich<sup>1</sup>, Tanaporn Tanupabrungsun<sup>1</sup>, Sangobtip Pongstabodee<sup>2,\*</sup><sup>1</sup>Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok, Thailand.E-mail: [Pakawan.K@student.chula.ac.th](mailto:Pakawan.K@student.chula.ac.th), [Tanaporn.T@student.chula.ac.th](mailto:Tanaporn.T@student.chula.ac.th), and [psangob@sc.chula.ac.th](mailto:psangob@sc.chula.ac.th)

**Abstract:** Treatment of waste coolant emulsions from metal-autopart industry was studied. The treatments were coagulation and flocculation using synthetic ferric chloride, ferric chloride, and aluminium sulphate as coagulants and using anionic and cationic polymers as flocculants. The effects of coagulant dose, flocculant dose, pH, turbidity, BOD, speed of rapid and slow mixing were considered. Electrophoresis measurements indicated that initial oil droplets had a negative zeta potential. When adding a coagulant to the emulsions, the zeta potential became more positive. The coagulants were shown to be effective in reducing the zeta potential of the oil droplets but in increasing oil droplet size. At optimum pH condition (pH = 6), the turbidity and BOD of the wastewater were reduced by 99.65 and 99.5 percent, respectively. In addition, oil separated from waste coolant emulsions was recycled as a fuel, then heat content of the oil was also investigated. The experimental results showed that heat content of oil separated from waste coolant emulsions was about 34,493.82 J/g.

**I0005-REMOVAL OF STABILIZED OIL IN WASTEWATER EMULSIONS BY INDUCED AIR FLOTATION**Chuleekorn Chooklin<sup>1</sup>, Sangobtip Pongstabodee<sup>1,2,\*</sup><sup>1</sup>Department of Chemical Technology, Faculty of Science, Chulalongkorn University, Bangkok, Thailand.<sup>2</sup>The National Research Center for Environmental and Hazardous Waste Management (NRC - EHWM), Faculty of Science, Chulalongkorn University, Bangkok, 10330, Thailand.E-mail address: [tooktiek007@hotmail.com](mailto:tooktiek007@hotmail.com) and [psangob@sc.chula.ac.th](mailto:psangob@sc.chula.ac.th)

**Abstract:** The removal stabilized oil in wastewater emulsions was studied by means of induced air flotation technique. The effect of several parameters on induced air flotation efficiency for removal of the emulsified oil was examined, namely: (a) the presence of nonionic surfactant (Polyoxyethylenesorbitan monooleate, Tween 80) used for the stabilization of the emulsions and for long-life of bubble, (b). concentrations and types of electrolyte, (c).air flow rate, (d). gas bubble size and (e). flotation time. Zeta - potential, turbidity and UV-absorbance measurements were also monitored. At the optimum defined experimental conditions (1 CMC of Tween 80, pH 7, aluminium sulphate 160 mg/l, 8 ml/sec of air flow rate, 40 -100  $\mu\text{m}$  of gas bubble size and 5 min of flotation time) more than 99 % of the stabilized oil in wastewater emulsions was effectively removed from an initial concentration of 500 mg/l.

#### **I0006-REMOVAL OF HEAVY METALS FROM WASTEWATER BY ADSORPTION ON ACTIVATED CARBON**

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**Abstract:** The aim of this research is to study removal of copper ion from wastewater by adsorption on activated carbon. Effect of several factors has been investigated as a function of pH, contact time, concentration of copper ion in aqueous solution and type of activated carbon. The experimental results indicated that different type of activated carbon gave a different optimal condition of copper removal. Optimal pH when using Carbokarn to adsorbed copper was around 4. Meanwhile optimal pH when using C-gigantic, stream-activated 60 min and stream-activated 30 min was around 5. At the same pH condition, it was found that copper removal by adsorption on Carbokarn was higher than C-gigantic, stream-activated 60min and stream-activated 30min respectively. Increasing in copper ion concentration leads to reducing an adsorption efficiency of all activated carbon used in this work. To reach equilibrium, Carbokarn had shorter contact time than other.

#### **I0007-PRELIMINARY STUDY OF CONSERVATION IN A WORLD HERITAGE SITE: HUAI KHA KHAENG WILDLIFE SANCTUARY**

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**Abstract:** This work aims to study the existing condition of some physical and biological resources, human resources, tourism, and management of the Huai Kha Khaeng wildlife sanctuary. The methods were collecting secondary data and doing field work in the wildlife sanctuary. The geological data include rock types and soil texture. The data of water quality, DO, pH, conductivity, transparency and temperature of a stream were collected. Sampling plot in the forests were examined. 170 people living in 3 villages near the border of the wildlife sanctuary were interviewed with the use of questionnaires on the environmental and conservation items. Comments from tourists were investigated. Now (2004 AD) the Huai Kha Khaeng wildlife sanctuary is under the National Park, Wildlife and Plant Conservation Department, Ministry of Natural Resources and Environment, Thailand. The results of this study give rise to knowing the existing condition and problems of the Huai Kha Khaeng wildlife sanctuary. The solutions for the problems have been suggested.

#### **I0008-Utilization of Distillery Slop for the Rice Production in Khon Kaen Province**

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**Abstract:** Distillery slop is the wastewater from distillery process of liquor which has to be treated before discharge at a very high cost. However, as it contains large quantities of organic matter and plant nutrients, especially potassium, it can be used to improve soil fertility and increase crop yield without destroying environment. This research is therefore aimed to study the appropriate doses of distillery slop that gives the optimal yield of jasmine scented rice or Khao-Dawk-Mali 105 planted on Sida Soil Series in Khon Kaen Province under the application of fertilizer, and to study the effect of distillery slop on chemical properties of soil and on the number of microorganisms as well as the effect on methane emission in paddy field. The result of the experiments, especially that of the second crop year, indicated that application of 20 m<sup>3</sup>/rai of distillery slop along with 30 kg/rai of fertilizer grade 16-16-8 gave the optimal rice yield. Application of increasing doses of distillery slop could increase the contents of some chemical properties of soil especially Potassium and Magnesium, but it had no significant effect on the number of bacteria and mold, especially at pre-planting and panicle-initiating periods. Utilization of distillery slop did not cause the increase of methane emission from the rice field.

#### **I0009-PREDICTING TIDE CHARACTERISTICS ON THE COASTLINE OF THE ANDAMAN SEA BY NON-HARMONIC METHOD**

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**Abstract:** This study was based on water level prediction data downloaded from the website of the Hydrographic Department, Royal Thai Navy, for the year 2002 at Ranong, Phuket, Phangnga, Krabi, Trang, and Satun stations. A non-harmonic method was used to determine tide types and compared them with the known published data. It was found that the *F* ratios at six stations were 0.161, 0.240, 0.229, 0.226, 0.199, and 0.249 respectively. The mean ranges were highest at Ranong station and lowest at Phangnga station. The maximum and minimum of the mean sea level were found at Krabi and Satun stations respectively. The tides at all six stations on the coastline of the Andaman Sea were semidiurnal. The result can be used to accurately predict tide characteristics of the area being studied.

#### I0010-COMPUTATION OF D8 FLOW LINE AT RON PHIBUN AREA, NAKHONSITHAMMARAT PROVINCE

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**ABSTRACT:** We developed a flow line computational technique based on the D8 method by using *Mathematica*. The technique was applied to Ron Phibun area, Nakhonsithammarat Province. This area is highly contaminated with arsenic 3 and 5. We found that our technique using *Mathematica* can produce similar results to those obtained from GRASS v 5.0.2.

#### I0011-ELEVATION MODEL (DEM)

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**Abstract:** The objective of the study was to develop a computational technique for generating a Digital Elevation Model (DEM). Contour lines, scanned from the 1:50,000 scale map of the Royal Thai Army Survey Department, were used to estimate the values of adjacent data points on continuous contour lines for computation of a DEM by means of Delaunay triangulation. The technique was found to be an economical way of converting continuous analogue data signals into a digital format of "x, y" or "x, y, z" coordinates.

#### I0012-FLASH FLOODING PREDICTION BY RAIN EXPOSURE INDEX (REI)

##### BASED ON GOES-9 SATELLITE DATA

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**Abstract:** A new geocomputing Rain Exposure Index (REI), which can predict flash flooding resulting from a series of heavy rainfalls, was constructed and tested. The index was constructed by computing data from GOES-9 satellite using combinations of image processing and functional constructs. The hypothesis was tested by two events of flash flooding in Prachuapkhirikhan, Phetchaburi, and Tak Provinces in Thailand as well as one event in Southern Leyte Province in the Philippines. The results indicated that REI was capable of accurate prediction of flash flooding 1-2 days in advance of the event.

#### I0013-REMOVAL OF CHROMIUM FROM CONTAMINATED SOIL BY SOIL WASHING METHOD

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**Abstract:** This research aims to study the removal of chromium from contaminated soil by washing with water, ethylenediamine tetraacetic acid (EDTA) solution and sodium dodecyl sulfate (SDS) solution. The samples employed in this research once had been used in the previous research—Remediation of Chromium-Contaminated Soil by Planting the Broad Leaf Plants. The soil was divided into two groups. The first group was spiked with 100 ppm of chromium solution/10 grams of soil (0.10 mg Cr/1 g of soil), while the second group was not. The Broad Leaf Plants have been planted in both groups of soil for 60 days. After that, the second group of sample was spiked with chromium solution at the same concentration as spiked in the first group. Both groups were processed the experiments in order to compare the results. The outcomes demonstrated the same tendency. The soil washed with SDS solution at concentration of three times of chromium concentration in soil shows the best efficiency, while the soil washed with water adjusted to pH = 2, and the soil washed with EDTA solution adjusted to pH = 2 at concentration of two times of chromium concentration in soil show respective efficiency.

#### I0014-EFFECT OF OZONATION ON BACTERIA AND PHYTOPLANKTON IN THE WATER FROM SHRIMP POND

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**Abstract:** Effect of ozonation on bacteria and phytoplankton in the low salinity water from shrimp pond in Chachoengsao Province was evaluated in this study. For the first trial, it was found that ozonation for 60 minutes could reduce 97.1% of bacteria in the water. After mixing the water with shrimp feed and aerated for 5 days, ozonation could also reduce the number of bacteria and turbidity in the water. However, the efficiency of bacterial treatment was less than the first experiment. This was possibly due to high concentration of organic and inorganic compounds in the water. For the second trial, water from shrimp pond was mixed with phytoplankton (*Chaetoceros* sp.) before ozonation. The results showed that 95% of phytoplankton cells were reduced after 60 minute ozonation

#### I0015-A STUDY OF SORPTION OF HEAVY METALS USING *PADINA HAITIENSIS* THIVY

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**Abstract:** Conditions for adsorption of lead (Pb), cadmium (Cd) and chromium (Cr) in contaminated water samples using *Padina Hitiensis* Thivy were investigated. Variables affecting the metal adsorption were studied which included types and times of shaking, pH of solution and interfering metals. From these experiments, the optimum condition was found to be the shaking time of 3 hours and solution pH of 3.0. In case of the interfering metals, lead and chromium affects the adsorption of cadmium dramatically. This optimum condition is applicable to the adsorption of heavy metals in wastewater samples. The amounts of lead, cadmium and chromium adsorbed were found to be 146-314, 13-175 and 76-133 µg/g, respectively

#### I0016-DEGRADATION OF LEAD COMPLEX BY PHOTOOXIDATION IN THE PRESENCE OF HYDROGEN PEROXIDE

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**Abstract:** The degradation of PbEDTA in aqueous solution by a photooxidation process (H<sub>2</sub>O<sub>2</sub>/UV) was studied. The effect of H<sub>2</sub>O<sub>2</sub> content, pH of the solution and the presence of nitrate were investigated. PbEDTA degradation by a H<sub>2</sub>O<sub>2</sub>/UV process was shown to be accompanied by simultaneous lead precipitation. PbEDTA was decomposed rapidly in acidic solutions while lead precipitation was achieved only when the pH of the solution was higher than 6. The presence of nitrate in significant amounts (0.04 M) inhibited remarkably the degradation of the complex and metal precipitation. It was found that the decomposition of metal-EDTA complex and metal removal by the H<sub>2</sub>O<sub>2</sub>/UV process depend greatly on the nature of the metal. CdEDTA and ZnEDTA were decomposed rapidly but metal precipitation was not achieved. The major by-products of the degradation of metal-EDTA complexes observed were nitrilotriacetic acid (NTA), iminodiacetic acid (IDA), oxalic acid and nitrate.

#### I0017-INVESTIGATION OF A VARIETY OF CLAY MINERALS FOR THE ADSORPTION OF ZEARALENONE

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**Abstract:** Zearalenone (ZEN) is a hazardous mycotoxin that contaminated food and feedstuffs worldwide. ZEN contamination of commodities results in economic and health costs, creating a need to research to allay these problems. The objective of this research was to evaluate the ability of different types of clay minerals (e.g., kaolinite, smectite, mica), to adsorb ZEN *in vitro*. Clays utilized in this study were selected to represent a wide range of different physical and chemical characteristics, including unit cell configuration, organic and trace metal composition, surface area, swelling ability, and cation exchange capacity (CEC). The results indicated that various clay minerals possess a distinct structure that can bind ZEN differently. Important structural differences provide unique functional and chemical characteristics. The extent of sorption was dependent on the chemical and physical characteristics of the clays. Among tested clay minerals, smectite clays are suitable for ZEN sorption, because smectite clay minerals possessing high surface area, high cation exchange capacity, small particle size, and access to the interlayer region. These characteristics cause smectite clay minerals having higher capacities for ZEN adsorption as compared to other clay minerals.

#### I0018-COMPOSTING BY LOCAL COMMUNITY IN COMMERCIAL SCALE USING AERATED STATIC PILE SYSTEM

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**Abstract:** In this research three full-scale piles were studied. Each pile consisted of 6 m<sup>3</sup> of shredded leaves and 3 m<sup>3</sup> of cow manure, and was piled on opened ground in prism-like shape with the dimensions of 2.5x3.5x1.0 m (width x length x height). Urea fertilizer, phosphate rock, and seeding activators of 400, 200, and 90 grams, respectively, were added. The moisture content was controlled at 45-55 %. The air was forced twice a day (at 8.00 hours and 16.00 hours), 15 minutes each, through 4 inches perforated PVC pipe by a 3 hp blower at air flow rate of 0.118, 0.147, and 0.155 m<sup>3</sup>/sec for each pile. It took approximately 30 days to complete the composting and the suitable air flow rate was 0.155 m<sup>3</sup>/sec. Only 1.9-3.2 % of the materials were not completely decayed. The average electricity expense was 0.07 baht per kilogram of raw material per month. From the technology transfer, the Aerated Static Pile system was found to be a potential system in producing compost in commercial scale by local community because of its simple procedure, no turnover needed, low costs and less use of energy.

#### I0019-EFFECT OF HEAT TREATMENTS ON HECTORITE FOR THE ADSORPTION OF AFLATOXIN B<sub>1</sub>

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**Abstract:** The objective of this research was to evaluate the effect of heat treatments on hectorite for the adsorption of aflatoxin B<sub>1</sub> (AfB<sub>1</sub>). Each heated hectorite was prepared by heating the sample at each specified temperature for 1 hr. There were 11 different heating temperatures from 100°C to 1000°C (in increments of 100°C). The results indicated that among the heated hectorites, hectorite heated at 700°C for 1 hr demonstrated the highest AfB<sub>1</sub> adsorption (65.52 ± 0.92%). No significant difference in the increase in the adsorption of AfB<sub>1</sub> was observed when hectorite was heated at temperatures of 100°C, 200°C and 300°C when compared to the parent clay. The binding capacity was increased when temperature was increased to 400°C, 500°C or 600°C. A significantly lower binding was shown at 900°C (40.25 ± 3.11%) and at 1000°C (10.47 ± 6.83%) when the interlayer of clay was collapsed. This study indicates that hectorite clay could be effective for adsorption of AfB<sub>1</sub> and heating hectorite at proper temperature could increase binding capacity.

#### I0020-STUDY OF TOXICITY SITUATION OF FRESHWATER RESERVOIRS BY DETERMINATION OF MICROCYSTIN IN BLUE-GREEN ALGAE USING HPLC

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**Abstract:** Cyanobacteria, or blue-green algae, represent a serious problem in freshwater reservoirs in Thailand where all these reservoirs are contaminated with toxic cyanobacteria, *Microcystis aeruginosa* Kutz. The toxic compounds have been isolated and identified as microcystins, a cyclic heptapeptides. In this studies, the reversed-phase HPLC was used for detection and quantitation Microcystin LR which is one of microcystin analogues in samples of dried *Microcystis aeruginosa* cells. The methanolic solvent (60% MeOH) was used for elution of the toxic peptides. The HPLC condition were C18 ODS column, flow rate 1.0 ml/min, UV 238 nm detector. The HPLC chromatogram of the Microcystin LR identified in the microcystic cyanobacteria extract revealed the retention time of 2.12, which was fully compatible with the standard sample. The quantity of Microcystin LR was quantitated as 0.586 mg (0.0585% yield)

#### I0021-Cadmium Removal from Wastewater by Applying Natural Materials as Sorbents

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**Abstract:** The objective of this research was to study the efficiency of cadmium removal from wastewater using coconut husk, betel nut husk, palmyra husk and oil palm husk. The effect of initial pH of wastewater, initial concentration of cadmium, temperature of wastewater, time required for equilibrium, particle size of adsorbents were investigated and determined adsorption capacity of adsorbents. It was found that the suitable pH for cadmium adsorption onto coconut husk, betel nut husk, palmyra husk and oil palm husk were 4.0, 4.0, 5.0 and 6.0, respectively. The most suitable initial cadmium concentration was 100 mg/L, temperature 30°C, time required for equilibrium 24 hours, particle size 60 mesh. Adsorption capacity for coconut husk, betel nut husk, palmyra husk and oil palm husk were 1.04, 0.54, 0.71 and 0.69 mg/g respectively. After being applied the optimum condition found from the research for cadmium removal from wastewater, it was found that cadmium was adsorbed as followed: coconut husk(80.95%), betel nut husk(71.43%), palmyra husk (80.95%) and oil palm husk (76.19 %).

## I0032-THE MEASUREMENT OF CHEMICAL OXYGEN DEMAND (COD) WITH NO MERCURIC AND STANDARD PROCEDURES: A COMPARISON

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**Abstract:** Chemical Oxygen Demand (COD) is one of qualitative indicator that uses for evaluate organic pollution in water and wastewater. To develop the appropriated analytical method that reduce the amount of hazardous waste in environmental laboratory, no mercuric COD reagent has been focused. No mercuric COD closed reflux was compared with COD closed reflux, colorimetric standard method. These had been studied on KHP standard solution, spiked samples and 100 industrial wastewater samples including 20 of agroindustrial factories, 20 of feed and farm factories, 20 of tuna can factories, 20 of starch and modified starch factories and 20 of domestic wastewater. Recoveries of KHP 1,000 mg/L, spiked KHP 1,000 mg/L by COD standard method were  $101.7 \pm 3.06\%$  and  $99.8 \pm 2.74\%$  respectively. COD standard method on agroindustrial factories, feed and farm factories, tuna can factories, starch and modified starch factories and domestic wastewater showed 256-6,293 mg/L, 350-17,241 mg/L, 264-5,645 mg/L, 296-15,732 mg/L and 113-25,336 mg/L, respectively. No mercuric COD closed reflux showed 358-7,186 mg/L, 421-47,387 mg/L, 304-5,516 mg/L, 316-18,298 mg/L and 222-39,875 mg/L, respectively. The correlation ( $r^2$ ) of no mercuric COD closed reflux and COD standard method on agroindustrial factories, feed and farm factories, tuna can factories, starch and modified starch factories and domestic wastewater were 0.98, 0.99, 0.93, 0.98 and 0.998, respectively. When compared the results of no mercuric COD closed reflux and COD standard method from various kinds of wastewater, no significant difference was found at the 99% confidence interval. The correlation coefficient ( $r^2$ ) of no mercuric COD closed reflux and COD standard method from all kinds of wastewater in this study were 0.93-0.998. The use of no mercuric COD closed reflux has been found to be suitable for COD measurement on various kinds of wastewater in this studied.

## I0033-DEVELOPMENT OF MINIATURIZED CHEMICAL OXYGEN DEMAND (COD)

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**Abstract:** To developed the appropriated analytical method that reduce the amount of hazardous waste in environmental analysis laboratory, the miniaturized closed reflux method for the determination of chemical oxygen demand (COD) that reduced 5 time of reagents and sample amount used from standard method has been developed. To evaluate the miniaturized closed reflux method, the developed method was compared to closed reflux, standard method. The procedure was evaluated by analysis of KHP standard solution (500 mg/L), spike and various kinds of wastewater (COD range 425-4242.2 mg/L) in the total of 98 samples. The developed method showed COD of KHP, spike and various kinds of wastewater were 504.4-548.5 mg/L, 720.2-843.6 mg/L and 445.0-4242.2 mg/L, respectively. The COD from standard, closed reflux method were 512.4-537.8 mg/L, 460.4-621.6 mg/L and 278.6-3894.7 mg/L, respectively. Recoveries of KHP and spike by developed method were  $105.0 \pm 4.4\%$  ( $100.9 \pm 109.7\%$ ) and  $101.9 \pm 11.1\%$  ( $89.0 \pm 108.3\%$ ) and standard closed reflux method were  $104.3 \pm 2.8\%$  ( $102.5 \pm 107.6\%$ ) and  $100.3 \pm 9.0\%$  ( $91.2 \pm 108.2\%$ ), respectively. When compared the results of wastewater from developed and standard closed reflux, no significant difference between the two methods was found at the 99% confidence interval. And the correlation coefficient ( $r$ ) of the two methods was 0.84. The use of miniaturized COD closed reflux method has been found to be suitable for the determination of COD in wastewater.

## I0034-Effect of Chlorpyrifos on DNA damage in Haemocyte of Black Tiger Shrimp (*Penaeus monodon*)

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**Abstract:** Extensive use of organophosphorus pesticides has become the great concern on their effects to aquatic invertebrates. Black tiger shrimp (*Penaeus monodon*) is one of aquatic invertebrates that can be adversely affected by the pesticides. Therefore, the development of the sensitive and precise indicator for assessing the toxic effect of pesticides on the shrimp is needed. The single-cell gel electrophoresis (comet assay) has been conducted to test genotoxicity of chlorpyrifos on the shrimp Haemocytes ( $10^4$  cells) from each treatment was exposed to chlorpyrifos at the concentration of 0, 0.01, 0.05, or 0.25  $\mu$ g/L, respectively ( $N = 3$ ). After 6 hours of exposure, the significant increase of comet tail moment was detected ( $P < 0.05$ ) at the chlorpyrifos concentration of 0.05 and 0.25  $\mu$ g/L compared to control. Moreover, the severity of DNA damage coincided with the increase of chlorpyrifos concentration. It can be concluded from the result that chlorpyrifos has genotoxic effect on shrimp haemocytes.

**I0035-Biodiversity and bioactivity in hydrocarbon contaminated sediments**Poonsuk Pothiruckit-Prachyanusorn<sup>1</sup>, Jeremy R. Mason<sup>2</sup><sup>1</sup>Department of Biology Faculty of Science and Technology Rajabhat Surathani University Surathani Thailand 84100<sup>2</sup>Division of Life Science King's college University of London UK

**Abstract:** One strain of *Arthrobacter* sp. was eventually selected as most appropriate for a bioaugmentation study due its high solvent tolerance and ease of detection using molecular techniques. The study performed over a period of two hundred days involved assessing and monitoring bacterial species in a microcosm contaminated soil laboratory environment. The indigenous microbial community were monitored by means of both PCR, PCR-DGGE, RT-PCR-DGGE analysis of 16S rDNA and 16S rRNA. In addition, bioactivity and detection of degradative genes involved in benzene degradation were studied. Throughout the study, successive changes were observed amongst the microbial population, which was correlated to the changes in environmental conditions applied to the microcosm. Enumeration of both heterotrophic and benzene degraders were observed to fluctuate. In addition, the ratio of bioactivity measurements using radiolabelled [<sup>14</sup>C]-benzene could not be correlated to bacterial counts. Despite the continuous detection of the *Arthrobacter* sp. via PCR-DGGE of 16S rDNA analysis, RT-PCR analysis only detected the strain on day 114. The ability of the inoculant strain to be sub-cultured and identified by the end of the study indicated that the latter was capable of survival. The detection of both DNA and RNA transcripts of the *bedC1* gene throughout the study period indicates that the biodegradation of benzene can be attributed to the presence of the benzene dioxygenase enzyme involved in the initial microbial degradation pathway of benzene.

**I0036-Removal of Heavy Metal in Wastewater by Silica Gel Produced from Rice Husk Ash**

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**Abstract :** This research is to study how to produce silica gel from rice husk to remove heavy metal from wastewater. Removing organic compounds from rice husk by acid and burning always leads to the formation of rice husk ash (the content of SiO<sub>2</sub> to be 94.15 %W/W). Silica gel produced from rice husk ash has been characterized by several techniques. The optimized conditions for Chromium(Cr), Cadmium(Cd) and Lead(Pb) adsorption were studied. The appropriated pH and equilibration time were 5.0 and 6 hours, respectively. The adsorption capacity obtained from the batch method for Cr, Cd and Pb were 3.63, 6.76 and 11.22 mg.g<sup>-1</sup>, respectively. It also found that the adsorption capacity will be decreased when there was other cation in the solution. The studies of column method found that the amount of Cr, Cd and Pb adsorption were 4.09, 7.12 and 12.05 mg.g<sup>-1</sup>, respectively. The removal of Pb in wastewater using silica gel was studied both in the batch and column methods. The result showed that the removal of Pb obtained from the batch and column methods was 7.25 and 10.00 mg.g<sup>-1</sup>, respectively.

**I0037-AN EFFICIENCY EVALUATION OF PHOSPHATE TEST KIT THE DETERMINATION OF PHOSPHATE IN VARIOUS KINDS OF WASTEWATER**Sorasake Kulamai<sup>1\*</sup>, Suchada Chaisawadi<sup>1</sup>, Darawan Thongbutre<sup>1</sup>, and Waraporn Methawiriyasilp<sup>1</sup><sup>1</sup>Pilot Plant Development and Training Institute, King Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand,E-mail address: [sorasake@pdti.kmutt.ac.th](mailto:sorasake@pdti.kmutt.ac.th)

**Abstract:** To choose the appropriated analytical method that simple, rapid, cost-effective, reliable and reduce amount of hazardous waste, the rapid phosphate estimation including phosphate test kit had been proposed. The efficiency of EPA accepted phosphate test kit was compared to phosphate standard method. Phosphate test kit used in this study are EPA accepted phosphate test kit (0-2.5 mg/l) that take only 5 minutes for phosphate measurement. The procedure was evaluated by analysis of standard phosphate and various kinds of wastewater. The results standard phosphate (0.1,0.2,0.4 and 0.5 mg/L) by using phosphate test kit showed% recovery 96.4±0.84, 95.0±0.57, 111.2±0.14 and 95.3±0.34, respectively. showed standard phosphate (1,2,5 and 8mg/L) by using standard method with % recovery 103.3±9.32%, 108.3±3.56%, 102.3±1.42% and 107.8±3.08%, respectively. The results showed phosphate from standard method in domestic wastewater, tuna caned wastewater, feed farm factories wastewater and starch factories wastewater were 0.91±00 (0.1-2), 3.10 ±00 (1.8-6.4), 3.4±00 (2.9-4.7) and 2.03±00 (1.3-2.9) mg/L, respectively. Estimated phosphate from phosphate test kit were 0.72±00 (0.1-2.2), 1.31±00 (0.6-2.5), 2.2±00 (1.1-3.3) and 1.78±00 (1.1-2.5) mg/L, respectively. The correlation coefficient (*r*<sup>2</sup>) of EPA accepted phosphate test kit and phosphate standard method which were compared in various kinds of wastewater was 0.8227. No significant difference between the two methods was found at the 99% confidence interval in all kinds of wastewater. The use of phosphate test kit as the rapid estimation in various kinds of wastewater in this study have been conclude.

**I0038-ENVIRONMENTAL AND SAFETY MANAGEMENT IN UNIVERSIT: CASE STUDY KMUTT THAILAND**Solot Suwanyeun<sup>1\*</sup>, Suchada Chaisawadi<sup>1</sup>, Jarurat woranisarakul<sup>1</sup>, Naraporn Hanwajanawong<sup>1</sup>, Chalarmrij Wantawin<sup>1</sup>,Sirinthonthep Taopreyoon<sup>1</sup>, Nipawan Adisornvorawoot<sup>1</sup>, Linda Pengsuwan and Nantaporn NantaEnergy Environmental Safety and Health Office<sup>1</sup>, King's Mongkut's University of Technology Thonburi, Bangkok 10140, Thailand,E-mail address: [solot@pdti.kmutt.ac.th](mailto:solot@pdti.kmutt.ac.th)

**Abstract:** According to the environment impacts resulting from the activities on educational institutions and others, one of KMUTT policy is directed to Green University concept. The university activities on environment and safety have been

concerned, these include environmental and safety management for education and research. KMUTT is committed to the proper management of environment and safety provides an environmental and safety management service through the Energy, Environment, Safety and Health Office (EESH) Environmental management in KMUTT have been concerned on Chemical and Waste management. Chemical management system within KMUTT have been developed by using KMUTT Chemical database. To decrease the environmental pollution and minimize the risk of students, staffs and members of public. Laboratory waste management has been set up within KMUTT and aim to play an important role to maintain a safe and environmentally responsible within the university. Chemical and Laboratory waste management system within KMUTT has been established since 1999 according to research grant from the Thailand Research Fund of the master plan to establish a National Industry/University Cooperative Research Center (IUCRC). The system, procedures and manuals for the laboratory waste management and treatment were developed according to the Green University policy and standard practices. Waste minimization program has been set up and implemented in the pilot laboratory that successfully operated under the new developed system. Safety management have been developed according to standard practice with procedures and manuals on chemical safety, biosafety, electrical safety and equipment and machinery safety. Proper safety equipments and personal protective equipment (PPE) have been provided for students and staffs. Training and preparation on the developed procedures and systems have been given to majority of KMUTT staff. The system procedures and manuals for environmental and safety management have been developed and implemented for ten of pilot laboratories within the university. The systems evaluation show implementation require the cooperation and support of students, faculty and staff members. Nowaday, the environmental and safety management system have been implemented by 60% within KMUTT. And therefore, it is quite ready to expand the management system within KMUTT to cover all others in a near future. This paper describes the study and implementation experience on environmental and safety management in the university. As a results of this study, environmental and safety management within KMUTT can help to decrease the environmental impacts and maintain a sustainable management to all staffs and public.

#### **I0039-Analysis of Atmospheric Stability in Chiang Mai Province from Sounding and Calmet Model**

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**Abstract:** Analysis of atmospheric stability in Chiang Mai was conducted by both meteorological thermodynamic diagram analysis and Calmet modeling. Atmospheric stability was analyzed from the positive area and negative area of sounding data plotted on the thermodynamic charts. Stability classes of the atmosphere were classified from the output of the Calmet model with surface data, upper-air data, and geophysical data as the input data, according to Pasquill-Gifford-Turner (PGT) stability classes.

#### **I0040-Simulation of the favorable condition heavy rainfalls due to effect of the active south-west monsoon and Chanthu depression by MMS**

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**Abstract:** The weather conditions under the influence of the Chanthu depression and the active south-west monsoon in June, 2004 were investigated by the MMS. Favorable conditions for heavy rainfalls in Pitsanulok province and nearby areas were signified from the simulated convergence of the moist south-west monsoon and the Chanthu depression flow. Strong updrafts and the negative divergence of moist air over the affected areas were also indicated from the MMS outputs. The predicted range of rainfalls in Pitsanulok province on June 14, 2004 were 8.0-12.0 cm/24 hrs.

#### **I0041-Numerical simulation of the active low pressure area over Cambodia by MMS**

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**Abstract:** The effect of the active low pressure area over Cambodia was analyzed by the MMS during September 11-14, 2003. Surface moist air convergence was simulated over the active low pressure area which was supported by the negative divergence of the moist air. The maximum predicted rainfall were 6.2-6.5 mm

#### **I0042-Numerical weather simulation of the O2B cyclone in Thailand by WRF Model**

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**Abstract:** The investigation of the track of the O2B cyclone developed in the Andaman sea, the Indian ocean, which caused heavy rainfalls and severe floods in Tak province and nearby areas during May 15-21, 2004, was analyzed by the Weather Research and Forecasting model (WRF). Cyclonic flow and predicted rainfalls in the affected areas were simulated along the depression track. The simulated cyclonic flow was indicated in the Andaman sea at the 15° N latitude, the 94° E longitude with the wind speed at 50 km/hr on May 15, 2004 and later on at the 19° N latitude, the 92° E longitude with the wind speed at 54 km/hr on May 17, 2004. The maximum predicted rainfall on May 17, 2004 were 20-40 mm at Tak province.

#### **I0043-Numerical simulation of active monsoon trough over northeastern Thailand by MMS**

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**Abstract:** Monsoon trough is favorable condition for the development of big clouds and heavy rainfalls. Analysis of the weather in northeastern Thailand on September 11, 2003 by MM5 models indicated convergence of moist air, the updraft, heavy rainfall. Along the monsoon trough predicted maximum rainfall on September 11, 2003 were 60-62 mm./3 hrs

**I0044-Numerical Weather Simulation of the Chanthu depression track by WRF**

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**Abstract:** The Analysis of the Chanthu depression track was performed by the Weather Research Forecasting (WRF) model. Simulated track indicated the cyclonic flow of the Chanthu typhoon, developed in the South China Sea moving north-westward during June 9-15, 2004. The vortex of the depression on June 11, 2004 was found at the latitude 10°N, the longitude 120°E with the wind speed of 65 km/hr and moved onwards to Thailand at the latitude 16°N, the longitude 103°E with the wind speed of 50 km/hr on June 14, 2004. Heavy rainfall due to the influence of the depression was also detected in Phitsanulok province and nearby areas where severe floods were reported.

**I0045-Numerical simulation of the depression in the gulf of Thailand by WRF**

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**Abstract:** This study simulated the cyclonic flow track in the gulf of Thailand, the wind vector convergence and the effects on the rainfall in southern during October 21-24, 2003 by WRF model. The model detected the active low pressure area in the gulf of Thailand that developed into a depression moving north- westward resulted in heavy rainfalls and flash floods in the low lands of Prachuap Khiri khan, Chumphon, Surat Thani, Nakhon Si Thammarat and nearby provinces in southern Thailand.

**I0046-Application of CALPUFF Model on Sulfur Dioxide Dispersion from Mae Moh Power Plant**

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**Abstract:** This research uses the CALPUFF model, which consists of 3 sub - models; CALMET, CALPUFF and CALPOST to simulate the dispersion in Lagrangian form of exiting sulfur dioxide from the stack in Mae Moh Power Plant in Lampang as well as the wind speeds, wind directions and surface 2 SO concentrations. The study area covers 1600 square kilometre in the 18.1 - 18.5 ° N latitudes and the 99.5 - 100.0 ° E longitudes. Simulated 2 SO concentrations were 25.2 3 / g m μ and 6.4 3 / g m μ at the main station and the government center station respectively on Nov 11, 2002.

**I0047-REMOVAL OF CHROMIUM (III) AND CHROMIUM (VI) FROM AQUEOUS SOLUTION BY ALGAE *SPIRULINA* AND *CHLORELLA* SPECIES**

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**Abstract:** Chromium (Cr) removal has been studied using three types of algae, namely *Spirulina* sp., *Chlorella vulgaris* TISTR 8261 and *Chlorella vulgaris* TISTR 8580. Cr(III) and Cr(VI) were simultaneously determined by using ion interaction chromatography with the detection at 200 nm. From the result, it was found that three types of algae offered satisfactory results for removal, but only *Spirulina* sp. was selected to further work. According to the developed *Spirulina* sp. system, Cr(III) was completely removed (100%) at pH 8.0 within 15 hours of contact time with the metal uptake value of 41.2 mg Cr/g biomass. Meanwhile, at pH 2.0, Cr(VI) removal was nearly completed (88%) within 5 days of contact time with the metal uptake value of 36.6.

**I0048-LEAD REMOVAL IN WASTE WATER BY HEAT TREATED COCKLE SHELL AND MUSSEL SHELL**

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**Abstract:** The comparative studies on lead removal in synthetic wastewater have been investigated by using cockle shells and mussel shells as absorbents. Upon heating in a domestic cooking stove followed by rapid cooling, shells were broken into fine particles and the desired particle size of 0.125-0.250 mm can be obtained by screening. The structure and surface of absorbents were examined by using XRD and SEM, respectively. The XRD results showed that cockle shells were mainly composed of calcium hydroxide and calcium carbonate in form of calcite, while the major composition of mussel shells was

calcium carbonate in form of aragonite and calcite. Factors influencing adsorption in a batch process studied in this work included the contact time, the initial pH, the quantity of shells, and the Freundlich adsorption isotherm. The observed maximum absorption capacity of cockle shells was 0.5 mg (lead)/g (adsorbent) at 10 min and mussel shells was 5 mg/g at 5 min. The initial pH did not have a significance effect on the adsorption of lead. The adsorption constant in Freundlich isotherm was found to be  $1.21 \times 10^{-1}$  and  $1.31 \times 10^{-3}$  mg/g for cockle shells and mussel shells, respectively. The continuous process using a packed column was also studied. The results indicated that, under the conditions studied, both cockle shells and mussel shells could efficiently remove lead from the flowing solution. The effluent up to 15 and 45 times of the adsorbent bed volume could be treated by cockle shells and mussel shells, respectively, with the lead concentration in the effluent remaining lower than 0.2 mg/L, which is the standard for lead content in wastewater set by the Ministry of Industry. The results from batch and continuous processes similarly suggested that mussel shells had higher efficiency in lead removal than cockle shells.

#### **10049-THE POTENTIAL OF NARROW-LEAVED CATTAIL (*Typha angustifolia*) FOR DYE REMOVAL**

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**Abstract:** Textile wastewater mainly contained chemicals and dyes. Reactive dyes in textile wastewater can be dissolved well in water and caused unattractive to the public. Phytoremediation is an alternative method for decolorization of textile wastewater, which is low cost and easy to operate. Narrow-leaved cattail (*Typha angustifolia*) is selected for wastewater treatment because its ability to absorb the large amount of nutrient and contaminated substances. In this study, narrow-leaved cattail was conducted under the soilless conditions, with different synthetic dye and synthetic wastewater concentrations (0, 10, 20 and 30 mg·L<sup>-1</sup>). Comparison of Narrow-leaved cattail at initial pH of 5.8 and 8.8 was studied. The result showed that plant could remove dye well in the system pH with 5.6 - 6.4. The maximum dye removal was approximately 36 % in the treatment of wastewater containing 20 mg·L<sup>-1</sup> synthetic dye with initial pH 8.8. The further study will examine what chemical substances involved in dye removal and how dye can be uptake into the shoot. The defense mechanism of the plant will also be investigated.

#### **10050-Forecasting Peak Discharge at Chao Praya Dam (station C13) During September to November 2003 by using AIT River Network Model**

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**Abstract:** AIT River Network Model is the mathematical model in order to forecast the peak discharge and hydrograph forecasting at Chao Praya dam during September to November 2003, by utilizing 3 data requirements: daily rainfall from TMD during 1<sup>st</sup> July 2003 to 15<sup>th</sup> September 2003, daily discharge from Bhumibol and Sirikit dams during 1<sup>st</sup> July 2003 to 15<sup>th</sup> September 2003, and peak discharge at Chao Praya dam before 16<sup>th</sup> September 2003. Time base of hydrograph shows period of forecasting dates, which display the daily peak discharge (accuracy  $\pm 5\%$  and  $\pm 150$  days) and 9 to 26 days forecast (accuracy  $\pm 5$  days). This model is limited by the conditions that the peak discharge at Chao Praya dam will be not greater than 2500 cms. and the forecasting date will start when the ratio of Q/Qp is greater than 0.4. The result of this model can be used as upstream boundary condition in mathematical model and flood warning.

#### **10051-Relationship of Dam's Water Storage to be a Guideline for Dam's Water Management**

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**Abstract:** The research about relationship of dam's water storage to be a guideline for dam's water management has been divided into 2 parts; rainy (July - December) and dry (January - June) season. The model of this experiment was run on 8 dams around the country, which is, Banglang dam, Bhumibol dam, Kangkrachan dam, Rajaprabha dam, Sirikit dam, Srinagarind dam, and Ubonratana dam by using dam's data from Electricity Generating Authority of Thailand (EGAT) and monthly rainfall's data from Thai Meteorological Department (TMD). **In rainy season**, this research has the assumption that monthly rainfall in rainy season has affected to dam's water storage in rainy period. It was proved that monthly rainfall in rainy season has linked to dam's water storage in rainy period. **In dry season**, the research aimed to prove the assumption that dam's water level at the beginning of dry season has effected to dam's water storage in dry period. From the experiment, it was proved that dam's water level at the beginning of dry season has linked to dam's water storage in dry period. The result of this experiment could be used as a guideline for dam's water management in various conditions, by using water storage up dam and dam's water level

**10052-Relationship of Rainfall between TMD's station and TRMM's Satellite Image Archive**

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**Abstract:** TRMM (The Tropical Rainfall Measuring Mission) is a mission for record rainfall data in tropical regions from the satellite image archive. This research is aimed to compare daily rainfall data from TMD (Thai Meteorological Department) to the satellite image archive of TRMM in form of graph. from July 22, 2003 – January 20, 2004. The results from two of these sources are quite similar, hence, we could summarize that TRMM data can replace the missing data of TMD's rainfall stations.

**10053-Prediction of atmospheric polycyclic aromatic hydrocarbons using orange jasmine *Murraya paniculata* (L.) Jack leaves**

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**Abstract:** This work was to study sorption of atmospheric PAH in orange jasmine leaves, *Murraya paniculata* (L.) Jack and their potential to predict atmospheric PAH were investigated. The partitioning experiments between the leaves and the water were conducted and calculated for the leaf/air partition coefficients. The air and leaves at the same 4 Bangkok roadsides were collected and analyzed for 16 PAH. The actual measured PAH concentrations were compared to atmospheric concentrations calculated from the leaf/air partition coefficients to evaluate the potential indicator. There were close relationships between calculated and measured PAH in the air as indicated by good correlation coefficient ( $r^2 > 0.70$ ) particularly lower molecular weight (MW) PAH, which were ACY, ACE, FLU, PHE and ANT. This was due to lower MW PAH mostly present in gas phase, which played a major role in leaf sorption. Therefore, higher MW PAH existed mainly in particulate phase exhibited lower correlation coefficient ( $r^2 < 0.6$ ).

**10055-Preliminary study of elemental composition in tree leaves for using as biomonitor for air pollution**

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**Abstract** The use of plant tissue as biological monitor of air pollution had been of interest worldwide. The study on chemical composition of such biological monitor may provide important information on the levels and pathways of a variety of pollutants including heavy metals and trace toxic elements in atmosphere. The appropriate biomonitoring are such as herbaceous plants, tree leaves, bryophytes and lichens, with their possible advantages and/or limitations. In this research, an investigation of element composition in leaves was performed. The technique of Instrumental Neutron Activation Analysis (INAA) was developed to determine heavy metals and trace elements in 8 species of tree leaves collected from 3 different locations. From the experiments, it was found that content of elements might vary depending on species and environment. Some specific elements are discussed and compared in this report.

**10056-DETERMINATION OF FURAZORIDONE RESIDUE IN PORK SAMPLES IN MUNICIPAL AREA, AMPHUR MAUNG, UBON RATCHATHANI PROVINCE**

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**Abstracts :** Furazolidone, an antibacterial drug in the nitrofurans group, often be mixed to stimulate growth and prevent infection in animals. These compounds are carcinogenic. In this study, pork samples were collected from local market in municipal area, Amphur Maung, Ubon Ratchathani province. Furazolidone in pork samples were examined by spectrophotometric method. The result indicated that, furazolidone in heart, meat and skin of pork samples were  $4.36 \pm 0.09$ ,  $3.04 \pm 0.07$  and  $2.24 \pm 0.08$  mg/kg respectively. The percentage recoveries of furazolidone in heart, meat and skin were 105.0, 99.1 and 95.4 respectively.

**10057-DEVELOPMENT OF WASTE MANAGEMENT DATABASE WITHIN KMUTT**

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**Abstract:** Waste management database within KMUTT has been developed according to the policy and standard practices. In this database, the laboratory wastes were separated into 23 difference categories for storage and treatment according to the activities within KMUTT. The developed database system has been designed by using SQL server for database operating system, Microsoft Window 2003 Server for Server operating system and ASP for webpage development. Pilot laboratory Process and Environmental Analysis Center has been successfully operated under the new developed database system. The demonstration results indicate that the waste management database system established could be collected all data and analysed the amounts and categories of waste produced within the pilot laboratory. Training and preparation on the

developed procedures and system have been given to majority of laboratory staff on KMUTT. Nowaday, the waste management database system have been implemented by 50% of analytical laboratory within KMUTT. And therefore, it is quite ready to expand the system to cover all other laboratory operation within KMUTT in a near future.

**10058-Removal of Zinc (II) by silica gel produced from rice husk and modified with amino-thiol groups**

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**Abstract :** Silica was extracted from rice husk (the content of silica to be 99.82 % w/w) and was prepared for silica gel. The silica gel was immobilized with amino-thiol groups and it was characterized by FT-IR spectrum and showed the additional peaks at wavenumber at 3303 and 2553  $\text{cm}^{-1}$  which corresponded to  $-\text{NH}$  and  $-\text{SH}$  groups. The batch and column methods using this sorbent were demonstrated for removing Zn(II) from the Zinc electrolysis industrial wastewater which has concentration about 3300 ppm and the interference of Pb(II) Cd(II), Hg(II) and As (III) the total contents about 500 ppm. The results indicated that the removing in percent of Zn(II) on the batch and column methods were  $70.24 \pm 0.12$  and  $99.98 \pm 0.40$  respectively for 5 ml wastewater and 0.5 g sorbent dosage.

**10059-The Impacts of Natural Leaching and Production of Salt on the Water Quality of Mae Num Songkram**

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**ABSTRACT:** Water samples were collected from 13 stations between Ban Dung (Udonthani province) and Ban Ta-sa-ard (Nongkai province) in February, May, August and December. The collected samples were determined for the content of some anions, cations and heavy metalas including  $\text{Cl}^-$ ,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ ,  $\text{PO}_4^{3-}$ , Na, K, Mg, Ca, Pb, Cd, Mn and Hg. The result revealed that there was salt contamination from natural leaching at station 1 during early rain. The impact of salt production activity on water quality in Songkram river was clearly shown during dry reason. Because salt production was allowed only from November to May each year. Two major sources of salt production areas that contributed to Songkram river salt contamination were supposed to be Ban Dung area which resulted in maximum content of 3,207.3 ppm NaCl in Ta-ma-now reservoir and Ban Ta-sa-ard where underground saline water was taken from the middle of the river and transported to boiling factories on the nearby river shore. The content of salt in Songkram river at this station was 974.1 ppm NaCl in February. The content of some heavy metals, in all samples were normal according to the standard of surface water quality of Thailand.

**J0001-STRENGTHEN OF COUNTRY COMPETITIVENESS BY EXPLOIT PATENT INFORMATION.**

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**Abstract:** Patent information disclosed technology for the production of all kind of industrial products. These database of industrial technology accumulated for more than 200 years. About 30 million documents from 71 countries able to search very rapidly from European patent office at <http://ep.espacenet.com>. Patented technology that not registered in Thailand or in any other country are public properties, every body could commercialize to make world progress. Good performance were found in trial use of patent download software such as Patent Hunter, IP-Discover, Patent Browser. Patent analysis software such as INAS, Matheo Patent found to be very useful for patent intelligent to find trend of competitor and technology trend and patent mapping to analysis white space of technology. The promotion of patent information and utilization of patent software through publics mass media were done continuously. More than 2,000 persons participated in 48 training course on Patent search and patent software utilization. Recently, Competitiveness development office, Office of the National Economic and Social Development Board understand about an important of patent information for strengthen of country competitiveness going to exploit these patent information.

**J0002-GROWING OF CsI(Tl) CRYSTAL FOR SCINTILLATION**

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**Abstract:** A CsI(Tl) scintillation crystal was grown under a simple developed process using the Bridgman-Stockbarger method. An economical vertical furnace was designed for crystal growing. The 99.9% purity CsI powder and 99.999% purity TlI powder were mixed and processed in closed system of crystal growth tube under pressurized Argon gas. In these studies, the parameters of 0.1 mol% TlI mixing concentration, 2 mm/h translation rate of crystal growth tube and 37.48 °C/cm of temperature gradient at the crystal growing zone were applied. It was found that the CsI growth crystal rod was clear and the non-uniform concentration of activated Tl in CsI growth crystal was in range of 0.0256 – 0.0806 mol%. The developed CsI(Tl) crystal was tested by coupling with the P-I-N photodiode and assembled as a scintillation detector for gamma spectrum analyzing. The tested results have shown the energy resolution of 15.48% at 662 keV for 10 mm diameter and 8 mm thickness of a crystal.

**J0003-A THICKNESS CONTROLLING SYSTEM OF ELECTRICAL WIRE INSULATING MACHINE USING RADIATION TRANSMISSION TECHNIQUE**

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**Abstract:** The microfocus x-ray transmission radiography was applied for developing a thickness controlling system of an electrical wire insulating machine associated with the image edge detection by Sobel method to determine an insulation sheath thickness and evaluate a conductor wire off-center. The evaluated results was employed to generate an error signal which was proportional to shifting magnitude and could be used to control an injection rate of the wire insulating machine. The developed system consisted mainly of a microfocal spot x-ray generating system and a real time fluoroscopic system. An x-ray image signal of x and y axes were sent to microcomputer for image processing and displaying. In operations test, the thickness of PVC insulated for electrical wire at cross-section area of 1, 1.5, 2.5 and 4 mm<sup>2</sup> were inspected comparing with the standard method. It was found that the inspected value were less than 120 µm error and the error signal from conducting wire center shifting resulted at 0-0.16 mm corresponding to 0 – 9.33 V could be generated.

**J0004-RATE OF STYRENE-NR EMULSION COPOLYMERIZATION WITH HIGH RUBBER CONTENT IN VARIOUS REACTION CONDITIONS**

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**Abstract:** The emulsion copolymerization of NR and styrene monomer at high rubber content was done by mixing natural rubber latex, styrene, initiator, emulsifier, and water. The concentration of initiator, emulsifier, natural rubber, and temperature effected the rate of emulsion copolymerization. The initiator, emulsifier, styrene to rubber ratio, and temperature in polymerization recipe were increased from 0.8 to 1.4 parts, 4.5 to 6.5 parts, 2:3 to 1:1 per 100 parts of organic materials, and from 58 °C to 64 °C respectively. The rate of polymerization increased with these parameters. Moreover, the morphology of grafted polystyrene-

rubber consisted of NR core and polystyrene shell was observed by TEM study. The number of polystyrene and grafted polystyrene-rubber particles were obtained.

**J0005-Layout Improvement by Using Roll Heuristic**

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**Abstract:** This research presents a new construction algorithm for computer – aided plant layout which combined the advantage of several construction algorithm together. The placement procedure for placing all departments into the layout which is placed in the 'Roll Pattern'. For the layout design in flow shop production system, this research generated a new layout for the television assembly plant. The layout is evaluated by the minimize distance – weighted adjacency – based objective and the maximize adjacency – based objective. From the result found that the layout generated from Roll Heuristic has the layout score near the both objectives more than the layout generated from CORELAP, and it used material handling distance less than the layout generated from CORELAP about 21.89 %.

**J0006-Power Characteristic of Conventional Impellers and The Ekato Intermig for Liquid Mixing**

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**Abstract:** Power characteristic of two convention impellers (Pitched-blade and Bar) compared with a high efficient impellers (Ekato Intermig) all fitting with one, two, and three stages, was studied for turbulent fluid stirring in a reactor. Studying the power characteristic from the Power number,  $P_o$ , in turbulent regime and the energy dissipation rate per unit mass or power input ( $\varepsilon_T$ ) showed that turbulent  $Re$  ( $Re > 20,000$ ) and  $\varepsilon_T$  at the same impeller speeds of the Pitched-blade and the Bar was ~5 times higher than those of the Ekato Intermig. In addition, testing these three impeller types were carried out by stirring a rheologically complex fluid, (the alkaline-cell lysate) which was very viscoelastic, to extract plasmid DNA. Results showed that all three impeller types gave no difference in pladmid yield and mixing time for both cell lysis and neutralisation steps. These can be concluded that the Intermig worked essentially well when compared with two convention impellers and it dissipated ~5 times less power.

**J0007-BATCH SIMULATION OF CONTINUOUS COUNTERCURRENT RARE EARTH EXTRACTION**

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**Abstract:** Liquid-liquid extraction is applied to separate and purify individual rare earths. Organic phase and aqueous phase flow continuously in countercurrent direction. Aqueous phase is rare earth nitrate solution and organic phase is 50% tributylphosphate in kerosene. Six-stage continuous countercurrent liquid-liquid extraction was simulated using separatory funnels by varying flow ratio of organic solvent per feed (S/F) to investigate optimum and high efficiency operating conditions. It was found that at S/F equaled to "2", 95.23% lanthanum in raffinate was upgraded from 51.55% lanthanum in feed solution.

**J0008-NOVEL Fe-BASED CATALYSTS FOR FUEL SYNTHESIS**

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**Abstract:** Fischer-Tropsch synthesis involves reactions between carbon monoxide and hydrogen to produce paraffins and olefins with linear and branched chains, which are used as automobile fuels. This research focuses on the production of gasoline and diesel fuels using Fe supported ZSM-5 catalysts and studies the improvement of catalysts using Cu and K promoters. Several catalyst compositions were prepared systematically and characterized using XRD, BET, and SEM. Their catalytic performances were investigated by measuring and comparing kinetic parameters such as reaction rate, CO conversion, product selectivity and yield. A catalyst sample was pretreated with 30 ml/min of H<sub>2</sub> at 500°C for 4 h prior to Fischer-Tropsch reaction, which was carried out using a tubular fixed bed reactor in the temperature range from 300 to 500°C under atmospheric condition in order to determine the efficient reaction conditions. A 30 ml/min flow of reactant mixture having H<sub>2</sub>/CO equal to 2:3 was used to test Fe/ZSM-5 catalysts at different iron loadings i.e. 6, 8, and 30 wt%. Experiment results showed increase in CO conversion as temperature increased and gave maximum value at about 400°C. Loading of 18 wt% of Fe on ZSM-5 appeared to have highest CO conversion at this condition. The distribution of hydrocarbon products was analyzed for C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, and C<sub>4</sub>, in percentages as 8.75, 1.09, 0.44, and 0.11, respectively.

**J0009-The Development of an Elevator for a Single-crystal Furnace**

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**Abstract:** In a single-crystal growth of materials by moving a furnace along the growing area, an appropriate temperature of the growing area in a specific time is one of the main crucial factors on determining the quality of crystal growths by Bridgeman Stoebarger Technique. To this end, the using of an efficient furnace elevator is required. The main aim of this paper is to develop the elevator having antifriction bearings and a motor controller to provide a suitable heat transfer along the growing area. The motor controller is controlled by PIC16F877 microcontroller in combination with an optical rotary encoder and a real time clock. The constructed elevator was designed to lift a weight 1-10 kg at the speed of 0.5 - 3.0 millimeters per hour. Note that the elevator height is 25 centimeters. Our experiments show that the elevator can be used in the single crystal growth of LiF with the operating speed 2.0 millimeters per hour for 10 hours in a constant manner.

**J0010-PROCESS PARAMETERS AFFECTING THE KINETICS OF EUCALYPTUS KRAFT PULP DELIGNIFICATION WITH PEROXYACETIC ACID**Pongsatorn Chaivichit<sup>1</sup>, Panitnad Chandranupap<sup>1</sup> and Pravitra Chandranupap<sup>2</sup><sup>1</sup>Pulp and Paper Technology, Chemical Unit and Thermodynamics Research Group, Department of Chemical Engineering, Faculty of Engineering, King Mongkut's Institute of Technology North Bangkok, Thailand.<sup>2</sup>Department of Industrial Chemistry, Faculty of Applied Science, King Mongkut's Institute of Technology North Bangkok, Thailand

**Abstract:** Kraft pulp delignification with peroxyacetic acid is known to be affected by chemical charge and temperature. In order to describe the kinetic equation, other variables that might affect pulp delignification, pH was found to be an important factor. The delignification rate increased with increasing pH to the value of 6. High delignification rate was obtained when the pulp was chelated with prior to the peroxyacetic acid stage. Therefore, delignification reaction rate depends on peroxyacid charge, temperature and pH. Lignin removal is described as a single reaction. The rate of this reaction increases with increasing temperature, pH and peroxyacetic acid concentrations. The reaction order with respect to lignin is high (4.52), probably because the single reaction is actually a combination of several parallel and consecutive reactions. The reaction order with respect to peroxyacetic acid and hydronium ion are 1.92 and -0.4, respectively. The activation energy of delignification is 88.8 kJ/mol.

**J0011-Use of FEM to Predict the Leakage Behavior of a Exhaust Gasket Part II: Leakage Test under Thermal Cyclic Loading.**Wisansart Satana<sup>1</sup>, Karuna Tuchinda<sup>2</sup><sup>1</sup>Department of Tools and Materials Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, 10140. Email: [wisansart@yahoo.com](mailto:wisansart@yahoo.com)<sup>2</sup>Department of Tools and Materials Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, 10140. Email: [ikarisut@kmutt.ac.th](mailto:ikarisut@kmutt.ac.th)

**Abstract:** Leakage tests under high pressure and thermal cyclic loading are very important in the design and manufacturing of exhaust gaskets. The ability to simulate such tests using computational technique could lead to a huge reduction in time and cost consumption. In the first part of the current work, the finite element method (FEM) has been used as a tool to predict the behavior of a three-layer gasket during a leakage test under high pressure. The detail of this part of the work is described in Part I. In this paper, FEM has been applied to study the performance of the gasket similar to that studied in Part I but, instead, subjected to a leakage test under thermal loading. The main purpose of this work is to increase an understanding in the behavior of the gasket under thermal loading. It has been found that the thermal loading has a significant effect on the leakage behavior of the gasket. Moreover, the stress distributions developed in each layer of the gasket are different from those observed in the case where the gasket is subjected to high pressure

**J0012-Use of FEM to Predict the Leakage Behavior of Exhaust Gaskets Part I: Leakage Test under High Pressure**Wisansart Satana<sup>1</sup>, Karuna Tuchinda<sup>2</sup><sup>1</sup>Department of Tools and Materials Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, 10140. Email: [wisansart@yahoo.com](mailto:wisansart@yahoo.com)<sup>2</sup>Department of Tools and Materials Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, 10140. Email: [ikarisut@kmutt.ac.th](mailto:ikarisut@kmutt.ac.th)

**Abstract:** A gasket is generally used to minimize fluid leakage in exhaust pipes. Under operating conditions, an exhaust gasket will expose to the clamping force and the high temperature and pressure generated during the combustion. Different types of tests are usually required to ensure the good efficiency of a gasket. A leakage test under high pressure is one of the main standard tests. During the design process, a huge number of trial and error tests are usually performed which consumes a great deal of both time and cost. In this work, the finite element method (FEM) has been employed to simulate a standard leakage test under high pressure of a three-layer metal gasket in order to minimize the number of trial and error tests. It has been found that a performance of the gasket predicted by FEM agrees well with that observed from the experiment. Moreover, by using the

technique of modelling each layer of the gasket separately, a better understanding of the behavior of each layer under tests could be obtained.

#### J0013-The development of scaled-up new three-phase separator in a UASB reactor

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**Abstract:** The formation of microbial granules and reduction of granule losses at the outflow are important for optimal performances of Upflow Anaerobic Sludge Blanket systems (UASB). A new three phase separator in a lab scale UASB with working volume of 7.2 liter had been reported to help reduce particle losses with the effluent [1]. The objective of this study was to scale up the new three-phase separator and to evaluate its performance in a 30 liter UASB. A UASB with a conventional three phase separator was also set-up and operated in parallel for performance comparison. Wastewater, with COD between 5,000-8,000 mg l<sup>-1</sup> and pH 5-6, was accommodated from a canned fruit factory. The initial seed for microbial granules with volatile suspending solid around 23.37 g l<sup>-1</sup> was from an anaerobic digester system. The UASB operation was started up under the atmospheric temperature with the hydraulic retention time at 88 h, corresponding to organic loading rates around 2 kg COD m<sup>-3</sup> d<sup>-1</sup>. After 40 days of operation, both reactors showed good performances in treating wastewaters from a canned fruit production factory. In addition, based on the effluent VSS data, the UASB reactor with the new three-phase separator showed a the higher potential in retaining large-sized granules.

#### J0014-DESIGN AND CONSTRUCTION OF INDUSTRIAL SCALE VACUUM COATER.

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**Abstract:** The objective of this project is designing and construction of industrial scale vacuum coater for decorative industrial. The system consists of 7 major parts, namely, (1) a stainless steel vacuum chamber in octagon shape with 132 cm in diameter and 125 cm height, (2) vacuum pump system consists of diffusion pump, rotary pump and root pump, (3) a planar magnetron cathode, 22x67 cm, (4) a high voltage dc power supply was 3 phase 380 V, transforms to dc current, 20 kW, (5) cooling water system for cooling a cathode, a target and vacuum pump system, (6) the gas flow control system can adjust the rate of gas was mass flow controller and (7) system control unit for control all parts of vacuum coater. The ultimate pressure of this vacuum coater is 3.5x10<sup>-5</sup> mbar. (in 30 min). This vacuum coater can deposite an aluminum thin films on a large glass (substrate), it give a very bright color of this metal and good films adhesion.

#### J0015-DESIGN AND CONSTRUCTION OF INDUSTRIAL SCALE PLANAR MAGNETRON SPUTTERING CATHODE.

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**Abstract:** The objective of this research is to design and construction of unbalanced magnetron cathode for used in industrial scale vacuum coater. In this research we constructed magnetron cathode from stainless steel in rectangle shape and separated electrode with Teflon, the size of this cathode was 22.0 x 67.0 cm long, for sputter target in rectangle shape with 15.0 x 60.0 x 4.6 cm. and using water for cooling the cathode. The magnetic field of this cathode was from the NdFeB permanent magnetic which attached to the back of cathode, which had asymmetry types, and high voltage DC power supply, 3 phase 380 V, 20 kW. This cathode can generated glow discharge with pressure about 2.0x10<sup>-2</sup> mbar, 300 voltage and 1 A. The cathode can deposited the metal thin films of aluminium and gold on the large flat glass substrates (80.0 x 80.0 cm) which give a very bright color of those metals and good films adhesion.

#### J0016-DETERMINATION OF CONVECTIVE HEAT TRANSFER COEFFICIENT OF GINGER DRYING UNDER NATURAL CONVECTION

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**Abstract:** This paper, an attempt has been made to evaluate the convective heat transfer coefficient operating in ginger drying in open sun drying conditions (natural convection). Values of the constant C and  $n$  were obtained by linear regression analysis from experimental data obtained for ginger. Based on the values of C and  $n$  convective heat transfer coefficient for ginger drying was determined of 26.25 W/m<sup>2</sup> °C.

**J0017-SPEED CONTROL SYSTEM OF DC MOTOR USING FUZZY LOGIC FOR A MACHANICAL ASSISTED MACHINE SYSTEM**

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**Abstract:** In this work, we propose the speed control system using fuzzy logic controller for dc motor. The design of fuzzy logic controller for driving a dc motor is for constant speed control with fast response. The application of this work is to use in a mechanical assisted machine with more than two energy sources.

**J0018-EFFECT OF TEMPERATURE ON ORDERING WITHIN SUBMONOLAYER FILMS GROWN THROUGH SLOW DEPOSITION OF PARTICLES**

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**Abstract:** Using Monte Carlo simulations, we have found that monolayer structures grown through sequential deposition of particles on a perfect solid surface shows increasing degrees of clustering as the temperature is lowered. In the low-temperature limit, a two-dimensional model system with a non-degenerate ground state would result in almost a perfect crystal. The opposite, high-temperature limit corresponds to the case of random sequential addition (RSA). In the present work we study the continuous evolution from disorder to order at intermediate states using a triangular well potential to represent particle short-ranged interactions. For each temperature, we investigate the bond order parameter as measures of the degree of crystallinity of the structures up to a reduced number density of 0.65, which is close to the jamming limit of RSA.

**J0019-LOW COST AND SIMPLE ASSEMBLY SHORT-LONG WAVELENGTH UV-BOX FOR ORGANIC CHEMISTRY LABORATORY**

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**Abstract:** The cheaply short (254 nm)-long (366 nm) wavelength UV box for organic chemistry laboratory without any exotic components and winding any transformers has been created. The manufacture UV box being from the domestic materials. The general lamp of UV and fluorescent 220 Volt, 10 Watts and 50 Hertz as the main components were connected in the wooden box (24 x 12 x 15). The commercial low pressure mercury UV lamp was used. The front of the box is clear wood so that the exhibit can be viewed and convenient for insert any TLC side. The top of wooden box contained glass window for observing the color point of mixed UV indicator TLC. The inside box was painted with dark color to make it more clear for the exhibit UV absorption.

**J0020-OZONE GENERATING METHOD USING PLUSE WIDTH MODULATION**

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**Abstract:** This paper presents the design of the ozone generating procedure using Pulse Width Modulation (PWM) with high voltage high frequency inverter. With the working process of the increasing voltage half - bridge inverter, TL494 is in controlled of the switching. The half bridge inverter is designed to operate at 10 – 100 kHz frequency through a high frequency switching transformer at output voltage of 2.7 kVp. By adapting the highly nonuniform electric field to the stainless electrode design of the ozonizer, one-hour operating yields the maximum ozone generating capacity of 1.2 gO<sub>3</sub>/hr.

**J0021-Speed Sensorless DC Motor Using Digital Signal Processing System**

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**Abstract:** This paper proposes a new application of digital signal processing system estimate speed sensorless DC motor. In the design, the mathematical model of DC motor in discrete state-space form will be created[1, 2, 8]; the speed of DC motor which is considered as state variable and can be estimated by using digital signal processing system. In the experiment; TMS320C31 floating point digital signal processor is used for hardware implementation[3, 4]. The experimental results show the speed of DC

motor which is estimated by using digital signal processing system has good accuracy when compared with the results from tacho-meter.

#### **J0022-Real time ECG Compression/Decompression System with Multirate Digital signal processing**

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**Abstract:** This research introduces the real-time ECG compression/decompression system using multirate digital signal processing implemented on TMS320C31 DSP board[2]. The designed ECG compress/decompress system is able to compress the ECG signals at ratio of 2 times, 4 times, and 8 times by decimation technique. The compressed signal is then recovered back by decompression and interpolation techniques. The consistency of this ECG compress/decompress system is showed by low PRDs (Percent Root Mean Square Differences)[4,5] compared between the decompressed signal and the original signal. The reliable of estimated signal of the ECG compression/decompression system make it suitable for the application in Telemedicine and home-based patient monitoring.

#### **J0023-Harmonic Removal in ECG Signal Based on Digital Notch Filter**

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**Abstract:** The following article is introducing the harmonic removal of AC power line from ECG signals[4] by applying digital notch filter[1]. The main design of this notch filter is pole-zero positioning within the unit circle on the z-plane which the user can design the filters to meet the user's specifications such as center frequencies as well as the bandwidths. The design and simulation is done by using MATLAB while the actual implementation is done on TMS320C3x DSP board[2, 3]. The experiment results have shown that the multi-band digital band-stop filters function according to the specification with high accuracies while eliminating the noises from AC power line harmonic which contaminate ECG signals with efficiency.

#### **J0024-Emergency Alarm for Patients**

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**Abstract:** The following article is introducing the design and construction of the emergency alarm for the patient to enhance the efficiency of the patient monitor with the highest safety. This emergency alarm for the patient is a portable alarm which patient can carry out and the alarm will ring out to wake the nurses up to rescue the patient after patient has pushed the button to remote micro controller during the emergencies. The main function for this alarm is the infrared transmitter and receiver controlled and decoded by MCS-51[1] micro controller to identify the source of signal from patient who needs the emergency care and the room where the machine alarmed. The results from the experiments have shown that this emergency alarm works with high accuracy.

#### **J0025-MATHEMATICAL MODELING FOR VAPOR DIFFUSION IN 2-D STOCHASTIC PORE NETWORK**

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**Abstract:** The objective of this study was to investigate preliminary study of pore network theory. The mathematical model of pore network was simulated using Numerical Explicit method. The simulation model based on principle of Kirchoff's current rule was applied for predicting of the drying kinetic of porous media. The evolution of moisture transfer of single cylindrical porous media was determined among drying time. A simple two dimensions (2-D) pore network also can be carried on by this simulation. Finally, the effective diffusivity of porous media with 2x2 nodes was determined and presented in this work. The simulation results indicated that the pore network model has a good agreement to predict the moisture ratio of each pore throat and effective diffusivity is relatively related to drying time.

**J0026-STUDY OF MOISTURE ADSORPTION OF WHEAT BY RICE HUSK**Yuthana Tirawanichakul<sup>1</sup>, Keiichi Inoue<sup>2</sup>, Toru Hayashi<sup>3</sup> and Somchart Soponronnarit<sup>4</sup><sup>1</sup>Plasma and Laser Technology Lab, Department of Physics, Faculty of Science, Prince of Songkla University, Hatyai Campus, Songkhla, Thailand 90110.<sup>2</sup>Laboratory of Agricultural Machinery, National Agricultural Research Center for Hokkaido Region(NARCH), Hokkaido, Japan<sup>3</sup>Food Science and Technology Division, Japan International Research Center for Agricultural Sciences (JIRCAS), Ohwashi, Tsukuba, Ibaraki, 305-8686 Japan<sup>4</sup>School of Energy and Materials, King Mongkut's University of Technology Thonburi, BKK, Thailand 10140

**Abstract:** The objective of this work is to investigate a grain moisture adsorption using rice husk. Advantage of this technique is low energy consumption and uses an agricultural residue as adsorbent. The mathematical modeling of rice husk drying was used for predicting evolution of moisture among the operating time. The simulated results show that the drying rate has highly relation to weight (or volume) ratio between rice husk and grain and initial moisture content. For the experiment, the fresh wheat and husk with initial moisture contents of 25.6% and 5.6% wet basis, respectively was dried by well-mixing rice husk/wheat ratio of 0.6:1.0 by volume. The results drying rate was relatively slow. However, the simulation was good agreement to the experimental results. Thus, the grain moisture adsorption by rice husk dryer is technically feasible.

**J0027-THE STUDY OF NATURAL HEAT CONVECTION WITHIN THE BIOCLIMATIC ROOF BY USING THE COMPUTATIONAL FLUID DYNAMICS (CFD) TECHNIQUE**J. Waewsak<sup>1,\*</sup>, A. R. T. Golaka<sup>2</sup> and R. Sarachitti<sup>3</sup><sup>1</sup>Physics Department, Faculty of Science, Thaksin University, Songkhla, 90000, Thailand<sup>2</sup>Ph D. Candidate, Energy Division, The Joint Graduate School of Energy and Environment (JGSEE) King Mongkut's University of Technology Thonburi, Bangkok, 10140, Thailand<sup>3</sup>Quantitative Science Department, Faculty of Arts and Sciences, Dhurakijpundit University, Bangkok, 10210, ThailandE-mail address: [jompob@tsu.ac.th](mailto:jompob@tsu.ac.th)

**Abstract:** This paper presents the study of natural heat convection within the bioclimatic roof (BCR) by means of the computational fluid dynamics (CFD) technique. Temperature and velocity contour as well as velocity vector in the air gap and the average convective heat transfer coefficient ( $h_c$ ) of the BCR have been investigated in three dimensions based upon the standard  $k - \varepsilon$  turbulence model. Results showed that the average convective heat transfer coefficients of the upper and lower surface in the air gap of the BCR were in the range of  $1.98\text{--}9.22 \text{ W/m}^2 \cdot \text{K}$ .

**J0028-Modeling of Weather Data for Renewable Energy System Applications in southern Thailand**Suwit Phethuayluk<sup>1</sup>, Pompana Boonma<sup>1</sup>, Suppakorn Katathikarnkul<sup>1</sup><sup>1</sup>Renewable Energy System Research and Demonstration Unit,

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**Abstract:** Monthly average daily data of climatic condition over the period 1971 – 2000 in southern Thailand was studied. Regression method was used to fit polynomial function to the monthly averages for nine parameters, namely atmosphere pressure, relative humidity, sunshine hours, solar radiation, dew point and ambient temperature, wind speed, evaporation and rainfall. The results, found that the relative equations with month of atmosphere pressure, solar radiation and sunshine hours were the best fits with the determination coefficient of better than 98%. But, the model for the evaporation is relatively low coefficient of determination, 86%. Thus the parameter functions have been enable to useful for renewable energy system application in this studied area.

**J0029-STRUCTURAL MODIFICATION OF CHITOSAN FOR NANOSPHERES**Rangrong Yoksai<sup>1</sup> and Suwabun Chirachanchai<sup>2</sup><sup>1</sup>Division of Physico-Chemical Process technology, Faculty of Agro-Industry, Kasetart University, Bangkok, Thailand.<sup>2</sup>The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok, Thailand.E-mail address: [rangrong.y@ku.ac.th](mailto:rangrong.y@ku.ac.th) and [csuwabun@chula.ac.th](mailto:csuwabun@chula.ac.th)

**Abstract:** Chitosan nanosphere (*N*-phthaloylchitosan grafted mPEG) is accomplished by the dialysis against water of the mixture obtained from homogeneous reaction of hydrophobic *N*-phthaloylchitosan and hydrophilic mPEG-COOH. The obtained product is sphere with the size in nano-level varying from 85 to 400 nm depending on the chain length of hydrophilic part as observed from TEM technique. Alkylamines, which are applied as model drugs, can be incorporated into chitosan nanosphere as

confirmed from FT-IR, SEM, and TGA techniques. Chitosan nanosphere is expected to use as a carrier material for drug delivery system.

#### J0030-FLOTATION DEINKING OF PRINTED PAPER BY USING NATURAL SURFACTANT

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**Abstract:** This work studied flotation deinking of printed paper by using natural surfactant. The experiment was divided into 3 steps. The first one was the extraction of dried soapberry fruits (*Sapindus rarak* A.DC.) with mixture of organic solvents to obtain the crude products. Then, crude saponin was tested with thin layer chromatography and Liebermann-Burchard reaction in order to specify saponin type. The second step was to do flotation deinking of printed paper by using surfactant of various mixture ratios between crude saponin and sodium lauryl sulphate (SLS). The total amount of chemical used was 0.5% by weight of oven dried pulp. The last one is the analysis of recycled pulps by brightness and dirt count. The results showed that mixture ratio of saponin:SLS = 40:60 gave the best result in brightness at 82.82%. 100% of crude saponin gave the lowest ability in deinking but the lowest lost weight.

#### J0031-Development of Integrated Silicon Pressure Sensor from Pressure Transducer

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**Abstract:** Model and development of integrated silicon pressure sensor are very such as Float-type Water Stage Recorder or Pressure Transducer. Thus, integrated silicon pressure sensor has been developed to be suitable to application in general condition with the lower price. Applying integrated silicon pressure sensor from Pressure Transducer, the device can measure water level from 0 to 5 meters with  $\pm 1$  inconsistent. We have tested the device at Samsen station (C.12), Royal Irrigation Department by collecting the data every 10 minutes since January 27, 2004 to February 12, 2004 (17 days). We have compared the collected data with the data from Float-type Water Stage Recorder of Royal Irrigation Department. The results were similar. The device is installed in small mobile telemetering which is developed in order to measure water level and precipitation and display the data through Internet network. It can also be used in order to trace water condition for water management in general and critical situation such as flood or drought.

#### J0032-FOURIER TRANSFORM INTERFEROMETRY: A SIMPLE METHOD OF THE WAVELENGTH MEASUREMENT

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**Abstract:** This paper presents a method of wavelength measurement. This method uses a Michelson interferometer in which one of the two mirrors is attached to a speaker. The vibration of the mirror depends on a signal that is sent to modulate the speaker. A condition for this method is to keep the amplitude of the vibrating mirror constant. The modulated mirror method, changing the optical path difference, gives rise to the output interference signal. We can calculate an unknown wavelength of a light source by comparing a number of fringes of the signal that is detected to those taken from reference light source (HeNe laser). Discrete Fourier Transform is used to determine the spectrum of the light source and, subsequently the unknown wavelength.

#### J0033-DEVELOPMENT OF MULTI-NATURAL DYES DYEING PROCESS ON COTTON YARN FOR VARIOUS SHADES OF GREEN FOR COTTAGE INDUSTRY

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**Abstract:** This research had developed the multi-natural dyes dyeing process in order to form various shades of green from blue and yellow dyes on cotton yarn for cottage industry. Blue dye was obtained from indigo, which was used in the range of 0.14-2.86 % o.w.f. Yellow dyes were boil-extracted from jack-fruit heartwood, Tewdaeng leaves and Umbrella tree leaves. The ratios of yarn : water : plant were in the range of 1:10:0.1 to 1:10:2. The effect of the order of dyeing on dyed cotton was studied. The dyeing of yellow dye solutions were carried out at 70 °C for 1 hour by using copper mordant for jack-fruit heartwood and Tewdaeng leaves and aluminium mordant for Umbrella tree leaves. While indigo was dyed at room temperature. Various shades of green were obtained including the deep green, which could not gain from a single plant dyeing. Furthermore, in order to

achieve deep green with a good leveling, dyeing with blue dye once and yellow dyes twice was recommended. However, the wash and light fastness properties in case of dyeing yellow dye first, then dyed over with blue dye and finally with the yellow dye again was better than starting with blue dye and then dyed over twice with yellow dye.

**J0034-Multi-Natural Dyes Dyeing on Cotton Yarn for Black Color**

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**Abstract:** The research studied multi-dyes dyeing on cotton yarn for black color. Multi-dyes dyeing uses two or more natural dye materials. Natural dyes were obtained from umbrella tree leaves, indigo and Rokfah bark. An experimental study has been undertaken to obtain the optimum conditions for dyeing, method of mordanting, wash fastness and light fastness. It was found that shade of black color depends on the pairing of dyeing material selected, mordant types, dyeing method and dye succession. The black colors obtained were various shades. Moreover they were more wash fastness and light fastness.

**J0035-MULTI-NATURAL DYES DYEING ON COTTON YARN FOR VARIOUS SHADES OF BROWN**

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**Abstract:** In this research obtains various brown shades of natural dyes from Rokfah bark and Umbrella tree leaves. Second natural dye from Tewdaeng leaves, American cassia leaves, and Saabsaea leaves which give yellow to greenish yellow color, was applied. Dyeing experiments were performed using the suitable mordant and dyeing conditions. Co-dyeing and top-dyeing of two natural dyes were tested at various dye concentration ratios. It was concluded that second natural dye affected the shade of brown color and color fastness of dyed yarn. However the change depended on the couple of raw materials, dye concentration ratio and dyeing succession.

**J0036-Effects of Some Salts and Tannic Acid on Dyeing of Cotton Yarn with Dye Extract from Heartwood of Jackfruit**

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**Abstract:** The effects of three different salts (sodium chloride, sodium sulfate and sodium carbonate) and tannic acid on dyeing of cotton yarn with dye extract obtained from heartwood of Jackfruit (*Artocarpus Integrifolia*) were studied. The investigated parameters were as followed: salt content in the range of 0-2% w.f. and salt addition timing. The cleaned cotton yarn was dyed for 1 hour at the constant temperature of 70°C. Dye exhaustion was followed by spectrophotometry. Dyed yarn was subjected to color measurement by using CIELAB system and tested for color fastness to washing. It was found that, under the conditions used, salt content and salt addition timing had no any effect on dye exhaustion, but dye exhaustion was slightly increased with increasing sodium sulfate content of the dye bath. Salts had some effects on hue and chroma of dyed yarn but showed no any effect on color fastness. However sodium carbonate seemed to give dyed yarn with less color fastness to washing in comparison with that obtained from dye bath without salt. Dye exhaustion increased with increasing tannic acid content but the acid addition timing had no effect on dye exhaustion. Tannic acid affected hue and chroma of dyed yarn and slightly decreased color fastness to washing of dyed yarn.

# K

## **K0001-The compact TEA N<sub>2</sub>-laser**

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**Abstract:** TEA N<sub>2</sub>-laser was built to demonstrate the principle of gas laser. The two parallel electrodes were made from stainless steel with length of 20 cm. It was placed on the rectangular aluminium bar. The capacitor plates were made from aluminium foil and mylar sheet which have capacitance of 11.54 and 5.17 nF. The A4-white paper, which was placed far from the laser channel around 30-100 cm, was used for demonstrating laser irradiance. The size beam was measured and recorded by digital camera Nikon coolpix 4300. The diameter of 6-20 mm was present and recorded. Then divergence of beam was 9.94 mrad when 13-14 kV<sub>dc</sub> was supplied and the flow rate of nitrogen gas was 1 l/min.

## **K0002-SIMPLE ROTATIONAL SPECTRUM OF DIATOMIC MOLECULE**

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**Abstract:** The computer program calculates and plots rotational spectrum for diatomic molecule. It interprets the spectrum by plotting vertical lines for the relative intensity of the absorption bands and the rotational transition involved in each band is given by the rotational quantum number. A simple knowledge of masses, bond length and temperature is required to predict the spectrum. The user easily can change the data of diatomic molecule and see how that change affects the spectrum.

## **K0004-INTRODUCTORY PHYSICS STUDENTS UNDERSTANDING TO ACCELERATION**

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**Abstract:** This research was conducted to study the understanding and conception on force and motion of the first year students that learned the introductory physics course. The first year students of Khon Kaen University were asked to do Force and Motion Conceptual Evaluation (FMCE) at the first class meeting of introductory physics course. The results were shown that most of students had misconception on acceleration and force. One group of students was asked to join the Interactive Lecture Demonstration on motion topic. Their predictions on each situation were collected in the prediction-sheet. The studied situation was the ball-on-ramp that had constant acceleration. By document analysis method, it was found that the students had misunderstanding on the acceleration of the assigned situation.

## **K0005-Metrology and Physics of Instrumentation Research Unit, Department of Physics, Faculty of Science, Kasetsart University, Bangkok**

ສັນນາ ຕິດຕະຫຼາດພາກພະນັກງານ, ຖະໜາດ ດີຈຳວິນາຍຸນ, ດັວນຫຼານ ອະນິດຖາ

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**Abstract:** This project is a part of The Research for Development of Basic Physics Laboratory System.\* This study for an appropriate applying a computer network to practical physics education. From surveyed information the system is designed in 3 parts, experiment part, instructors service part and laboratory management part. Knowledge of Physics and Metrology blend with System Analysis result to relation database system, database management system and user interfaces. Objectives are support concept of student center, applicable to an interesting modern instrument. Not only keep an achievement skill of practical physics learning but also has benefit of good data management. Students can know their result after period end for improving their next experiments. It is more convenient to instructors and accommodating laboratory management according to education quality assurance.

## **K0006-COMPUTER ASSISTED INSTRUCTION (CAI) FOR INFRARED SPECTROSCOPY**

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**Abstract:** A computer assisted instruction program for infrared spectroscopy was developed by using Authorware 5.0, Adobe ImageStyler 1.0 and Adobe Photoshop 7.0. The contents included the basic theory of infrared spectroscopy, the instrumentation of infrared spectroscopy, the interpretation of infrared spectra and tables of characteristics infrared absorptions regions of functional groups. The program was also provided examples, exercises, emphasized on infrared

spectra interpretation to determine functional groups of unknown compounds and solutions for self study. The software will improve the efficiency in learning and teaching this aspect of chemistry.

**K0007-DEVELOPMENT OF A LEARNING MATERIAL IN BIOLOGY: A WANDERING THROUGH THE MUSCLE WORLD – WITH A DIFFERENCE**

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**Abstract:** This set of learning materials, A Wandering Through The Muscle World, has been developed with the aim to make a better understanding of how striated muscle works and to lay down the basis for the study of non-muscle motility. It was designed for senior high school and undergraduate students consisting of two parts, computational multimedia and hand held illustrating model. The multimedia, developed to display in the Thai language, can be accessed by CD-ROM or internet. The content of the multimedia was designed to contain colorful illustrations and motion pictures in order to make enjoyable study and show relationships in many areas of muscle science including anatomy, physiology, biochemistry, physiology of exercise, kinesiology and meat science. The learning tasks in each chapter should help learners learn quickly and they should make meaningful connections to real-life situation. The problems provided in the final chapter were designed to allow learners think and be capable of self-assessment. The learning materials also demonstrate the arrangement of contractile proteins and their mechanism in muscle contraction which can be presented in 3-D illustration and in combination with the model of muscle sarcomere which can be pushed and pulled by hand to show its volume in relaxation and contraction state.

**K0008-THE STUDY OF SATISFACTORY EVALUATION AND IMPROVEMENT OF INSTRUCTIONAL MODEL OF BIOLOGY LABORATORY IN THE TOPIC OF ANIMAL TISSUE FOR FIRST YEAR UNDERGRADUATED STUDENTS, MAHIDOL UNIVERSITY**

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**Abstract:** To evaluate the satisfaction and improvement of the biology laboratory in the topic of animal tissue for the first year undergraduated students at Mahidol University, the 500 registered students in the first semester of academic year 2003 were purposive sampled to be the sample group. The observation form and the satisfaction evaluation form were used for the data collection. The present study shows that the students had the discussion to solve problems, attempt to join the activities and participation in group activities in the highest level, but the originative thinking expression was the lowest level. Most instructors used the questioning, stimulating, and reinforcement in the medium level. The students' satisfaction was in the high level; in addition, the student had the useful suggestions such as some instructional media were not appropriated to the learning activities, the lecturers' assistants were not enough, the technical terms in the instructional process should be decreased, and the laboratory temperature was too high. Moreover, the researchers were also purposed the new improved model for the instruction in the future.

**K0009-USING ROLE PLAY, MIND MAPPING AND SCIENCE QUIZ SHOW TO DEVELOP SCIENCE LEARNING MODEL: STUDENT CENTERED IN LARGE CLASS LEARNING**

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**Abstract:** This study presents the development in new science learning model called student centered in large class learning. The model contains three activities; role play, mind mapping and science quiz show. We applied this method with 287 first-year and fourth-year science students who receive fund from The Project for the Promotion of Science and Mathematic Talent Teacher (PSMT). These students come from 6 different universities in the north-east region of Thailand. The results show that PSMT students had positive attitude with this model. Moreover the students gave the useful suggestions such as, it could help students gain their knowledge better, provided more conceptual understanding, increased long term memory, increased students' participation during learning and could also be really applied to the small or medium size classroom. In addition, they offered other factors which have to be concerned; such as the limitation of time and curriculum contents.

**K0010-THE DEVELOPMENT OF A MULTIMEDIA IN BIOLOGY: MUTATION**

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**Abstract:** Mutation is the process that always occurs in the organisms. The study of mutation is one important topic in biology; however, mutation contains the complex process that is difficult to understand. Thus, the effective instructional media is able to support the mutation study's objectives. The researchers had developed the multimedia in the topic "mutation" to support the classroom study. In addition, the multimedia also presents on the internet website or CD - ROM, that students can access contents without the limitation of times and distance. The students can learn by themselves and self assessment. The multimedia is displayed in Thai version with the photos, diagrams, animation by the integration of biology, chemistry, and mathematics. The multimedia topics contain mutagens, mutation rate, mutation studies, DNA repair, the effect of mutation and application, the pretest-posttest questions for the students to assess themselves. This multimedia is the alternative to support the instruction in the mutation.

#### **K0011-THE STUDY OF HIGH SCHOOL STUDENTS' MISCONCEPTIONS IN FORCE AND MOTION BY USING CONCEPTUAL STANDARDIZED TEST**

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**Abstract:** This research is to study the use of Force and Motion Conceptual Evaluation (FMCE) test which is a research-based multiple choice assessment instrument. It was designed by Thornton and Sokoloff (1998). The test can be used to probe a conceptual understanding of students on Newtonian Mechanics. It consists of 43 questions, which are devide into five sets. i.e. The sled moving on ice, Cart on ramp, Coin Toss; Third Newton's Law and Graphical Evaluation. We have used the standardized test for the first year science students of mahidol university since 2001. In 2003, we applied this test to the high school students at Watsuti wararam school. It places more emphasis on students' understanding of graphical representation of velocity, acceleration and force and Third Newton's Law. The results from the pre-test and post-test indicate that there are only few students who understand correctly on force and motion, especially in Cart on Ramp. This set of questions are shown in figure 1.

#### **K0012-MULTIMEDIA: INTEGRATION OF ELECTROCHEMISTRY**

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**Abstract:** The interconversion of electrical energy and chemical energy is called electrochemistry which is important to all living creatures. The explanation of the functions in living process and in some equipment is not simple because we have to combine our knowledge in chemistry, physics, biology, and mathematics together. Hence, Integration of Electrochemistry as multimedia had generated in website and CD-ROM for supporting the conventional classrooms. This multimedia, presented in Thai with multi-illustration, can be accessed by everyone with unlimited time and distance. The content includes the fundamental electrochemistry, redox in plant, redox in cell respiration, and electrochemical analysis by the integration of chemistry, physics, biology, and mathematics.

#### **K0013-THE USE OF MULTIMEDIA FOR CHEMISTRY LABORATORY TEACHING IN HIGH SCHOOL**

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**Abstract:** It is well accepted that practical experiments in chemistry laboratory are essential to enhance knowledge in chemistry principles and concepts. Unfortunately, chemistry teaching in most of high schools in Thailand frequently avoid those practical experiments as a result of inadequate of equipments and chemicals. Moreover, practising the experiments is a time consuming process and it may lead to insufficient time for lecture in classroom. These problems cause high school students confronting with the lack of experiences in leaning from laboratory. Consequently, multimedia in chemistry experiments, CD and website, is developed to provide an alternative method for chemistry laboratory teaching. The questionnaire from students reveal their interests and demand of this multimedia to fulfill their chemistry courses.

#### **K0014-Tools for Deaf: Learning Thai-Thai Sign language**

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**Abstract:** Deaf Thai people use the Thai sign language to communicate. The sign language and the spoken Thai language differ in syntax. For this reason deaf people have to learn Thai language in order to communicate with other people. Moreover, processing Thai Language is difficult for deaf. We developed an automatic system for deaf people that generate pictures and Thai sign language to improve literacy. The software is widespread and available for everybody. Deaf people use computer to repeat, to experiment and to focus on areas where they need to improve. They can progress at their own individual pace.

#### **K0016-An Analysis of Local Agriculture Tools as Related to Science in The Upper Northern Part of Thailand.**

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**Abstract:** The research purpose is to study the local agriculture tools in the upper northern part of Thailand. The research studies agriculture tools in case of model, how to make, how to use and how useful it done. The other hand is an analysis of local agriculture tool related to Science and bring it into Local Curriculum, to make student realize in "Thai local wisdom" and they can mix it with global knowledge.

The result of this research, it can analyze the local agriculture tools in 4 groups.

- 1) Tool for prepare soil : a plow, a rake.
- 2) Tool for prepare water : a water wheel, a dam.
- 3) Tool for collected products : a sickle, a barn or a silo, a cart.
- 4) Tool for maintain products : potent bamboo flag and scare crow.

The most of science principle related to the local agriculture tools was Physic, Chemistry and Biological at the least.

#### **K0017-LOGIC INTELLIGENT TUTORING SYSTEM FOR HIGH SCHOOL STUDENTS**

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**Abstract:** In this paper, we present Intelligent Tutoring System (ITS) in mathematics logic for high school student. The student can be Mathayom 1-6 students and higher level for reviewing to be useful in the future. The purpose of this research is to support life-long learning and support the different learning style of the user. The system is responsible for preparing the presentation of the lesson that is corresponding to the student learning style and basic knowledge. First the system recognizes the characteristic, learning style and basic knowledge of the student from the data informed by student when registration to the system. Then select the most appropriate lesson plan to generate the presentation. The students who have different characteristic, learning style, and basic knowledge will learn with the different lesson.

#### **K0018-Personalized Information Retrieval in Instructional Software System**

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**Abstract:** To support student-centered learning, educational software system should be interactive individually with the learners. The individualization was met by recognizing student individual characteristics and creating student model to tailor the learning activities, sequence of lessons, and evaluation. Personalized information retrieval (PIR) is added to extend individual interaction and facilitation the learners when they are learning. The PIR perform the Thai keywords by taking student model and history of student learning activities into account.

#### **K0019-THE CORRECTION OF MISCONCEPTION IN SOUND WAVE IN A RESONANCE TUBE**

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**Abstract:** This work presents the study of misconception of sound wave in a resonance tube in the undergraduate students. We found that most of them visualized the vibrating air particles to be the vertical direction. By discussion, we discovered that this misconception caused by ways of teaching method using an image of node and antinode pattern as shown in the Figure1. Since this pattern is similar to a standing wave in a vibration string, the students think that this is a pictorial of wave in a resonance tube. Consequently, they think that this wave is a transverse wave but in fact the sound wave is a longitudinal wave. To correct this misconception of the students we invented an instrument to demonstrated the physical behavior of sound wave in a resonance tube that showed the movement of the colloid in the air as shown in the Figure2. When this instrument was used as part of Interactive Lecture Demonstrations (ILDs), it was found that the percentage of students who had this misconception decreased.

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To confirm the effectiveness of this method, the students will reexamine the concept using the same worksheet in two weeks after the end of this semester.

#### **K0021-A study of the effect of crystal geometry to the output power of a diode-pumped Nd:YAG laser**

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**Abstract:** During the development of Nd:YAG Laser using the Laser Diode to side pump the crystal rod at 20 watts it was found that the output laser power of 3 watts was not stable and tend to drop quickly. The system was redesigned by using a different shape of crystal. The new system used a slab shape of Nd:YAG crystal with the dimension of 6mm x4mm x 30mm .The YAG slab was pumped at 20 watts by laser diode with pumping length 10mm. It was found that with this new design the output power of laser was smaller at 2 watts output but was much more stable.

#### **K0022-A DEVELOPMENT OF COMPUTER – ASSISTED INSTRUCTION FOR PHYSICS LESSON ENTITLED PHOTOELECTRIC EFFECT FOR THE UPPER SECONDARY LEVEL**

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**Abstract:** The purpose of this research was to construct and develop a computer assisted instruction (CAI) for Physics lesson entitled Photoelectric Effect for the upper secondary level. The efficiency of the CAI was also examined. The experimental samples were 30 students of Matthayom Suksa V at Saint Gabrial's College, Dusit District, Bangkok. The study was carried out during the second semester of the 2001 academic year. The students were randomly selected by using Simple Random Sampling method. The Randomized Control Group Pretest-Posttest Design was used in the study. The statistical data, learning achievement scores, was analyzed by using t-test Dependent method. The results revealed that the computer assisted instruction entitled Photoelectric Effect was at the 85/85 of efficient criteria. Students' achievement after studying with CAI was significantly higher than before studying at .01 level.

#### **K0024-The Study of Misconceptions in Kinematics, Force and Energy by Using Conceptual Standardized Test**

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**Abstract:** This research is to study of a test to survey students' scientific conception emphasizing on kinematics, force and energy. This standard test can check or indicate students' basic conceptual understanding in physics deeply and correctly. It was developed by many physics education researcher groups. For example, Force Concept Inventory (FCI), Force and Motion Conceptual Evaluation (FMCE) and Mechanics Baseline Test (MBT). On this research, researcher took the test, FMCE, to test with first-year students at Mahidol University, academic semester 2004. According to pre-test and post-test focusing on velocity the enhancement of the correction students' understanding is about 10% increased.

**L0001-CHITOSAN USED AS A NATURAL DISINFECTANT UNDER PHYSIOLOGICAL CONDITIONS**

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**Abstract:** The antibacterial properties of chitosan were investigated in the media against *E. coli* to assess the potential for using chitosan as a natural disinfectant under various physiological conditions. Results show that, during a 24 h incubation, chitosan effectively inhibited the growth of *E. coli* culture in Muller Hilton culture media, phosphate buffered saline, platelet poor plasma and acidic urine, while the antibacterial properties of chitosan were suppressed in alkaline urine. Clinically relevant biomaterials including polyethylene and silicone were used as controls. Suppression of antibacterial activity was also seen by prewashing the chitosan film with ammonium hydroxide prior to incubation in all media. These results indicate that the effective cationic amine groups on chitosan may be shielded by ammonium hydroxide forming in alkaline urine. These studies results show that chitosan could potentially be used as a natural disinfectant in the biomedical field for applications not involving alkaline urine.

**L0002-ENDOTHELIALIZATION ON CHITOSAN: EFFECT OF DEGREE OF DEACETYLATION, MOLECULAR WEIGHT AND SOLUTION CONCENTRATION**

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**Abstract:** The objective of this study is to evaluate the effect of differences in physical and chemical properties of chitosan on endothelialization. Fibronectin coated wells (FN), polyethylene (PE) and tissue culture polystyrene (TCPS) were used as surface controls. All chitosan films were able to support human umbilical vein endothelial cell (HUVEC) adhesion and growth to some degree. Optically, the surface showed patches of confluent cells with the typical HUVEC cobblestone morphology similar to those on FN, and areas of no cell growth. Greater cell adhesion and growth were seen with increasing degree of deacetylation, molecular weight and concentration of chitosan. These results indicate that the chemical and physical properties of chitosan will influence EC adhesion and growth.

**L0003-PHYSICAL PROPERTIES AND EFFECTIVENESS OF CHITOSAN IN MOUTHWASH PREPARATION**

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**Abstract:** The viscosity of mouthwash solutions containing chitosan (0.1, 0.3 and 0.5%) was higher than that of control (without chitosan). The higher amount of chitosan added, the higher viscosity of solution obtained. The taste of preparation containing chitosan was unpleasant. The physical properties of the solution did not change after one week. The solution containing chitosan did not show significant effect on retarding growth of bacteria and fungi comparing with the control. However, it shows significantly reducing the amount of microorganism from mouth cavity.

**L0004-DEVELOPING CHITOSAN-BASED COMPOSITE WOUND DRESSING**

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**Abstract:** Composite wound dressing was designed to consist of three layers: chitosan nonwoven, absorbent polymer, and protecting layers. The chitosan nonwovens were prepared via two techniques: wet laid and freeze-dry. Absorbent polymers were hydrogels of crosslinked polyvinyl alcohol (PVA) and crosslinked polyvinyl pyrrolidone (PVP), prepared by Gamma irradiation (at total dose 10, 20, 30, and 40 kGy) of polymer solutions. Results showed that chitosan nonwoven prepared from chitosan fibers by wet laid technique exhibited better water transport, both water vapor and liquid water, than that prepared by freeze-dry technique. It, however, showed disadvantage on surface roughness. Treatment with glycerol solution resulted in softer surface. For absorbent polymers, all hydrogels showed liquid absorbent capacity up to 20-30 times of their dry weights. Hydrogels of polyvinyl alcohol showed better characteristics for wound dressing application than those of polyvinyl pyrrolidone as they had better flexibility and resistance to high force without breaking. Hydrogel films showed variation in thickness and became curly after drying due to shrinkage, which made it difficult to form smooth thin hydrogel film for composite assembling. The wound dressing protocol achieved need further development in desired properties of each layer, assembling of wound dressing composite, and simple yet effective production line.

**L0005-REMOVAL OF HEAVY METALS FROM WASTEWATER BY ADSORPTION ON VARIOUS FORMS OF CHITOSAN**

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**Abstract:** The purpose of this work was to investigate removal of Cu (II) and Cd (II) ion from wastewater by adsorption on various forms of chitosan such a flake, bead, modified bead, and cross-linked chitosan with glutaraldehyde (GLA). The crosslinked chitosan was also very stable and maintain their strength even in acidic and basic solution. The experimental results showed different pH optimum was found when using different forms of chitosan to adsorb Cu (II) and Cd (II) ion from wastewater. Isotherm adsorption was also considered in this work. In case of the same form of chitosan but different degree of deacetylation, performance of Cu (II) and Cd (II) ion removal from wastewater were closely. When keeping degree of deacetylation of chitosan, forms of chitosan had a significant effect on adsorption of Cu (II) and Cd (II) ion from wastewater.

#### L0006-REMOVAL OF EXHAUSTED METAL WORKING FLUID BY ADSORPTION ON CHITOSAN

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**Abstract:** Metal working fluid (MWF) onto chitosan bead, carboxylated chitosan and cross-linked carboxylated chitosan with glutaraldehyde (GLA) had been investigated. Chitosan beads were modified by chloroacetic acid and cross-link with GLA in order to obtain sorbents that were insoluble in aqueous acid and basic solution. Batch adsorption experiments were carried out as a function of pH and adding surfactant. The results showed that MWF adsorption obtained when no adding surfactant was lower than that obtained when adding cationic and nonionic surfactant. Adsorption capacity obtained when adding anionic surfactant was lowest. In cases of adding surfactant and no adding surfactant, the optimal pH is around 5.

#### L0008-Factors Influencing Pore Formation in Chitosan Temporary Scaffolds

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**Abstract:** Porous scaffolds were fabricated from chitosan by lyophilization process. The effects of chitosan concentration (1, 2, and 3 wt%), type of chitosan (alpha and beta forms) and freezing temperature (-10 °C, -80 °C and -196 °C) on pore size and morphology were studied by SEM. It was found that the freezing temperature was an important factor affecting on the pore morphology. Among the freezing temperature studied, -10 °C gave interconnecting round pore with 30-50 µm in size. The chitosan concentration and type of chitosan rarely influenced the pore size and morphology. The compressive modulus tended to be higher when chitosan concentration used to prepare the scaffold was increased.

#### L0009-CHITIN WHISKERS-CHITOSAN NANOCOMPOSITE FIBER

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**Abstract:** Chitin is hydrolyzed to obtain chitin whiskers with the size of 200-500 nm as observed by Transmission Electron Microscope (TEM). The mixing of chitin whisker with chitosan salt is a novel approach to prepare chitin-chitosan nanocomposite. The present work shows a simple fiber fabrication which chitosan matrices are reinforced with chitin whisker at nanoscale. The fiber obtained was characterized by Fourier Transform Infrared Spectroscopy (FT-IR), Thermogravimetry Analysis (TGA), and X-ray Diffraction (XRD).

#### L0010-Amino acid as a salt forming agent of protein loaded chitosan nanoparticles

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**Abstract:** To investigate the potential of amino acid as a salt forming agent for chitosan nanoparticles Chitosan salts were prepared by the application of amino acid as a salt forming agent. The chitosan solutions at 3 molecular weights (MW), i.e. 35, 100 and 800 kDa were dried by spray drying method. The nanoparticles obtained from chitosan salt in comparison to

chitosan base were produced based on ionotropic gelation process of tripolyphosphate (TPP) and chitosan. Bovine serum albumin (BSA) was applied as a model protein. The increasing MW and BSA concentration, in general, showed a larger size. Higher encapsulation efficiency (EE) and in vitro release were obtained for chitosan salts in comparison to chitosan base. The influence of molecular weight on the EE and release were observed for the chitosan salts, but not for the chitosan base. This study showed that the characteristics of chitosan nanoparticles loaded with a protein drug could be readily modulated by changing the salt form or the molecular weight of the chitosan carrier. Therefore, chitosan salt can be a potential carrier in drug delivery system of macromolecules and amino acid could be applied as a salt forming agent in the preparation of chitosan salt.

#### L0011-EVALUATION OF SPRAY-DRIED CHITOSAN SALTS AS NOVEL BINDERS FOR SUSTAINED RELEASE TABLETS

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**Abstract:** This research aims to evaluate the potential of spray-dried chitosan acetate (SCTA) and hydrochloride (SCTH) as novel tablet binders. Chitosan (MW 814 kDa, 88 %DD) obtained from source available in Thailand was dissolved in acetic acid and hydrochloric acid at molar ratio 1:2 and 1:0.8, respectively and was further spray-dried to obtain chitosan salts. Physicochemical and micromeritic properties of the salts were evaluated. The salts were spherical particles with rough surface. The particle size distribution mostly was under 75  $\mu$ m. SCTA was of an amorphous state and SCTH was of semi-crystalline form. FTIR and solid-state <sup>13</sup>C NMR spectra exhibited the molecular structure of both salts as acetate and hydrochloride salts. Flowability of both salts was poor. However, flowability and strength of the granules and friability and hardness of the tablets using theophylline as a model drug and both salts as binders were closed to those using polyvinyl pyrrolidone, PVP K30. The approximate 100%-drug release within 24 h was obtained. It was concluded that the simple incorporation of spray-dried chitosan salts as tablet binders could give rise to controlled drug delivery systems exhibiting sustained release.

#### L0013-EFFECT OF ACIDIC MEDIUM ON SWELLING AND RELEASE BEHAVIOR OF CHITOSAN-REINFORCED CALCIUM PECTINATE GEL BEADS

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**Abstract:** Chitosan-reinforced calcium pectinate (ChCP) gel beads were prepared by ionotropic gelation method. The swelling of ChCP gel beads and release behavior of indomethacin from the beads were investigated and compared to conventional calcium pectinate (CP) gel beads. The factors, such as molecular weight of chitosan, concentration of chitosan, and release medium, which can have a significant effect on the swelling and release behaviors from the beads, were discussed in this study. The mechanical test showed that the ChCP beads have slightly higher strength than that of CP beads. The swelling index of the ChCP beads in acidic medium was much lower than that in neutral medium. The release of indomethacin from ChCP beads under conditions mimicking intestinal transit were evaluated in simulated intestinal fluid (i.e., pH 7.4 Tris buffer). The effect of acid pretreatment on the drug release revealed that the drugs release faster. The less swelling in acidic medium and faster drug release of acid-pretreated ChCP beads may be due to the dissolution of chitosan from the beads in acidic medium. The results suggested that the acid, which essentially found in stomach, influenced the swelling and release behaviors of ChCP beads.

#### L0015-PREPARATION OF N-ACETYL-D-GLUCOSAMINE AND N,N-DIACETYLCHITOBIOSE BY ENZYMATIC HYDROLYSIS OF CHITIN

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**Abstract:** This work presents an investigation for optimum conditions in a production of *N*-acetyl-D-glucosamine (GlcNAc) and *N,N*'-diacetylchitobiose ((GlcNAc)<sub>2</sub>) from  $\beta$ -chitin using various sources of enzyme: chitinase from *Aspergillus fumigatus* fungus<sup>1</sup>, *Serratia* sp. bacterium (Chi 60)<sup>2</sup>, and serum of para rubber tree (*Hevea brasiliensis*)<sup>3</sup>. We found that chitinase from *A. fumigatus* produced GlcNAc and (GlcNAc)<sub>2</sub> in 82% total yield in 5 days at 45 °C, pH 3 with concentration of  $\beta$ -chitin = 20 mg/mL and enzyme concentration = 80 mU/mL. Chi 60 hydrolyzed chitin to give GlcNAc and (GlcNAc)<sub>2</sub> in 81% total yield in 6 days at 37 °C, pH 6, using 30 mg/mL of  $\beta$ -chitin and 150 mU/mL of enzyme. When the low concentration of enzyme, less than 30 mU/mL, was used, the (GlcNAc)<sub>2</sub>/GlcNAc ratio as high as 93/7 was obtained in 6 days with 33% total yield of (GlcNAc)<sub>2</sub> and (GlcNAc). The serum of para rubber tree hydrolyzed  $\beta$ -chitin to give GlcNAc and (GlcNAc)<sub>2</sub> in 47% total yield in 8 days at 45 °C, pH 4 using 60 mg/mL of chitin and 13 mU/mL of enzyme, where the reaction produced both (GlcNAc)<sub>2</sub> and GlcNAc with the product mole ratio ((GlcNAc)<sub>2</sub>/GlcNAc) approximately 2:1.

## L0016-EFFECTS OF CHITOSAN DEACETYLATION AND ENVIRONMENTAL CONDITIONS ON FLOCCULATION OF METHANOGENIC BACTERIA

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**Abstract:** Chitosan is one of the most effective granulation enhancements for UASB systems. In this study, the effects of chitosan characteristics and environmental conditions on the flocculation of Methanogenic bacteria were investigated. The study focused on the effects of degree of deacetylation (DD), concentration of chitosan, pH and ionic strength on the flocculation efficiency. The results showed that chitosan with either 70% or 85%DD improved the flocculation efficiency as compared to the control (without chitosan addition). Chitosan with 85%DD was more effective than that with 70%DD as the former required only 2 mg/g dry weight to obtain 90% flocculation at all studied pH. Restabilization or deflocculation was observed when chitosan was overdosed, but the reduction of deflocculation could be obtained by increasing the ionic strength of the medium.

## L0018-PREPARATION AND CHARACTERIZATION OF CHITOSAN MEMBRANE ON WATER DESALINATION

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**Abstract:** Chitosan was synthesized from shrimp shell with molecular mass of 14.10<sup>6</sup> Dalton. The membranes were prepared from chitosan solution of 1.5% by weight in 1% by weight acetic acid. Desalination properties of the chitosan membranes were investigated in plate and frame module using 4% by weight of NaCl solution. It was found that the highest salt rejection of 80.83±4% was obtained from the membrane with evaporation time of 4 h. It was then used for desalination of real wastewater with salinity of 2-2.5%.

## L0019-STUDY OF EFFECTS OF CARBOXYMETHYLCHITOSAN-BASED HYDROGELS ON HEALING OF DEEP PARTIAL THICKNESS WOUNDS IN GUINEA-PIGS

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**Abstract :**Carboxymethylchitosan (CM-chitosan)-based hydrogels (CM-chitosan and CM-chitosan/CM-cellulose blended hydrogels) were applied as wound dressings in this study. The effects of both dressings on the wound healing were comparatively evaluated with that of a commercial dressing, Cutinova hydro<sup>3</sup> (a control). Two mirror image areas of 1x1 cm<sup>2</sup> deep partial thickness incisions were made on the backs of guinea-pigs and separately dressed with CM-chitosan and Cutinova hydro<sup>3</sup>. Pairs of the treated animals were housed for given periods. When times reached, the wounds were inspected, and the remaining wound areas were photographed and measured by image analysis prior to the histological examination. A similar trial was conducted to comparatively study the effects of CM-chitosan and CM-chitosan/CM-cellulose blended dressings on the healing of similar wounds. The results revealed that, compared with the wounds dressed with Cutinova hydro<sup>3</sup>, those covered with the CM-chitosan-based hydrogels showed no signs of infection and healed more efficiently. The blended dressing, however, seemed to slightly outdo the pure CM-chitosan dressing.

## L0020-STUDY ON EFFECTS OF CHITIN, CHITOSAN, AND THEIR DERIVATIVES ON *IN VITRO* BLOOD COAGULATION

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**Abstract:** Severe hemorrhage is a leading cause of death from trauma. New methods of hemostasis have been developed to reduce hemorrhagic mortality. The objective of this study was to study the effect of chitin, chitosan, and their derivatives on *in vitro* human blood coagulation. The derivatives used were water-soluble. The water solubility of the materials expectedly affected the blood coagulation process. Whole blood was mixed with each material, and the venous clotting time (VCT) was subsequently measured using a Lee and White method. The results showed that chitin, chitosan, and carboxymethylchitosan (CM-chitosan) significantly reduced VCT with respect to that of the pure whole blood ( $p < 0.05$ ), while *N*-sulfated chitosan and *N*-(2-hydroxy)propyl-3-trimethylammonium chloride (HTACC) had no effects on VCT. In another blood coagulation testing method, platelet-poor plasma (PPP) was mixed with each material, and the recalcification time (RT) was

then determined using a hook method. Chitosan had no effect on RT. Chitin and CM-chitosan shortened RT significantly ( $p < 0.05$ ), whereas *N*-sulfated chitosan and HTAC $\text{C}$  prolonged RT.

#### L0021-CREAMING OF SKIM NATURAL RUBBER LATEX USING *N*-(2-HYDROXY)PROPYL-3-TRIMETHYLAMMONIUM CHITOSAN CHLORIDE (HTAC $\text{h}$ )

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**Abstract:** Skim natural rubber (SNR) latex, containing 3.8% w/w of rubber with small particle size, is residual latex obtained as a byproduct of concentrating process of natural rubber (NR) latex by centrifugation. A problem of skim natural rubber latex is the difficulty to recover the residual rubber. The usual method to recover solid rubber from SNR latex is by coagulation with concentrated sulfuric acid. However, in acid coagulation, the acid content of the coagulated rubber reduces its quality and the remaining acid leads to generation of highly acidic effluent. In this article, as a method to recover residual rubber in the form of concentrated latex and reduce water pollution, we have focused on creaming using *N*-(2-hydroxy)propyl-3-trimethylammonium chitosan chloride (HTAC $\text{h}$ ). Its simple synthetic method used chitosan, a biodegradable, non-toxic and renewable resource, as raw material as well as its cationic functional groups render HTAC $\text{h}$  a very interesting agent. In this study, HTAC $\text{h}$  was prepared from shrimp shell. Using the new creaming method, effects of HTAC $\text{h}$  concentration on creaming ability and creaming mechanism of skim rubber latex are investigated.

#### L0022-STUDY OF *IN VITRO* RELEASE AND SKIN PERMEATION OF CHITOSAN FILMS LOADED WITH METHIMAZOLE FOR TRANSDERMAL DELIVERY

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**Abstract:** It is important to develop methimazole, antithyroid agent [1-2], for transdermal drug delivery system which is much convenient for patient compliance. Since methimazole is available only in an oral dosage form, the use in patients is limited, especially those who could not take the drug by oral route [3-4]. To investigate *in vitro* drug release and skin permeation which are important properties for development of transdermal delivery, methimazole was loaded into the films prepared from chitosan, a natural biopolymer, varying in molecular weight (MW). The drug was found existed in films as an amorphous state by using Differential Scanning Calorimetry (DSC). No drug-polymer interaction was found by using Fourier Transform Infrared (FTIR) spectroscopy. *In vitro* drug release study revealed that methimazole was released rapidly from low MW chitosan film. The increase in MW of chitosan resulted in slow release of drug; however, there was not significant different in permeation across new born pig skin.

#### L0023-CONTROL OF CHITOSAN DEACETYLATION DEGREE BY COMBINED EFFECTS OF DEACETYLATION TEMPERATURE, NUMBER OF REPEATED BATCH, AND TIME

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**Abstract:** Control of chitosan deacetylation degree by combined effects of deacetylation temperature, number of repeated batch, and time was demonstrated. Firstly, a whole-dried shrimp shell was demineralized using 1 N hydrochloric acid at ambient temperature for 1 hour, and deproteinized using 2 N sodium hydroxide at 55°C for 1 hour consecutively to yield chitin. Chitin were then ground and deacetylated with 50% w/w sodium hydroxide at different combinations of process conditions; that is, 110 °C, 120 °C, and 130 °C with the number of repeated batch of 1, 2, and 3, for 1 hour, 2 hours, and 3 hours to yield chitosan products. More extent of chitosan deacetylation degree achieved by combined higher deacetylation temperature, higher number of repeated batch, and the longer the time of reaction used for deacetylation process ( $p \leq 0.05$ ). The highest degree of deacetylation was obtained at 130 °C, 95.04±1.01%, using 3 repeated batches at 3 hour interval whereas the lowest degree of deacetylation was obtained at 110 °C, 81.29±3.14%, using 1 repeated batch at 1 hour interval ( $p \leq 0.05$ ).

#### L0024-Effect of Chitosan Coating on Storability of Coated Tangerine Orange

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**ABSTRACT:** Films of seven commercially available chitosan samples were evaluated in order to investigate their oxygen and water permeability. Chitosan with the molecular weight (856,000) and degree of deacetylation (75.89%) showed highest oxygen permeability ( $67.53 \text{ ml.mm.m}^{-2} \text{ day}^{-1} \text{ atm}^{-1}$ ) was chosen for coating the orange. 1% (w/v) chitosan solution was used for coating study of tangerine orange. Non-coated tangerine orange was served as a control. Samples of orange were stored at 28 °C, 75%RH for 15 days and at 5 °C, 95%RH for 49 days. Samples were taken at time intervals and analysis for fruit's internal atmosphere (oxygen and carbon dioxide gases), ethanol content, total soluble solid, total titrable acidity and ascorbic acid concentration. For coated oranges stored at 28 °C, 75%RH, ethanol content was increased throughout the storage period. Coated oranges lost their weight for about 11.58% and non-coated orange lost their weight for about 12.36%. For coated oranges stored at 5 °C, 95%RH, ethanol content was increased at lower rate than that stored at 28 °C, 75%RH. Coated oranges lost their weight for about 5.83% and non-coated orange lost their weight for about 6.75%.

#### L0025-CAPABILITY OF CHITOSAN FLAKES ON DECOLORIZATION OF DYE WASTEWATER

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**Abstract:** This paper presented the capability of chitosan flakes on decolorization of acid and direct dye effluents from 2 case factories. The flakes of 710-850 micron were prepared from shrimp shells in laboratory under nitrogen atmosphere. Their degree of deacetylation was 90.1±4.5%. The optimum treatment conditions of both effluents by Jar test technique were same at pH 6 and dosing of 0.4 g. chitosan per 200 ml. effluent. The decreases in the maximum absorption of acid and direct dye effluents were  $90.24 \pm 0.36$  and  $98.87 \pm 0.23\%$ , respectively. The adsorption isotherms of synthetic acid and direct dye waters could be fitted well with both Langmuir and Freundlich equations. The equilibrium sorption capacities of chitosan for acid and direct dyes by Langmuir equation were 13.40 and 25.51 mg g<sup>-1</sup>, respectively.

#### L0026-Preparation of Surface-Charged Chitosan

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**Abstract:** Two methods were used to create charges on chitosan films. In the first method the amino group (-NH<sub>2</sub>) of chitosan was allowed to react with methyl iodide to form positively-charged quaternary ammonium salt. The second method was to create a negatively charged film by the reaction between the amino group and 5-formyl-2-furan sulfonic acid, which contain a negatively charged sulfonate group. Results from X-ray photoelectron spectroscopy (XPS) indicated iodide counter ion present in the positively charged films, while sulfur and sodium were found from the negatively charged film. The presence of quaternary ammonium [-N<sup>+</sup>(CH<sub>3</sub>)<sub>3</sub>] and sulfonate group [-OSO<sub>3</sub><sup>-</sup>] were confirmed by attenuated total reflectance IR (ATR-IR). The hydrophilicity of both modified films was higher than the non-modified film, as determined by air-water contact measurement. The value also increased when the reaction time and reagent amounts increased.

#### L0027-MOLECULAR WEIGHT REDUCTION OF CHITOSAN VIA $\gamma$ -RAY IRRADIATION

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**Abstract:** Chitosan is  $\gamma$ -ray irradiated with various doses up to 160 kGy in simple conditions with/without radical initiators. The molecular weight of chitosans decreases from  $6.7 \times 10^6 \sim 1.2 \times 10^6$  to  $1.0 \times 10^6$  Dalton with the primary structure retained under the  $\gamma$ -ray amount of 50 kGy for the conditions of chitosan solid flakes and chitosan dispersed in water. The similar level of molecular weight reduction can be achieved by only 20 kGy in the presence of radical initiator (H<sub>2</sub>O<sub>2</sub>). The reactivity of irradiated chitosan was enhanced 50-60% as observed from the coupling reaction with carbonyldiimidazolide (CDI). In the case of chitosan in acetic acid solution, the structure of irradiated product is changed as determined from FT-IR, TGA, and XRD techniques.

#### L0028-EFFECTS OF DEGREE OF DEACETYLATION AND MOLECULAR WEIGHT OF CHITOSAN ON THE CONTROLLED DICLOFENAC SODIUM RELEASE

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**Abstract:** This study is to investigate the influence of degree of deacetylation (%DD) and molecular weight (MW) of chitosan on a release behavior of diclofenac sodium (DS) from the chitosan matrix. In addition, an effect of drug delivery vehicle design of chitosan beads with diameter in the range of 500-1000  $\mu\text{m}$ , chitosan microparticles with mean sized diameter 37  $\mu\text{m}$ . Beads of chitosan with %DD of 70 and 91 and the MW of 150,000, 400,000 and 600,000 Daltons were prepared. Bead size was not affected by %DD and MW. A phosphate buffer with pH 6.8 was chosen as a media for DS release study. This condition mimics small intestinal fluid found in human digestive system. The DS releasing rate increased slightly with the increase in DD and molecular weight of chitosan. Maximal release from the matrices beads and microparticles take place at approximately 75% and 85%, respectively.

#### L0029-STRUCTURAL MODIFICATION OF CHITOSAN FOR NANOSPHERES

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**Abstract:** Chitosan nanosphere (*N*-phthaloylchitosan grafted mPEG) is accomplished by the dialysis against water of the mixture obtained from homogeneous reaction of hydrophobic *N*-phthaloylchitosan and hydrophilic mPEG-COOH. The obtained product is sphere with the size in nano-level varying from 85 to 400 nm depending on the chain length of hydrophilic part as observed from TEM technique. Alkylamines, which are applied as model drugs, can be incorporated into chitosan nanosphere as confirmed from FT-IR, SEM, and TGA techniques. Chitosan nanosphere is expected to use as a carrier material for drug delivery system.

#### L0030-ANTIOXIDANT ACTIVITY OF CURCUMIN RELEASED FROM CHITOSAN-ALGINATE MICROSpheres

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**Abstract:** Chitosan-alginate microspheres containing curcumin were prepared by complex coacervation/ emulsification technique. The mean particle size,  $d_{50}$ , of the microspheres was found between 11.35 – 15.67  $\mu\text{m}$ . The SEM determination indicated the porous morphology of the microspheres. The release of curcumin from the microspheres was controlled over 48 hours. The antioxidant activity  $EC_{50}$  of curcumin microspheres was  $2.00 \pm 0.44 \mu\text{g/ml}$  compared to  $2.20 \pm 0.37 \mu\text{g/ml}$  of standard curcumin and  $2.60 \pm 0.10 \mu\text{g/ml}$  of vitamin C.

#### L0031-Growth restraint activity of chitosan against a tomato leaf spot bacterium

##### *Xanthomonas campestris* pv. *vesicatoria*

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**Abstract:** A leaf spot disease of tomato caused by *Xanthomonas campestris* pv. *vesicatoria* is one of the most serious problem of seed producing industry and export marketing at international level due to its seed transmission capability. A high cost of investment according to chemical control was obviously needed in spite of a high risk for environment safety. A natural compound such as chitosan is one of the most promising agent suggested for antibacterial substance in many cases. In this study, chitosan formulas ranged from 80, 85, 90 and 95% degree of deacetylation (DD) were tested for growth restraint activity against *X. campestris* pv. *vesicatoria*, a bacterial leaf spot of tomato. Similar effect was obtained with all deacetylated chitosan formulas from 2.5 up to 30.0 mg/ml concentration, that the growth inhibition zone size was increasing from 10.2 mm to 20.8 mm following an increasing of chitosan concentration. The size of inhibition zone by chitosan at 30.0 mg/ml was comparable to conventional antibiotics chloramphenical, streptomycin, tetracycline and chemical cuprous oxide at regular therapeutic concentration, 3.0 mg/ml. While the treatment with other chemicals such as benlate, copper oxychloride, mancozeb and ridomyl yielded only minor growth restraint activity.

#### L0032-Physical and mechanical properties of chitosan film prepared with three organic acids

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**Abstract:** A preliminary study for a suitable method and base line data for a possibility of biodegradable cling film production from chitosan, which obtained from black tiger shrimp waste, was conducted. Effects of experimental conditions, as well as other factors on quality of chitosan film were evaluated. The results showed that in 1% lactic acid solution, the complete dissolution of chitosan could be observed. The chitosan film with suitable quality for further study on cling film production could be prepared from a 150 ml solution contained 1: 100 (w:v) chitosan. The physical properties of the produced chitosan film were: weight 1.5020 mg /piece, film thickness 0.0593 mm, tensile strength 60.5833 N /mm<sup>2</sup>, elongation at break 13.408 mm, water vapor permeability  $0.1564 \times 10^{-3}$  g.mm/mm<sup>2</sup>hr .mm Hg .

#### L0033-STUDY THE ADSORPTION CAPACITY OF REACTIVE DYES USING ACTIVATED CARBON POWDER, CHITOSAN-ENCAPSULATED ACTIVATED CARBON AND CHITOSAN BEAD

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**Abstract:** Water pollution caused by reactive dyes from textile factories is one of the problems that need to be solved. As activated carbon and chitosan have high adsorption efficiency, chitosan-encapsulated activated carbon (CEAC) will have more efficiency. The purpose of this work is to compare the adsorption of red and blue reaction dyes, by using activated carbon powder, CEAC, and chitosan bead. By spectrophotometry technique, it was found that CEAC has higher adsorption efficiency than activated carbon powder and chitosan bead. CEAC with 1 min coating time can adsorb red and blue dyes at 9100-8%, which is the highest efficiency obtained. The high efficiency is correlated with the photo from scanning electron microscope showing that the coated film of CEAC with the coating time 1-2 min is equally and not too thick or too thin.

#### L0034-Characterization and gene cloning of chitinolytic enzymes from *Bacillus* sp. PP8.

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**Abstract:** *Bacillus* sp. PP8 was isolated from PP Island, Krabi, Thailand. When *Bacillus* sp. PP8 was grown in liquid medium containing chitinous sources. Chitinase and chitosanase activity was detected. However, when it was grown in medium containing various types of chitosan only chitosanase activity was detected. The best inducer for chitinase and chitosanase activity was colloidal chitin and colloidal chitosan, respectively. GlcNAc can induce low level of chitinase production from PP8, however GlcN cannot induce either chitinase or chitosanase production. The optimum pH and temperature of the chitinase and chitosanase was pH 8.0 / 50°C and pH 7.0 / 50°C, respectively. GlcNAc and (GlcNAc)<sub>2</sub> are major products from colloidal chitin hydrolysis by PP8 chitinase. When crude enzyme from PP8 was analyzed by SDS-PAGE followed by activity staining, Five bands (145, 66, 55, 45 and less than 15 kDa in size) with chitinase activity and a single band of 47.5 kDa with chitosanase activity were observed. Chitinase encoding gene was cloned by shot gun cloning. Three colonies producing different clear zones on the selective agar designated, pST24, pST847 and pST1691 were selected. The highest chitinase activity, pST847 was chosen for further analysis. Nucleotide sequence revealed an open reading frame of 1797 bp encoding for 599 amino acids with signal peptide corresponding to 66.20 kDa. The chitinase gene expression was performed using pET19b and pTrcHis-2C. The chitinase activity was found in the culture medium and confirmed by SDS-PAGE followed by activity staining. The optimum pH, temperature, and products of colloidal chitin hydrolysis of the recombinant chitinase corresponded to the 66 kDa native chitinase from *Bacillus* sp. PP8. The enzyme did not degrade when kept in pH 5-8, at 4°C for 2 months.

#### L0035-SYNTHESIS AND ANTIMICROBIAL ACTIVITIES OF QUATERNARY AMMONIUM SALT OF N-ALKYLATED CHITOSANS

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**Abstract:** The *N*-alkylated chitosan derivatives were prepared from the reactions between the amino groups of chitosan with aldehydes under acidic condition via imine intermediates which were simultaneously reduced by sodium cyanoborohydride. It was found that the degree of substitution was in the range of 0.04-0.75 depending on the equivalent amount of the aldehyde and reaction time. The quaternization was performed by using two methylating agents, i.e., methyl iodide and glycidyltrimethylammonium chloride (GTMAC) in basic and acidic conditions, respectively. The results showed that the alkyl substituents and the methylating agents affected the degree of quaternization and quaternary ammonium derivatives of chitosan showed antimicrobial activity. The structures of all chitosan derivatives were illustrated by <sup>1</sup>H-NMR, and FT-IR spectroscopic methods.

**L0036-A Preliminary Study of Improvement Red Wine Making from Table Grapes by Using Chitosan**

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**Abstract:** This research was a preliminary study of red grape wine improvement by using chitosan in wine precipitation, comparing to flocculants used at the present. Two parts of the experiment were investigated. In the first part was to study of the ability of chitosan solution in wine precipitation, the results were found that chitosan solution could be able to use as flocculant in wine precipitation process. In the second part was to study of the optimum dose of chitosan solution in wine precipitation, the results were found that the amount of sugar and pH in red wine weren't affected by any flocculants, e.g. pectinase, bentonite, chitosan solution 50, 100, 150, 200, 250, 300 and 350 ppm. For the amount of alcohol, was the most affected by bentonite, but there were no different between adding any doses of chitosan solution, pectinase and without adding flocculant. The comparison in red wine transparency was found that chitosan solution 200 ppm was the most effective. The result of tannin analysis was found that the amount of tannin was reduced effectively by pectinase, the secondary were chitosan solution 150 ppm.

**L0037-A Study of Application of Chitosan as Meat Duck Growth Promoter**Piyabutr Wanichpongpan<sup>1</sup>, Siripong Congchoo<sup>2</sup> and Kan Chantrapromma<sup>3</sup><sup>1</sup>Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, Tel. 0-2470-9220, Fax. 0-2428-3534

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**Abstract:** Chitosan, a natural, biodegradable, biocompatible and growth promoter biopolymer has many agricultural applications. In this research used the powder 50 mesh of shrimp chitosan with 70.6 %DD. It was found that the addition of chitosan 35 gram into 100 kg of the meat duck feed stock (350 ppm) had affected the maximum ADG of 60.54 g/head-day and the best FCR of 1.852 with the same size in the tested group as well as good healthy and beautiful feather. The different size of the meat duck was found in the control group with the lower ADG of 57.05 g/head-day and the less FCR of 2.141. The FCR and the ADG of the second experimental group used the chitosan addition of 25 g into 100 kg of the meat duck feed stock (250 ppm) had the value in between the maximum dose of chitosan addition group and control group. Even though, the initial weight was less than the other groups, it had a good result of the better FCR with the same size of meat duck as well as good healthy.

**L0038-Copper Removal by Chitosan Porous Bead**Piyabutr Wanichpongpan<sup>1</sup>, Raphat Petchniyom<sup>2</sup> and Niran Sappawinyoo<sup>1</sup><sup>1</sup>Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, Tel. 0-2470-9220, Fax. 0-2428-3534

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**Abstract:** In this research was used chitosan with degree of deacetylation 96%, molecular weight 300,000 g/mol and mean powder size in range of 0.297–0.590 mm. Chitosan porous bead was developed from 4% chitosan solution in 2% acetic acid. The result was found that chitosan porous bead had higher efficiency of copper removal than chitosan powder. 0 g of chitosan porous bead had copper removal efficiency of 94% while 0.6 g chitosan powder had 67% of copper removal. Absorption isotherm of copper of chitosan porous bead and chitosan powder were not different. However, chitosan porous bead could adsorb copper better than chitosan powder at low concentration of copper solution while chitosan powder could be better at high concentration of copper solution.

**L0039-A Study Mass Balance of Pacific White Shrimp (*Litopenaeus vannamei*) Growth**Piyabutr Wanichpongpan<sup>1</sup>, Hathairat Jeerathawatchai<sup>2</sup> and Wiwat Ruenglertpanyakul<sup>1</sup><sup>1</sup>Department of Chemical Engineering, Faculty of Engineering, King Mongkut's University of Technology Thonburi, Bangkok, Thailand, Tel. 0-2470-9220, Fax. 0-2428-3534

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**Abstract:** This research studied mass balance of pacific white shrimp (*Litopenaeus vannamei*) by using 100 ppm concentration of 1% chitosan solution in 1% acetic acid coating-on the shrimp feed for every 3 days and 2 meals a day in field test using 3200 m<sup>2</sup> size of soil pond. Forty heads per time were sampled at the 40<sup>th</sup>, 80<sup>th</sup> and 115<sup>th</sup> cultivation date. Their total weight, meat weight, shell weight, waste weight, weight of hepatopancreatic were measured and the mass balance was calculated based on protein, calcium, lipid, fiber, chitin and ash content. Applying chitosan was found to positively affect the shrimp growth, frequency of molting, and chitin development process in all measured aspects. The chitosan feed additive dose at 100 ppm promoted the shell chitin had higher contents of 21.02% at the 115<sup>th</sup> day than the control set at 20.85%.

**L0040-A Study of Protein Removal by Chitosan Porous Bead**

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**Abstract:** This research studied the comparison of protein removal efficiencies of chitosan porous bead between the poultry slaughtering wastewater and the standard solution of BSA at 706 mg/l and 5,000 mg/l respectively. It was found that chitosan porous bead had maximum protein removal efficiencies for the poultry slaughtering wastewater and the standard solution of BSA of 64.8% and 27.0%, and also had maximum protein adsorption rate for the poultry slaughtering wastewater and the standard solution of BSA of 800 and 1,048 gram of protein per gram of chitosan. It could well explain the adsorption characteristics by Langmuir's isotherm that protein was linearly favorable adsorbed by chitosan porous bead as monolayer, while the protein adsorption between the poultry slaughtering wastewater and the standard solution of BSA had value of Q (dosage adsorption protein using chitosan porous bead) at 57 and 250 and value of b (adsorption constant) at  $3.22 \times 10^{-3}$  and  $1.77 \times 10^{-4}$  respectively.

ដ័លជាជីវិត

និងជាជីវិត

**INVITED SPEAKER INDEX  
AND  
AUTHOR INDEX FOR**

<b>Section A</b> →	<b>Mathematics, Computing and Information Technology (A-)</b>
<b>Section B.</b> →	<b>Biological Science (B-)</b>
<b>Section C.</b> →	<b>Chemistry (C-)</b>
<b>Section D.</b> →	<b>Physics (D-)</b>
<b>Section E.</b> →	<b>Materials Science (E-)</b>
<b>Section F.</b> →	<b>Agricultural &amp; Food Science (F-)</b>
<b>Section G.</b> →	<b>Geology (G-)</b>
<b>Section H.</b> →	<b>Medical Science (H-)</b>
<b>Section I.</b> →	<b>Environmental Science &amp; Technology (I-)</b>
<b>Section J.</b> →	<b>Engineering &amp; Technology (J-)</b>
<b>Section K.</b> →	<b>Science Communication &amp; Education (K-)</b>
<b>Section L.</b> →	<b>Chitin-Chitosan (L-)</b>

ដំណឹងឯកសារជាមួយ

និងដំណឹងឯកសារជាមួយ

**INVITED SPEAKER INDEX  
AND  
AUTHOR INDEX FOR**

<b>Section A</b> →	<b>Mathematics, Computing and Information Technology (A-)</b>
<b>Section B.</b> →	<b>Biological Science (B-)</b>
<b>Section C.</b> →	<b>Chemistry (C-)</b>
<b>Section D.</b> →	<b>Physics (D-)</b>
<b>Section E.</b> →	<b>Materials Science (E-)</b>
<b>Section F.</b> →	<b>Agricultural &amp; Food Science (F-)</b>
<b>Section G.</b> →	<b>Geology (G-)</b>
<b>Section H.</b> →	<b>Medical Science (H-)</b>
<b>Section I.</b> →	<b>Environmental Science &amp; Technology (I-)</b>
<b>Section J.</b> →	<b>Engineering &amp; Technology (J-)</b>
<b>Section K.</b> →	<b>Science Communication &amp; Education (K-)</b>
<b>Section L.</b> →	<b>Chitin-Chitosan (L-)</b>

## Section A - MATHEMATICS, COMPUTING AND INFORMATION TECHNOLOGY

<b>B</b>		<b>T</b>	
Boonyanuch Wathanyu	A0002	Taweetham Limpanuparb	A0001
<b>C</b>		Thammasak Thianniwit	A0011
Chalothorn Liamwirat	A0018	Tipanun Thepsri	A0002
Chanun Lewchalermvongs	A0021	Treechada Tawornmas	A0026
Chonvit Tholieng	A0008		
Chusak Sochara	A0005		
<b>E</b>		<b>U</b>	
Erwin Mues	A0003	Ungsana Chundang	A0003
<b>J</b>			
Jeerayut Chaijaruwanich	A0018	Wacharapong Srisang	A0016
<b>K</b>		Warabhorn Preechaporn	A0017
Kate Grudpan	A0018	Waraporn Viyanon	A0024
Khwanjai Pasapan	A0025	Woranut Koetsinchai	A0015
Kittisak Kerdprasop	A0011, A0012		
Komin Piromchom	A0013, A0014		
Krisanadej Jaroensutasinee	A0005		
<b>L</b>			
Laksamee Khomnotai	A0011		
<b>M</b>			
Michael A. Allen	A0019		
Mullica Jaroensutasinee	A0016		
<b>N</b>			
Naris Mingmora	A0012, A0013		
Narisa Chutinara	A0023		
Narong Lenghor	A0018		
Nathnarong Khajohnsaksumeth	A0020		
Natt Piyapramote	A0029		
Nawat Nantesen	A0006		
Nikolay Moshkin	A0010		
Nittaya Kerdprasop	A0011, A0012		
Nurupon Wongprachanukul	A0013, A0014		
	A0012, A0013		
<b>O</b>			
Oranit Panprasitwech	A0015		
Orawan Kaewkanjana	A0003		
<b>P</b>			
Panjit Musik	A0028		
Parichat Rattanasaring	A0011		
Pavadee Sompagdee	A0008		
Peiangpob Mounnumprang	A0010		
Pitsamai Hanmongkolpipat	A0002		
<b>S</b>			
Sakauwrat Jongpattanakorn	A0009		
Sarawut Poltue	A0005		
Sarun Phibanchon	A0019		
Sittichai Bussaman	A0005, A0006		
Somsak Orankitjaroen	A0020, A0021		
	A0025		
Sopak Chaichana	A0005		
Sunee Raksakietisak	A0022		

## Section B – BIOLOGICAL SCIENCE

	<b>A</b>			
Achariya Sailasuta	B0010	Chortip Kantachote	B0048	
Achariya Rangsiruji	B0018, B0019	Churee Pramatwinai	B0076	
Achra Thammathaworn	B0048	Chusri Talubmook	B0154, B0155	
Albert J. Ketterman	B0044, B0075	Damrong Santiarvorn	<b>D</b> B0001	
Amara Naksathit	B0020	Darawan Thongbute	B0138	
Amnat Rojanapaibul	B0051	Derek Bannajak	B0087	
Amornrat Promboon	B0045, B0046	Dolnapa Kaewpa	B0130	
	B0063	Duangkamol Thong-a-ram	B0129	
Anchalee Tassanakajon	B0030, B0031	Duangkamol Tangpong	B0144	
	B0082	Duanpen Sandee	B0109	
Anchana Prathee	B0028	Duriya Chantasingh	B0120	
Anchana Thancharoen	B0021		<b>E</b> B0115	
Ancharlie Na-Chiangmai	B0098	Ek Sangvichien	<b>G</b> B0016	
Anoma Dongsansuk	B0107		<b>H</b> B0073	
Anudep Rangsipipat	B0076	Gerd Katzenmeier	<b>I</b> B0074	
Anuwat Wanthon	B0127, B0128	Hataichanoke Niamsup	<b>J</b> B0124, B014	
Apichai Bouchookarn	B0068, B0070		<b>K</b> B0049	
Apiradee Riennukool	B0034	Isarapong Pongsirikul	B0033	
Aram Khumklang	B0074	Itsara Nuratsa	B0119	
Aranya Manostroi	B0013, B0041		B0154	
	B0042	J. Promya	B0108	
Aranya Pimmongkol	B0132	James R. Ketudat-Cairns	B0074	
Araya Jatisatienr	B0026	Jarupan Kobsuk	B0013, B0042	
Aree Thattiyaphong	B0063	Jeeraphan Suksringarm	B0137	
Arisra Rodmuai	B0065	Jeeraphun Jaiinpon	B0064, B0066	
Artit Rukkasikorn	B0029	Jeeraporn Pekkoh	B0066, B0121	
Arunrat Chaveerach	B0106	Jiradej Manosroi	B0131	
<b>B</b>			B0108	
Banyong Khantawa	B0001		B0075	
Bavornlak Khamnamtong	B0082	Jirarach Srijunngam	B0150	
Benchamart Moolmuang	B0072, B0098	Jirasak Kongkiattikajorn		
Benchaporn Buaban	B0121			
Benjamaporn Wonganu	B0058	Jirundon Yuvaniyama		
Boonhaing Promdonkoy	B0069, B0090	Juthamart Piromjitpong		
	B0091, B0092	Juthaporn Khampila		
Boonserm Withyachumarnku	B0004			
Bundit Tengjaroenkul	B0061, B0062	Kanchana Bunnuang	<b>K</b> B0105	
Bungorn Thaewnon-ngiw	B0153	Kanchanee Tonak	B0009	
Busabun Chaisalee	B0034, B0092	Kanchit Thammasiri	B0006	
<b>C</b>		Kanjana Vongkuna	B0152	
Chaivat Kittigul	B0063	Kanlaya Yoonan	B0064, B0064	
Chaiyasisi Sittiwit	B0079	Kanok Rattanakanokchai	B0064	
Chalermchai Wongwattana	B0139	Kanokon Riwluang	B0035	
Chalermporn Ongvarrasopone	B0094	Kanokphan Wongprasert	B0004	
Chanikul Chutrakul	B0111	Kanokporn Saenphet	B0100	
Chapen Chanchao	B0148, B0149	Kanokporn Triwitayakorn	B0034, B0098	
Chantima Keyanont	B0046	Kanokrat Namsinuan	B0098	
Charles Drewes	B0103	Kansri Boonpragob	B0125	
Chartchai Kritanai	B0068, B0090		B0113, B0115	
	B0069, B0070	Kanya Santanachote	B0152	
Chinuma Pinkate	B0052			

Kanyaratt Supaibulwatana	B0136	Nakhon Norkeaw	B0015
Kanyawim Kirtikara	B0118, B0055	Nalena Praphairaksit	B0103
	B0109, B0110	Naowarat Cheeptham	B0108
	B0111, B0121	Napat Puranamaneewiwat	B0073
Karuna Manoban	B0125	Narit Sitasuwan	B0014
Kasem Soytong	B0017	Narongsak Puanglarp	B0036, B00.
Katewadee Boonyapakron	B0055	Narumol Thongwai	B0026
Kawinnat Buaruang	B0115	Narumon Jeyashoke	B0039
Kenji Mutsui	B0125	Narumon Meesreruang	B0115
Kestip Isarankura Na Ayudhya	B0147	Narupat Hongdilokkul	B0136
Khajeenat Photivetkul	B0125	Naruphat Paphattarapong	B0077
Khajornsak Tragoolpua	B0026	Nat Malainual	B0054
Khanok Ratanakhanokchai	B0039, B0117	Natsurang Homchantara	B0115
Khesorn Nanthachit	B0001	Nattha Wannissorn	B0140
Khin Lay Kyu	B0039, B0117	Nattida Puenphasook	B0014
Khomsorn Lomthaisong	B0127, B0128	Nichanun Phochanukul	B0059
Kienghathai Yeunyongsawan	B0066	Nicharat Swasdipan	B0132
Kingkaew Wattanasirmkit	B0137	Nichaya Praditsup	B0020
Kittapong Tang	B0118	Nipaporn Sankuntaw	B0024
Kittisak Ajariyakajorn	B0078	Niramol Donghong	B0053
Komson Ruangrit	B0074	Nongnuch Gumlungpat	B0003
Kosum Chansiri	B0125	Nongnud Tangkrock-olan	B0002
Kraijak Booncheun	B0004	Nonthawat Prachantasena	B0137
Krisanadej Jaroensutasinee	B0040, B0047	Nunthawun Uawonggul	B0106
	B0089, B0105	Nuttira Gavinjan	B0146
Kristine Stubberud	B0157		
Krongkaew Supawat	B0063		
Krongsakda Noipanitl	B0117	Orawan Satyalai	O B0010
Kumpul Meesawad	B0105		
Kun Anantasomboon	B0004	P. Hongvityakorn	B0049
Kunya Sutjarityvongsanond	B0074	P. Rojvirat	B0135
Kusol Pootanakit	B0055, B0056	Padermsak Jarayabhand	B0030, B0031
	B0057, B0058		B0032
	B0120	Padungkwan Chitropas	B0062
<b>L</b>	B0101, B0156	Paisarn Sithigormgul	B0007, B0038
La-aw Ampornpan	B0158	Paitoon Leksawasdi	B0029
Lertluk Ngernsiri	B0045	Pakorn Winayanuwattikun	B0044
Lily Eurwilaichitr	B0055, B0058	Panadda Boonserm	B0092
	B0118, B0121	Panadda Larpkern	B0156
	B0119, B0120	Panrithai Budthongsri	B0017
<b>M</b>	B0033	Paramita Phanwong	B0027
Mana Kaomek	B0093	Parichat Phumkhachorn	B0024
Manit Kosittrakun	B0089	Parin Chaivisuthangkura	B0007, B0038
Manit Polar	B0141		B0104
Manus Suwamin	B0156	Patamaporn Tilarux	B0093
Marit Eriksen	B0122	Patchara Nithirojpakdee	B0060
Masao Nakamura	B0026	Patcharee Promdonkoy	B0091, B0092
Matcha Porn-in	B0003	Pathom Sawanpunyalert	B0063
Mayuva Areekijsseree	B0095, B0096	Patompon Wongtrakoongate	B0126
Miloslav Juricek	B0114	Pattanop Kanokratana	B0120
Mongkol Pangpet	B0090	Paul J. Groteb	B0027
Mongkon Audtho	B0040, B0047	Paveena Tapaneeyaworawong	B0085
Mullica Jaroensutasinee	B0089, B0105	Pawin Saihu	B0062
		Penphun Naenna	B0079
		Pensiri Sriburi	B0011

Pensri Pootrakool	B0103	Sakol Panyim	B0090, B0091
Permchai Itthisoponpisarn	B0095		B0092, B0094
Petcharat Werukamku	B0158		B0096, B0098
Phattara-orn Chongsatja	B0068	Salika Aritajat	B0100
Philip D. Round	B0020	Sa-ngium Promkutkaew	B0122
Phiromsak Phattanapaijitku	B0038, B0104	Sangvorn Kitthawee	B0021
Piamsak Menasveta	B0023, B0032	Sansook Boonseub	B0036
	B0036, B0037	Saowalak Pongpaichit	B0133
	B0051, B0082	Saowapa Sontichai	B0122, B0146
	B0086, B0099	Seewapong Chamratpan	B0151
Piboon Mongkolsuk	B0115	Shen Yuemao	B0116
Pilai Poonswad	B0020, B0021	Shigeyuki Tajima	B0073
Pinich Wangsomnuk	B0008	Shivcharn S. Dhillion	B0156, B0158
Pintip Pongpech	B0079		B0101
Piti Amparyup	B0031	Siam Popluechai	B0043
Piyada Theerakulpisut	B0107, B0129	Sirawut Klinbunga	B0030, B0031
Piyarat Chansiripornchai	B0076		B0032, B0037
Plaipol Dedvisitsakul	B0057		B0082
Pongsak Rattanachaikunsopon	B0024	Sirikanya Chungthanawong	B0086
Pongsarun Junshum	B0051, B0083	Siripen Trichaiyaporn	B0050, B0051
Pongsathorn Dhumtanom	B0013		B0052, B0053
Pongsopee Attasart	B0059		B0083
Pornpimol Rongnoparut	B0130	Siripong Tangprasertkit	B0045
Pornpimon Numsanguan	B0046	Sirirat Fa-aroonsawat	B0043
Pragrom Prayoonrat	B0012	Sirirat Rengpipat	B0007
Prakart Sawangchotea	B0027	Siriwat Wongsiri	B0148, B0149
Pramote Triboun	B0150	Sittipon Intarapat	B0010
Pranadda Pimsee	B0142	Siwaporn Longyant	B0007, B0038
Pranee Pttanapipitpaisal	B0124, B0145		B0104
Pranom Chantaranothai	B0048, B0129	Soamrutai Boonsuepsakul	B0130
Prasert Meeratana	B0004	Solot Suwanyeun	B0138
Priamsak Menasveta	B0030	Sombat Rukpratanporn	B0007, B0038
<b>R</b>			
Ranu Yucharoen	B0026	Somdej Kanokmedhakul	B0017
Ratapol Sornprasert	B0009, B0035	Somdet Srichairatanakool	B0087, B0088
Ratikorn Chatchanayuenyong.	B0155	Somkiat Piyatiratitivorakul	B0023, B0086
Ratsamee Ketpadung	B0002	Sompeng Thammasirak	B0106, B0127
Raveewan Siripokasupkul	B0076	Somporn Chunluchanon	B0051
Rawadee Thongbai	B0041	Somporn Bua-Kang	B0153
Renu Vejaratpimol	B0003	Somsak Sarangbin	B0141, B0142
Ruchanok Cheotacha	B0011	Songklod Saraput	B0130
Rumpalai Padoongsupalai	B0148	Soratun Ramangkoon	B0123
Rungjit Yoddee	B0023	Sorawit Powtongsook	B0085, B0099
Rungnapa Leelatanawit	B0030, B0032	Srisupaph Poonlaphdecha	B0037
Rutchadaporn Sriprang	B0118, B0119	Sriwan Wongwisansri	B0110
	B0121	Suchada Chaisawadi	B0138
Ruttikarn Mungmai	B0074	Suchada Saengwiman	B0096
<b>S</b>			
S. Traichaiyaporn	B0049	Suda Saowakon	B0042
S. Tungpradabkul	B0135	Suda Tunpiboonsak	B0134
Saisamorn Lumyong	B0108, B0116	Sudaporn Tongsiri	B0074
Sakaewan Ounjaijean	B0088	Sujaree Khamparat	B0132
Sakda Daduang	B0017, B0106	Sukanya Jesadanont	B0077, B0079
Sakol Panyim	B0059, B0072	Sukonthip Savatenalinton	B0153
		Suluk Vutteerapol	B0100
		Sumalee Tangpradubkul	B0126, B0134

Sumontip Bunnag	B0093, B0107 B0144	Unchulee Pongwiwatana	B0077
Sunan Pongsamart	B0076	Vanicha Vichai	B0109
Sunanta Pongsamart	B0077	Verapong Kiatsoonthorn	B0097
Sunanta Ratanapo	B0045	Verawat Champreda	B0118, B0119
Sunanta Pongsamart	B0078, B0079	Verawat Champreda	B0121
Sunanta Ratanapo	B0046, B0063	Vichaya Gunbua	B0085
Sunee Kertbundit	B0095, B0096	Vimolmas Lipipun	B0077, B0078
Suntaree Preangkarn	B0074	Viriya Nitteranon	B0056
Supachai Boonnumma	B0138	Visut Baimai	B0021
Supajit Sraphet	B0072, B0098		<b>W</b>
Supanee Liengpornpan	B0040	Wachiraporn Tipsuwan	B0087
Supaporn Thumrungtanakit	B0030	Wanchai Sonthichai	B0108
Suparporn Sutin	B0047	Wannipa Phianphak	B0007
Suporn Nuchadomrong	B0017	Wansuk Senanan	B0060
Surapon Piboonpocanun	B0054	Wanutsanun Tunyapanit	B0133
Surapong Pinitglang	B0117	Wanwarang Pathaichindachote	B0090
Suthasinee Somyong	B0094	Warannya Udomkam	B0155
Sutinee sinutok	B0028	Warayut Suranarakun	B0024
Sutipa Tanapongpipat	B0056, B0118 B0119, B0121	Warinee Palasarn	B0132
Suttatorn Suwanrat	B0146	Wasana Chausook	B0113
Suttikarn Sutti	B0099	Wasinee Wimonsuk	B0115
Suwaree Sompong	B0138	Watchara Wongkerdsuk	B0004
Suwisa Pilalum	B0149	Watcharee Khunkitti	B0062
		Weerachon Tepanant	B0069
		Weeradaj khonsantear	B0128
<b>T</b>		Weerasak Saksirirat	B0107
Tadahiko Kajiwara	B0125	Weerawan Sithigorngul	B0007, B0038
Takashi Aoki	B0031		B0104
Tanatchaporn Phaunfoong	B0078		
Tanatchaporn Utairungsee	B0118	Wetchasart Polyiam	B0113
Tanussara Laochareonsuk	B0005	Wichian Magtoon	B0081, B0018
Tapawittra Pongpawe	B0019		B0123
Tarinee Arkaravichien	B0106	Wilawan Phromprom	B0154
Taweesak Khuantairong	B0050	Winanda Seangtong	B0022
Tawin Iempridee	B0016	Wipa Chungjatupornchai	B0043
Teerarat Chamchaiyaporn	B0139	Wiriya Khwancong	B0005
Thanawan Tejangkura	B0104	Wisut Nualchuen	B0159
Thararat Supasiri	B0141, B0142	Witayaporn Pornchuti	B0006
Thawat Donsakul	B0018, B0019	Witoon Khawsuk	B0022
Thawat Donsakul	B0081, B0123	Wiwit Samasanti	B0133
Theerawat Prasertanan	B0131	Wut Dumrongsak	B0039
Thitirat Ngaoteprutaram	B0054	Wuttipong Mahakham.	B0150
Thongchai Taechowisan	B0116		<b>Y</b>
Tian Kanpuy	B0035	Yingmanee Tragoolpua	B0026
Tinnagorn Seeprasert	B0129	Yupin Taitobsakul	B0079
		Yuttana Mundee	B0087
<b>U</b>		Yuwadee Peerapornpisal	B0074
Udomphan Khansuwan	B0088	Yuwadee Watanapokasin	B0141, B0142
Unchalee Kongbantad	B0155		
Unchera Sookmark	B0006	Yuwapin Dandusitapun	B0065

## Section C – CHEMISTRY

### A

Acharawadee Chooyimpanit	C0071	C0220, C0221
Adrian E. Flood	C0205	C0130, C0202
Adrian Mulholland	C0169	C0059, C0061
Aimon Tongpenyai	C0209	C0140
Alakkhana Suwanvisut	C0158	C0184, C0185
Amarawan Intasiri	C0004, C0005	C0215
Amorn Chaiyasat	C0084	C0031
Amorn Petsom	C0162, C0163	C0094, C0095
Ampan Promsiri	C0088	C0246
Anan Jean-Anong	C0199	C0017
Anan Tongraar	C0240	C0138, C0144
Anawat Ajavakom	C0247	C0145
Ankana Patomsakul	C0226	C0128
Anuch Hasakunpaisarn	C0246	C0244
Anucha Munchaidee	C0227	<b>C</b>
Anukorn Phuruengrat	C0018	Chaalev Pachthong
Anuson Niyompan	C0157	C0140
Apakorn Yudee	C0254	Chadaporn Supannanuyok
Aphiwat Teerawutgulrag	C0066	C0016
Apichai Sivaphraghorn	C0015	Chaiyuth Sae-kung
Apichart Boonmalai	C0093	C0238
Apichart Suksamrarn	C0029, C0030	Chalerm Ruangviriyachai
Apichart Suksamrarn	C0185, C0208	C0038, C0048
Apichat Chaicharnattee	C0211	Chalerm Jansom
Apichat Imyim	C0115	C0013
Apinya Chaivisuthangkura	C0152	Chalermrat Akarawitoo
Aranya Manosroi	C0066	C0211
Araya Jatisatiens	C0139	Chalev Pachthong
Arisa Jaiyu	C0194	C0139, C0142
Arjaree Suntichai	C0016	Challa V. Kumar
Aroon Jankum	C0215	C0152
Aroonsiri Shitangkoon	C0023	Chananate Uthaisar
Aroonsri Priyem	C0048	C0106
Arusa Chaovanalikit	C0213	Chanida Palanuvej
Arworn Donchai	C0104	C0163
Ashley T. Townsend	C0067	Chanita Ponglimanont
Atchara Buachuen	C0112	C0001
Athit Dathornng	C0205	Chantana Sae-Lim
Atitaya Samontha	C0076	C0195
Atitaya Siripinyanond	C0074, C0075, C0077, C0078	Chantip Saeton
	C0080	C0146
Attapol Pinsa	C0252	Chanwit Photicunapat
Attasak Rattanasumrit	C0243	C0171
Attera Worayingyong	C0035, C0109	Chareonchai Jeamchanya
Atthawan Benjamas	C0022	C0013
Auamphon Rattanasing	C0055	Charnwit Phacharapongsakul
Aungkhoon Bunya	C0099	C0147
Aurasorn Saraphanchotiwitthaya	C0143	Chatchai Ponchio

### B

Banchob Wanno	C0201, C0219
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Chorchat Soonthornpalin	C0132	Jeerawan Promchan	C0073
Chote Jitrangsri	C0204	Jetsuda Areephong	C0223, C0224
Chuchaat Thammacharoen	C0198, C0199	Jianzhong Li	C0214
	C0200	Jinda Yuenyongchaiwat	C0107
Chulee Serumnuay	C0006	Jintana Klamtet	C0051
Chumanan Tungchitpienchai	C0219	Jintana Pinwatananurak	C0006
Churairat Duangdeun	C0081	Jiradej Manosoi	C0066
Chutima Kukusamude	C0037	Jirasak Threeprom	C0177, C0178
Colin W. Gray	C0150		C0227
<b>D</b>			
Dammrong Santiarwam	C0241	Jirayu Makchit	C0094
Darinee Sae-Tang	C0137	Jitraporn Vongsivut	C0197
David James Harding	C0217, C0218	John Korth	C0104
Disyapong Jainuknan	C0056	Julaluk Phunnoi	C0237
Duang Buddhasuk	C0066, C0139	Jumras Limtrakul	C0096, C0097
Duangjai Nacapricha	C0058, C0059		C0122, C0123
	C0060, C0061		C0126, C0127
	C0062, C0063		C0128, C0129
Duangrat Thongkum	C0117		C0130, C0131
Dumrat Supyen	C0139		C0132, C0133
<b>E</b>			
Ekkachai Ruangdam	C0173	Juntadej Kositcharoenkul	C0186
<b>F</b>			
Frank W. Harris	C0248	Juwadee Shiwatana	C0062, C0072
Fuangfa Unob	C0115		C0073, C0075
Fumitaka Horii	C0233		C0076, C0077
<b>G</b>			
Greg Dicinoski	C0067		C0079, C0080
Griangkai Kungtong	C0002	Kammal Kumar Pawa	C0150
Gudrun Stengle	C0198	Kamonthip Sereenonchai	
<b>H</b>			
Hans Mosbæk	C0083	Kamonwan Anan	C0146
Harinate Mungpayabal	C0253	Kan Chantrapromma	C0001
Herman H.-Y. Sung	C0206	Kanchana Watla-iad	C0044
Hideaki Otsuka	C0236	Kanda Panthong	C0014, C0064
Hironori Kaji	C0233	Kanidtha Hansongnern	C0010, C0011
Horst Geckeis	C0049		C0012, C0117
Hussadee Detsen	C0121	Kanjana Rotpradit	C0118
<b>I</b>			
Ian D. Williams	C0206	Kannika Kranlert	C0222
Ian McKelvie	C0063	Kanyanat Kokkaew	C0057
<b>J</b>			
J.J. Brophy	C0070	Kanyarat Kalpakom	C0041
Jakkapan Sirijaraensre	C0123	Karan Bobuatong	C0162
Jamnong Kaewtubtim	C0013	Karnjana Tanapaiboon	C0126
Jane Chantarasupasen	C0054	Kate Grudpan	C0154
Janya Buanuam	C0072		C0042, C0044
Jaroon Jakmunee	C0042, C0045		C0045, C0046
	C0046, C0047		C0047, C0049
	C0093, C0193		C0058, C0093
	C0214, C0256		C0193, C0214
<b>K</b>			
Jarun Lomratsiri	C0131	Kedthip Suppavanit	C0256
Jarunee Kraikaew	C0057	Kenneth J. Haller	C0098
Jason Fernandez	C0197	Ketsiri Kueseng	C0205, C0206
Jatuporn Wittayakun	C0017	Khomson Thiansomjit	C0028
Jaturong Phatchimkun	C0092	Kirawit Supakornchailert	C0161
		Kittipong Chainok	C0219
		Kittiya Muaksang	C0206
			C0010

Kornvalai Panpae	C0016	Nirun Sanoondee	C0160
Kowit Kittiwutthisakdi	C0028	Nisa Nauangchammong	C0105
Krissada Ngarmtab	C0147	Nitiphong Jirathiwathanakul	C0103
Kritsana Jitmanee	C0043, C0256	Nitirat Chitmoi	C0030, C0208
Kritsana Saganik	C0240		C0215
Kullaya Youngnoy	C0140	Nongnuch Muangsin	C0056
Kulwadee Pinwattana	C0051	Nongnuch Tantidanai	C0119
Kunlayanee Hansuthirakul	C0247	Nongnuj Muangsin	C0121, C0144
<b>L</b>			
Ladda Meesuk	C0022	Noocharin Ratthanaporn	C0016
Likhit Khawngam	C0188	Nopporn Rueangsupapichart	C0223, C0224
Lop Pathimapornlert	C0225	Noria Mohamed	C0171
Luksamee Sahavisit	C0012	Nuanlaor Ratanawimarnwong	C0063
<b>M</b>			
Maethinee Boonchupleing	C0086	Nuanphun Chantarasiri	C0121
Malee Prajubsuk	C0157	Nuchanart Kitjavises	C0178
Maliwan Amatatongchai	C0058	Nuntana Aroonrerk	C0029
Maliwan Sookseam	C0039	Nuttaporn Pimpha	C0248
Manat Pohmakot	C0252	Nuttinee Supamathanon	C0053
Mangkorn Kitiphatmontree	C0086	<b>O</b>	
Marisa Arunchaiya	C0099	On-Uma Kheowan	C0106, C0149
Mark Bradley	C0184	Orapin Chienthavorn	C0033, C0034
Mark Braiman	C0197	Orapin Komutiban	C0208
Mark Haworth	C0184	Orapun Thaworninsurakul	C0119
Mayuso Kuno	C0156, C0210	Oravan Sanguanruang	C0103
Michael Kiselev	C0176	Orawan Sirichote	C0007
Miki Kanna	C0007	Orawan Tue-Ngeun	C0047
Mongkol Sukwattanasinitt	C0194, C0195	Orawon Chailapakul	C0058, C0181
Monpichar Sirsa-art	C0247	Ornuma Konghuirob	C0023
Muriel Bouby	C0162	<b>P</b>	
<b>N</b>			
Namfon Tongtavee	C0150	Pakakrong Thongdeeying	C0001
Napaporn Sansila	C0188	Palangpol Kongsaree	C0056, C0194
Napaporn Youngvises	C0068, C0105		C0209
Nareerat Thongchai	C0110	Panida Surawattanawong	C0096
Narisara Suwannapoch	C0108	Panit Sherdshoophongse	C0171
Narong Pungwiwat	C0210	Pannee Leeladee	C0056
Narongdate Wattanavichian	C0238	Panomwan Panseeta	C0030
Narongsak Chaichit	C0161	Panuwat Padungros	C0232
Narumol Vachirapatama	C0121	Paramee Pengprecha	C0159, C0160
Natchanon Amornthammarong	C0067	Parichat Damrongpong	C0100
Nathachai Aunchai	C0060	Parichutr Paungmanee	C0187
Nathawut Choengchan	C0210	Parinya Theramongkol	C0161
Nattawan Kuppithayanant	C0059, C0061	Pataraporn Eutirak	C0235
Nattawut Chaiyut	C0175	Patchanee Charoenying	C0024
Nattawut Kaveevivitchai	C0233	Patcharee Ngamviriayavong	C0231
Nattaya Poolkeaw	C0027	Patcharee Preedasuriyachai	C0250
Natthapong Jongrak	C0107	Patcharee Pripdeevech	C0088
Nathee Phattae	C0111	Patcharin Chaisuwan	C0059, C0060
Nawona Boonnak	C0226		C0062
Ngampong Kongkathip	C0064	Patcharin Moktip	C0158
Nipaka Sukpirom	C0246	Pathumwadee Intharathep	C0240
Nipaporn Meepun	C0102	Patoomratana Tuchinda	C0252
Nirand Pongpun	C0244	Patraporn Luksinkul	C0129
	C0207	Pattana Sriyalikit	C0143
		Pattara Sawasdee	C0236
		Patumtip Samuapark	C0158
		Paul B. Savage	C0026, C0027
		Paul R. Haddad	C0067

Paween Nookong	C0118	Preeyaporn Chaiyasat	C0084
Peerapol Nunrium	C0156	Prin Kerdsiri	C0142
Peerapong Nichamnarn	C0113	Prissana Junyuha	C0227
Penpan Khanrin	C0066	Puchong Wararattananuruk	C0009, C0153
Penporn Nermhom	C0143	Pulaporn Woasamneang	C0207
Perapat Anujaravat	C0060	Purnendu K. Dasgupta	C0214
Phadoong Boonsin	C0007	Puttirat Saraban	C0196
Phanee Rattanachaisit	C0006		<b>R</b>
Phanu Poonsawus	C0227	Rabiab Suwanpetch	C0009
Philippe A. Bopp	C0136	Rachada Haritakun	C0210
Phimpakha Klanginsirikul	C0217, C0218	Raewadee Srisakuldee	C0006
Piboon Pantu	C0122, C0127	Ramida Rattanakam	C0109
Pichit Sutta	C0113	Ratana Rungsirisakun	C0202
Pilawan Haouykawe	C0159	Rattanapon Meekabsom	C0178
Pimonporn Tiengtham	C0236	Rattikan Chantiwas	C0042, C0044
Pimthong Thongnokpun	C0200	Reweeworn Bunnum	C0181
Piniti Ratananukul	C0029, C0030	Riantong Seetongchairungrot	C0105
Pinyo Wongthong	C0208, C0210	Richard L. Deming	C0177
Pipat Chooto	C0133	Robert T. Blickenstaff	C0204
Pipat Khongpracha	C0171, C0173	Rodjana Burakham	C0046
Pipat Pichestapong	C0226	Ronald G. McLaren	C0150
Pitak Yoomee	C0129, C0135	Ronald Grigg	C0246
Piti Treesukol	C0253	Roongroje Ratana-ohpas	C0071, C0244
Pongtip Winotai	C0002	Rungrot Cherdtrakulkiat	C0114, C0196
Ponlayuth Sooksamiti	C0135	Rungtiwa Chidthong	C0125
Poolsak Sahakitpichan	C0148, C0216		<b>S</b>
Poonsuk Poosimma	C0142	Saengrawee Sutthiparinyanont	C0048
Poramest Boonsri	C0019	Saiphon Chanpaka	C0205
Pornchan Sangkarn	C0090	Saisunee Liawruangrath	C0094, C0095
Pornlada Daorattanachai	C0015		C0068, C0110
Pornmanee Khamloet	C0086		C0116
Pornpan Pungpo	C0115	Saksit Chanthai	C0038, C0040
Pornpimol Muangthai	C0005		C0048
Pornprapa Krasar	C0157, C0158	Samran Prabpais	C0194, C0209
Pornthep Suksaranjit	C0113	Sanong Ekgasit	C0197, C0198
Pornthip Boonsri	C0059, C0061		C0199, C0200
Porntip Charoenniyomporn	C0087	Saowaluck Nganrungreung	C0044
Porntipa Picha	C0156	Saowanaporn Choksakulpon	C0228
Potjaman Poolmee	C0250	Saowanee Kumpun	C0185, C0215
Piyanete Sritharathikhun	C0041, C0104	Saowanee Rattanaphani	C0116
Prachya Kongtawelert	C0146	Saowanit Saithong	C0008
Prakai Sesto	C0125, C0134	Saowapa Chotisawan	C0017
Prancharee Teerathanakit	C0222	Saowapa Suphapong	C0114
Pranee Boonwat	C0043	Saowarux Fuangswasdi	C0026, C0027
Pranee Nandhasri	C0042	Saravut Dejmanee	C0071, C0244
Pranee Phukphatthanachai	C0227	Sarayut Yongprapat	C0069
Prapassurn Chaisai	C0238	Seiney Kruanetr	C0116
Prapin Wilairat	C0024	Shoji Motomizu	C0043, C0256
Prasit Purachat	C0013	Sila Kittiwachana	C0193
Pravit Sudkeaw	C0080	Sirichai Lawanvisuth	C0249
	C0253	Sirinan Thuphimthed	C0151
	C0058, C0059	Sirinapa Arenamnart	C0101
	C0061, C0062	Siripat Suteerapataranon	C0045, C0049
	C0063	Siripen Jarikasem	C0070, C0151
	C0032	Siriporn Jungsuttiwong	C0179
	C0008	Sirirat Phaisansuthichol	C0018

Siritha Ausadasuk	C0035	Supawan Tantayanon	C0248
Soamwadee Chaianansutcharit	C0102	Supharart Sangsawong	C0074
Somchai Lapanantnoppakhun	C0046, C0193	Supichai Kantrasiri	C0149
	C0256	Supon Samran	C0015
Somjai Pengprecha	C0186	Supot Hannongbua	C0176
Somkiat Srijaranai	C0037	Suppadcharee Roddecha	C0097
Somporn Chantara	C0025, C0083	Surapol Natakankitkul	C0241
Somporn Prasertsongsakun	C0003	Surasak Pongpansook	C0057
Somsak Aramraeng	C0165	Surin Laosooksathit	C0108, C0238
Somsak Ruchirawat	C0019, C0114	Suriya Ounnunkad	C0216
	C0196, C0210	Surudee Treetepvijit	C0181
Somsak Saelim	C0021	Suwanna Vejabhikul	C0241
Somsak Sirichai	C0174	Suwassa Bamrungsap	C0129
Somying Leelasubcharoen	C0090, C0091	Suwat Pabchanda	C0122
Songtham Ruangchaithaweesuk	C0144	Simon Aonlamoon	C0142
Sopon Purawatt	C0072	<b>T</b>	
Sowaluk Aubpatham	C0153	Tadao Sakai	C0256
Soycom Kunchanawatta	C0029	Tadtanu Shanyib	C0242
Sriprajak Krongsuk	C0176	Tanawat Kanjanaboonmalert	C0102
Stephen G. Pyne	C0104	Tanawat Prommanuwat	C0082
Subpachai Jayasvasti	C0256	Tanin Nanok	C0136
Suchaya B. Pongsai	C0036	Tanin Tangkuaram	C0120
Sudarat Saeseaw	C0075	Tapparath Lelasattarathkul	C0110
Suekanya Jarupinthusopon	C0245	Tawatchai Keving	C0201
Sugunya Wongpornchai	C0087, C0088	Taweechai Amornsakchai	C0233
Sujitra Youngme	C0090, C0092	Teerakiat Kerdcharoen	C0176
Sukanda Jiansirisomboon	C0254	Teerasak Seibsa	C0161
Sukanya Wongpornchai	C0089	Teerayuth LiwPorncharoenvong	C0207
Sukij Thongban	C0165	Tepparat Lelasattarathkul	C0068
Sukon Phanichphant	C0002	Terence Cardwell	C0063
Sukunya Sukprem	C0016	Thanaporn Poonsukcharoen	C0033, C0034
Sumalee Ninlaphruk	C0253	Thanawan Boonyasakseri	C0113
Sumattana Worapanyanond	C0078	Thanh N. Truong	C0135, C0179
Sumpun Wongnawa	C0007, C0008	Thanit Praneenarat	C0138
Sumrit Mopoung	C0180	Thanwa Udom-piriyasak	C0238
Sunan Chainakul	C0041, C0146	Thanyada Rungrotmongkol	C0169
	C0207	Thanyarat Chuesaard	C0095
Sunanta Wangkarn	C0054, C0083	Thanyarat Techalertmanee	C0079
Suneerat Pipatmanomai	C0107	Thassanee Peerayuth	C0006
Sunit Suksamram	C0029, C0030	Thawatchai Tuntulani	C0026, C0027
	C0208, C0210		C0055, C0056
Suntree Rincome	C0050		C0144
Supa Hannongbua	C0124, C0125	Theerachart Leepasert	C0124
	C0134, C0137	Thitima Jiyavarantan	C0253
	C0156, C0169	Thitirat Mantim	C0062
Supalax Srijaranai	C0222	Thomas Fanghaenel	C0049
	C0037, C0039	Thunnoon Nhujak	C0162, C0163
	C0040	Tienthong Thongpanchang	C0223, C0224
Supaluk Prachayasittikul	C0114, C0196		C0250
Supana Techasakul	C0124	Tim Elliott	C0184
Supap Silapakamprirapap	C0107	Tinnagron Seesiadka	C0087, C0089
Supapan Srisukho	C0253	Tirayut Vilaivan	C0154, C0231
Supaporn Kradtap	C0042, C0093		C0229, C0230
	C0193		C0232
Supawadee Namuangruk	C0127	Tossapon Ruttanasit	C0188
Supawan Hattiya	C0160	Tritaporn Choosri	C0053

Tuanjai Yubolpas	C0004	Wichanee Meeto	C0125, C0134
Ubon Rerk-am	C0070, C0151	Wichien Sang-aroon	C0255
Udom Jingit	C0173, C0226	Wichitr Rattanaphani	C0116
Udom Nusalo	C0108	Wijitar Duanchai	C0181
Unchulee Suksangpanya	C0092	Wilawan Mahabusarakam	C0171
Urai Tengjaroenkul	C0025, C0111	Wimonrat Trakarnpruk	C0100, C0101
Uraiwan Changsaluk	C0011	Winai Ouangpipath	C0110, C0225
Usa Onthong	C0157	Winyu Chitsamphandhvej	C0147
Usarat Kamtabtim	C0077	Wipapan Pongcharaen	C0014
Uthaiwan Sonjarearn	C0161	Wipaporn Phatvej	C0151
<b>V</b>			
Vanida Chairgulprasert	C0003	Wiphada Hongthani	C0038
Varawut Tangpasuthadol	C0154	Wirat Phuwiwat	C0024
Vatcharin Rukachaisirikul	C0014, C0020	Wiratda Wichaporn	C0003
Veeramol Vailikhit	C0021	Wolfgang Knoll	C0198
Vichai Reutrakul	C0124	Woraluk Mansawat	C0229
Vinay Soukharath	C0252	Worawan Bhanthumnavin	C0229
Vinich Promarak	C0041	Wutthisak Prachamon	C0157
Virapong Prachayasittikul	C0203	<b>Y</b>	
Virasak Chuamanochan	C0114, C0196	Yaowapha Jirakiattikul	C0067
Virasak Dungsrikaew	C0241	Yongsak Sritana-anant	C0228
Virat Sungkawisit	C0028	Yongyuth Tundulawessa	C0112, C0187
Vithaya Ruangpornvisuti	C0040	C0212	
Voranuch Srijesdsadaruk	C0121, C0201	Yot Kijchanalert	C0105
Vorawit Banphavichit	C0219, C0220	Yuppharat Pinkaew	C0091
<b>W</b>			
Wachiraphon Sinthavathavorn	C0221, C0234	Yuttana Tantirungrojchai	C0096, C0097
Wachirawan Pimrote	C0242, C0243	C0098	
Walailuk Poetpaiboon	C0249, C0255		
Walaya Sangchan	C0039		
Wandee Bunyarachata	C0229, C0230		
Wannee Srinuttrakul			
Wannilak Wannachai			
Wanpen Naklue			
Wanphen Boonruksa			
Wansiri Pitakkiattikul			
Wantida Srisongmeoung			
Waradool Chutrong			
Warankana Suksom			
Waret Veerasai			
Warinthorn Chavasiri			
Wasana Chamnan			
Watsaka Siriangularnawut			
Weerachai Phutdhawong			
Weeraphat Pon-un			
Weerasak Chomkitichai			
Werayut Srichaisiriwech			

## Section D – PHYSICS

A				
Abiding Dasaesamoh	D0010	Damrongsak Maneepongswadi	D0002, D0004	
Adisak Punyanut	D0081	David Ruffolo	D0035, D0045	
Alejandro Sáiz	D0045	Duangmanee La-Orauttapong	D0051, D0094	
Amporn Poyai	D0027	Dusit Ngamrungroj	D0085	
Anongnad Charoenruai	D0003			E
Anurak Udomvech	D0048	Eddy Simoen	D0027	
Anurak Prasatkhetragarn	D0066, D0070	Ekapan Swatsitang	D0009	
Apaporn Thongphud	D0054	Ekkachai Jantayod	D0013	
Areefen Rassamesard	D0033			F
Areratt Komduangkaeo	D0081, D0079	Fuanglada Veerasai	D0093	
Artorn Pokaipisit	D0082	Galayanee Doungchawee	D0029	
Arunee Intasorn	D0021			G
Athikom Manoil	D0040, D0053	Gerald J. Diebold	D0023	
Auppatham Nakaruk	D0025	Glenn Mason	D0035	
	D0064	Gorge Siopsis	D0055	
B				H
B. Soodchomshom	D0089	Hathaitip Rojsuparat	D0074	
Bancha Panacharoensawad	D0028, D0077	Hirokazu Hasegawa	D0079	
Benjang Sangchuk	D0054			I
Bernard Hennion	D0094	Itti Rittaporn	D0027	
Boonsong Sutapun	D0029			J
Buncha Silskulsuk	D0007	Jarupat Disrattakit	D0029	
Burin Asavapibhop	D0043	Jatuporn Thongsri	D0008	
		Jean Toulouse	D0094	
C				K
Cattleya Petchsingh	D0047	Jessada Chureemart	D0016	
Chalermwat Wongwanitwattana	D0059	Jipawat Chamchang	D0079, D0081	
Chanan Angsuthanasombat	D0058, D0088	Jirapa Sukhowattanakij	D0081	
Chanruangrit Channok	D0035	Jirapat Ladawan	D0059	
Chanwit Chityuttakan	D0015	Jiraporn Pongsopa	D0007	
Charnwit Ruangchalermwong	D0042	John W. Bieber	D0045	
Charoen Larppitakpong	D0082			L
Chat Pholnak	D0076	K. Takashina	D0047	
Chatchai Pawong	D0006	Kachain Dangudom	D0071	
Chatchawal Sripakdee	D0005	Kageeporn Wongpreedee	D0051	
Chitnarong Sirisathitkul	D0090	Kajornyod Yoodee	D0015, D0041	
Chitra Kedkeaw	D0018			M
Chivalrat Masingboon	D0009	Kanokpoj Areekul	D0042	
Chome Thongleurn	D0050			N
Chonticha Suwattanasophon	D0058, D0088			
Chuleeporn Wongtawatnugool	D0066, D0067	Kasin Kasemsuwan	D0077	
	D0068, D0069	Kittipong Tantisantisom	D0001	
	D0070, D0071	Korsakul Punyavardhana	D0015	
	D0072, D0073	Kriengsak Sriwichitkamol	D0028	
Cor Claeys	D0074, D0075	Krisanadej Jaroensutasinee	D0032	
	D0027	Krissada Kummabutr	D0017	
D		Krongkaw Tapsila	D0030	
D.Trikomoot	D0089			O
		L. Liabchai	D0032	
				P
				Q
				R
				S
				T
				U
				V
				W
				X
				Y
				Z

Laddawan Pdungsap	D0022	Pongtip Winotai	D0018
Ludda Trakulrum	D0065	Poramet Chunpang	D0005
Lukkana Ngamnasaew	D0084	Pornjuk Srepusharawoot	D0016
<b>M</b>			
Manoch Hengwattana	D0040	Pormpana Boonm	D0087
Mayuree Kittidechachan	D0049	Prathakon Srisongkam	D0032
Mayuree Natenapit	D0008	Preecha P. Yupapin	D0005
Michael G. Kiselev	D0088	Puchong Kijumnajsuk	D0036
Mihir Desai	D0035	<b>R</b>	
Montri Ajempanakit	D0041	R. J. Nicholas	D0047
<b>N</b>			
N. J. Mason	D0047	Rachan Jaroen	D0001
Napat Sansuthikul	D0052	Rakdiaw Maungma	D0068
Narong Boonyopakorn	D0050	Rattachat Mongkolnavin	D0085
Narong Suwanmanee	D0078	Ratthasart Amarit	D0029
Nason Phonphok	D0007	Rita Rooyackers	D0027
Ngamnit Gaewdan	D0091	Roger Pyle	D0045
Ngamnit Gaewdang	D0064	Rong Rujkorakarn	D0009
Nikorn Mangkorntong	D0060, D0061	Roongthum Sooksan	D0073
Nipon Thangprasert	D0062, D0076	<b>S</b>	
Niyom Hongstit	D0002, D0003	S. Denchittacharoen	D0089
Noparit Jinuntuya	D0004	S. Panyainkaew	D0063, D0089
<b>O</b>			
Nuthapol Liengphibul	D0036	Sampart Cheedket	D0086
Oleksiy Svitelskiy	D0094	Samran Lacharojana	D0066, D0067
Orawan Cherdchoo	D0049	<b>P</b>	
<b>P</b>			
P. harmanee	D0089	Santana Jeakjai	D0075
Pairat Niumprasert	D0093	Sarinrat Wonglee	D0084
Pairoj Jaideaew	D0032	Sasiphan Khaweerat	D0083, D0084
Pairote Jaideaw	D0034	Sathon Vijarnwannaluk	D0025
Pakorn Sittiketkorn	D0091	Satoshi Koizumi	D0079
Panatcha Anusasananan	D0003, D0004	Serewat Saminpanya	D0093
Patcha Chatraphorn	D0024, D0026	Sirasa Poomkeaw	D0029
Patohn Roatjanapanitkit	D0062	Siriluk Ruangrungrote	D0040, D0053
Paul Evenson	D0045	Sirimas Pongjunla	D0036
Pichet Limsuwan	D0021	Sithichai Pinkanjanaroj	D0037
Pikul Wanichapichart	D0046	Sithichai Pinkanjanarod	D0052
Pinpan Visal-athaphand	D0054	Sitthichai Kulsri	D0017
Pirut Kumsing	D0085	Sojiphong Chatraphorn	D0015, D0026
Piti Panichayunon	D0026	Somchai Pongkasem	D0041, D0042
Pitt Supaphol	D0054, D0079	<b>D</b>	
Piya parakoch	D0081	Sompak Sutsue	D0079, D0081
Piyachati wangmool	D0072	Sompanee Petchpraprasert	D0082
Pongsri Mangkorntong	D0060, D0061	Somporn Chongkum	D0082
	D0062, D0076	Somporn Maneetoon	D0082
		Somsak Dangtip	D0082
		Somsorn Singkarat	D0082
		Songvudhi Chimchinda	D0086
		Soontorn Chanyawadee	D0024

Sorasak Danworaphong	D0023	Toemsak Srihirin	D0029, D0032
Sornchai Tanunchai	D0060, D0061	Torrarin Chairuang Sri	D0033, D0034
	D0076	Trakool Rummachat	D0061
Sripen Towta	D0060, D0076	Tranee Kumlumlert	D0003
Sukrit Kirtsael	D0091	Treedej Kittiauchawal	D0030
Sumontha Songsom	D0053		D0019, D0020
Sunanta Patrashakorn	D0006	Udom Tiparat	<b>U</b> D0065
Sunun Taweeta	D0040	Udomsin Pinsook	D0016
Supab Choopun	D0060, D0061	Uraiwan Petlum1	D0002
	D0076		<b>V</b>
Supakorn Pookerd	D0065	V. Dhisthachareon	D0063
Supaluk Meeim	D0011, D0012		<b>W</b>
Supanee Limsuwan	D0018	Walter L. Craig	D0023
Supasarote Muensit	D0010	Wanchai Dharmavanij	D0080, D0083
Suphot Musiri	D0055	Waranont Anukool	D0062
Supiya Kulna	D0065	Warit Werapun	D0078
Suppalak Angkaew	D0049	Wattana Namchan	D0084
Supranee Lao-ubol	D0022	Wichian Ratanatongchai	D0054 ,D0080
Supreya Kumfu	D0019	Wichian Siriprom	D0039
Surachet Phadungdhitidhada	D0060	Wittaya Khruakham	D0069
Surapong Pimjun	D0083, D0084	Wutthikrai Busayaporn	D0043
Suthisa Leasen	D0036, D0037		<b>Y</b>
Suvijak Aticomkulchai	D0038	Yingyot Infahsaeng	D0034
Suwit Wongsila	D0060, D0062	Yodsoi Kanintronkul	D0001
	D0076	Yupeng Yan	D0086
<b>T</b>		Yuttanan Pansong	D0090
Tadsanapan Lerdsuchatawanich	D0044	Yutthana Tirawanichakul	D0078
Tanakorn Osotchan	D0032, D0033		
	D0034, D0048		
	D0050, D0088		
Tanapon Suklim	D0013 D0031		
Tanaporn Tansakul	D0051		
Tanattha Rattana	D0021		
Tanawat Wongluksanapan	D0046		
Tanut Jintakosol	D0020		
Tapanapong Tananchai	D0011, D0012		
Taveechai Taveechoenkool	D0058		
Teerakiat Kerdcharoen	D0001, D0032		
	D0048, D0058		
	D0088		
Teerasak Veerapasapong	D0006		
Teerasak Kamwanna	D0050		
Thidarat Khongthon	D0013,D0031		
Thiranee Khumlumlert	D0011, D0012		
	D0013,D0031		
Thitikorn Chanyatham	D0091		
Thitima Maturos	D0032		
Thitinan Gaewdang	D0064, D0091		
Titisak Kulkoulprakar	D0085		
Tiwakarn Phansanit	D0049		

## Section E – MATERIALS SCIENCE

### A

A.M.Russell	E0061
A.Udompom	E0098
Adisorn Poopattanapong	E0068
Alexander M. Jamieson	E0072
Amarawan Intasiri	E0067
Ampika Apichibukol	E0096
Anida Petchkaew	E0003
Anocha Munpakdee	E0034
Anusara Srirsroal	E0055
Anuson Niyompan	E0073, E0074 E0075

Anuvat Sirivat	E0072, E0085
Apichat Imyim	E0042
Apinon Nuntiya	E0021, E0022
Araporn Tanrattanakul	E0003
Aron Chaipanich	E0048, E0051 E0052
Arrak Klinbumrung	E0099
Arunee Intasorn	E0024
Athipong Ngamjarurojana	E0006, E0009 E0015
Athiya Kaengsilalai	E0082
Attavit Pisit-anusorn	E0011
Autchara Arunrattanapong	E0002

### B

Boonchoy Soontornworajit	E0085
Boonsong Sutapun	E0043
Bunsit Wattanathai	E0092

### C

Chakapun Thawornthira	E0059
Chalermwat Wongwanitwattana	E0080
Chanchai Thongpin	E0041

### D

Darunee Bhongsuwan	E0008
Daraporn Triampo	E0044
Duangduen Atong	E0054
Duangrudee Muakthong	E0092

### E

Ekaphan Swatsitang	E0012
--------------------	-------

### G

Gobwute Rujjanagul	E0039, E0056
Goson Dumsim	E0055

### H

Heiko Hessenkemper	E0040
--------------------	-------

### J

Jakapong Kruamun	E0018
Jantrawan phumchusak	E0095
Jerapong Tontragoon	E0030, E0031 E0032, E0033
Jiravadee Thaisongkram	E0034, E0038 E0088
Jittrawadee Phunkum	E0027
Joachim Kohn	E0068

Johannes Schwank

E0085

Jongrak Kluengsamrong

E0060

Juthamas Jitcharoen

E0014

Jutharat Sirisukprasert

E0056

### K

K.A. Gschneidner, Jr.

E0061

K.Songsiri

E0037

K.Wongpreedee

E0061

Kalyanee Sirisinha

E0028

Kamonpan Pengpat

E0017, E0031

E0032, E0050

E0052

Kanchana Keowkamnerd

E0040

Kasama Jarukumjorn

E0060

Kasinee Hemvichian

E0078

Kasinee Pathomwattanasak

E0018

Kittichai Sopunna

E0091

Kittiphan Techakittiroy

E0004

Kittisak Kuntiyawichai

E0014

Krungsiam Piri

E0049

Kulsinee Sintasanai

E0063

### L

Ladawan Wannatong

E0085

Laddawan Pdungsap

E0023

### M

Manit Sonsuk

E0078, E0086

Mayuree Srinunthakul

E0065

Meechai Tapnurat

E0081

Metha Ratnakornpituk

E0084

Michael McNallan

E0091

Monrudee Phongaksorn

E0082

### N

N. Sirikulrat

E0019

Nanthaya Kengkhetkit

E0095

Nantida Niyompanich

E0067

Narunchara Loikaew

E0049

Nattakarn Hongsriphan

E0018, E0041

Nattapong Nithi-Uthai

E0004, E0013

Nattaya Peardang

E0087

Nattida Siriwong

E0049

Neramitr Morakot

E0042

Netima Sawangwan

E0030, E0038

Nikorn Mangkorntong

E0081

Nilubon Jiampasud

E0041

Nimit Sriprang

E0002

Nimit Lueprasert

E0055

Nirun Witit-anun

E0059

Nitat Jira-arun

E0020, E0045

Nitnat Supakarn

E0060

Nitipong Chotiwiriyapon

E0041

Nittad Thirasart

E0094

Nittaya Khamma

E0016

Nongkran Chaiwong

E0021

Noppavan Chanunpanich

E0071

Nuanphun Chantarasiri	E0016, E0057	Saisunee Nilmaung	E0090
Numphet Plueksa-anan	E0058	Sakool Siryanalugsan	E0059
O	E0053	Santi Maensiri	E0083, E0090
Onuma Doaddara	E0026	Saovanee Kovuttikulrangsie	E0013
On-uma Nimitrakoolchai	E0044	Sauvarop Bualek-Limcharoen	E0043
P		Sawarin Chamunglap	E0005
P. Dararutana	E0019	Sayant Saengsuwan	E0088
P. Taowjamnong	E0019	Sirichai Serksiri	E0074
Pakinee Kittisuwannakul	E0042	Sirinya Chimdist	E0028
Panadda Nirnatlumpong	E0029	Sitthichai Wirojnupatump	E0099
Panu Punnarak	E0097	Sitthisak Prasanphan	E0021, E0022
Paradorn Ngamdee	E0084	Sitthisuntorn Supothina	E0070
Pasaree Laokijcharoen	E0097	Sittiphong Hanpimol	E0050
Pattamaporn Prapitpongwanich	E0017	Sombat Thanawan	E0025, E0062
Pattana Rakkwamsuk	E0055	Somehai Thongtem	E0091
Patrawin Gasemjit	E0043	Somkid Penshari	E0075
Paveena Laokul	E0083	Somsak Boonjaeng	E0051
Peera Pinetsiri	E0033	Somsak Boonjang	E0052
Peerayost Somchinda	E0094	Sorachon Yoriya	E0070
Phatecharin Thamasirianunt	E0025	Suchada Pongpat	E0086
Phiriyatorn Suwanmala	E0078	Suchada Pongpatn	E0087
Pichanon Suwannathada	E0040	Suchapa Netpradit	E0001
Pichit kajondecha	E0001	Suda Kiatkamjornwong	E0065
Pimsuda Heamtanon	E0062	Sudsiri Hemsri	E0049
Pipat Pichestapong	E0096	Sukanda Jiansirisomboon	E0029, E0099
Pisith Singjai	E0017, E0099	Sukanya Petchsirivej	E0043
Piyanoot Hiamtup	E0072	Sukdipown Thiansem	E0011
Pongsri Mangkorntong	E0081	Sukhum Eitssayeam	E0050
Pongtip Winotai	E0023	Sukon Phanichphant	E0040
Prachak Chantree	E0014	Sukum Eitssayeam	E0031, E0032
Prachya Malasri	E0056	Supab Choopun	E0081
Prajuk Tamee	E0012	Supanee Pathumarak	E0053
Pranee Chumsamrong	E0060	Suparerk Aukkaravittayapun	E0089
Pranee Phinyocheep	E0047, E0084	Supattra Visetpotjanakit	E0096
Prartana Kewsuwan	E0086, E0087	Supattra Wongsaenmai	E0006, E0009
Prawpillin Koonsorn	E0018		E0015
Putsadee Muhamud	E0092	Supawan Kasuriya	E0054
R		Supawan Tantayanon	E0097
Rakchart Traiphol	E0069	Supinya Prakanrat	E0047
Ratiros Wanreakl	E0008	Supon Ananta	E0005, E0006
Rattikorn Yimnirun	E0005, E0006		E0007, E0009
	E0007, E0009		E0011, E0015
Rewadee Wongmaneerung	E0007	Surajit Tekasakul	E0008
Rojcarin Chantarachindawong	E0043	Surasing Chaiyakun	E0059
Rungnapa Tipakontitkul	E0006, E0015	Surawut Choungchod	E0041
Rungsima Yeetsorn	E0071	Suriya Polsin	E0073
S		Suwimol Jatavattana	E0087
S. Ananta	E0098	Suwit Chaisupan	E0033
S. Jiansirisomboon	E0037	Suwit Wongsila	E0081
S. Promsean	E0019		
Sabaithip Tungkamani	E0082	T	
Sahachai Kanarkard	E0014	T. Huthayanon	E0077
Sain Baowkaew	E0092	T. Tunkasiri	E0035, E0036
		Tanakon Osotchan	E0037, E0077
			E0044

Tawee Tunkasiri	E0030, E0031 E0032, E0034 E0038, E0039 E0050, E0051 E0052, E0056 E0026, E0027 E0057 E0059 E0048 E0039 E0032, E0050 E0089 E0023 E0063 E0004 E0010 E0024 E0079 E0091 E0043, E0044 E0029	Vipavee P. Hoven Vittaya Amornkitbamrung W W. Nhuapeng W. Thamjaree Wanna Bannarukkul Wanrudee Kaewmesri Wantana Sukkaew Warangkana Kanjina Waret Veerasail Wassana Supmark Watcharaporn Keankeo Weachsuwan Porban Wilirat Cheewaseetham Wimonlak Sutapun Wimonrat Trakarnpruk Wipawee Na Ranong Wittaya Ngeon-tae Wiwat Nuansing Worapong Thiemsorn Worawan Bhanthumnavin Wutthisak Prachamon	E0065, E0068 E0083 E0035, E0036 E0077 E0035, E0036 E0077 E0093 E0020, E0045 E0080 E0046 E0089 E0010 E0024 E0080 E0013 E0060 E0046 E0058 E0042 E0090 E0040 E0093, E0094 E0073
Taweechai Amornsakchai			
Thammasinee Jainim			
Thanee Bupphakorn			
Thanongsak Nochaiya			
Theerachai Bongkarn			
Theeraphong Thongkum			
Theerayooth Theapsiri			
Thipvan Muangon			
Thirawan Nipithalul			
Thitipat Srinual			
Thongchai Panmatarith			
Thunyakorn Chuaytukpuan			
Tithinun Puatrakul			
Titipun Thongtem			
Toemsak Srikhirin			
Tongchai Choesjai			
<b>U</b>			
Uraiwan Intatha	E0031, E0032 E0050		
Uthaiwan Injarean	E0096	Yasuhiko Iwasaki	E0065
Uthaiwan Paka	E0088	Yongsak Sritana-anant	E0093, E0094
<b>V</b>			
Varawut Tangpasuthadol	E0067, E0097	Yupaporn Ruksakulpiwat	E0060

## Section F- AGRICULTURAL & FOOD SCIENCE

A				
Akkasit Jongjareonrak	F0029	Prasert Prasertkithwattana	F0026	
Anuttara Pokharatsiri	F0018, F0019	Pratoomporn Yingthongchai	F0023	
		Prawit Kongjan	F0004	
B				
Bongkoch Noppon	F0031	Romanee Sa-nguandeekul	R	
Boongeua Vajarasathira	F0018, F0019			
C				
Cameron Faustman	F0014	Saisamorn Lumyong	F0006	
Cattarin Theerawitaya	F0024	Saisunee Liawruangrath	F0026	
Chalermpol Kirdmanee	F0024	Santad Sriyota	F0030	
Chongrak Kaewprasit	F0027	Saranya Sribariwut	F0010	
D				
Darawan Thongbutre	F0021, F0022	Saroat Rawdkuen	F0013	
Duangjai Noiwun	F0002	Sasitorn Khamlhek	F0007	
F				
Friedrich Bauer	F0011	Sompoch Gomolmanee	F0002	
G				
Griangsak Chairote	F0007	Sompop Boontim	F0006	
I				
Itsara Khantikaew	F0017	Soottawat Benjakul	F0011, F0012	
J				
Jatuporn Phaophongthai	F0017	Sorasak Kulamai	F0013, F0014	
Jindawan Siruntawineti	F0018, F0019	Srinoi Chumkum	F0029	
Jirapa Setjintanin	F0028	Suchada Chaisawadi	F0021, F0022	
K				
Kanyaratt Supaibulwatana	F0024	Suchapa Netpradit	F0001	
Kwanjai Kanokmedhakul	F0017	Sumate Tantratian	F0028	
M				
Manat Chaijan	F0014	Sutatip Bhamarapratavi	F0020	
Morakot Tontichareon	F0024	Suwaree Sompong	F0021, F0022	
Munehiko Tanaka	F0029			
N				
Nipapan Kumngen	F0027	Tanatorn Tongsumrith	T	
Nitaya Boomtim	F0006	Teraboon Pojanagaroon	F0001	
Noknoy Chitchuankij	F0018, F0019	Tyre C. Lanier	F0026	
Nutakamol Triboon	F0002			
Nutchalee Khawnol	F0004	Uraporn Sardsud	F0013	
O				
Orathai Lalee	F0008	Vicha Sardsud	U	
Orawan Julavittayanukul	F0012	Vichitr Rattanaphani	F0005	
P				
Pairote Klinpituksa	F0004	Wae-asae Waehamad	V	
Panpim Vonkhorporn	F0016	Waraporn Methawiriyasilp	F0008	
Panuwat Suppakul	F0003	Warin Pimpa	F0022	
Parinya Chantrasri	F0005	Win Chaeychomsri	F0009, F0010	
Pasuree Littilert	F0009	Winai Oungpiper	F0018, F0019	
Pathanapong Thisong	F0031	Wittayachai Lertittikul	F0030	
Pattharavot Ruangrak	F0008	Wonnop Visessanguan	F0011	
Phongyut Juntong	F0001	Woraluck Kaewyou	F0012, F0013	
Pornrat Sirikhum	F0023		F0014, F0029	
Pramjitr Boonsaay	F0031	Yawadee Srimake	F0020	
Prapisri Borisoodtikoon	F0030	Yosapong Temsiripong	Y	
			F0016	
			F0018, F0019	

## Section G - Geology

B	C
Benjavun Ratanasthien	G0001, G0003
Boontrarika Srithai	G0001
C	Chairoj Pintukanon
Chaiwat Lersviriyantanakul	G0002
Chavalit Vidthayanon	G0003
M	Chalermpong Thongpoon
Marut Saelim	G0005
P	Charnsak Juengmankong
Pantip Wongtui	G0001
Pattara Aiyarak	G0002
R	Chidchanok Khamlert
Rattanaphorn Hanta	G0003
S	Chiroj Soorapanth
Sarunya Promkotra	G0004, G0005
Sayan Charerntham	G0001
Suntree Rincome	G0004
T	Chittin Chindaduangratn
Thitirat Insalee	G0005
W	Chonlayut Raweewan
Warawutti Lohawijarn	G0002
Withaya Kandharosa	G0001
Wutti Uttamo	G0001
Y	Chotika Suyarnsestakorn
Yutaka Kunimatsu	G0003
D	Dollada Srisai
	Duangporn Winijkul
	Duncan R. Smith
E	Dollada Srisai
	Ekarin Saifah
G	G.Rujijanakool
	Greetha Moungthong
H	Haruki Yamada
	Hiroaki Kiyohara
J	J.Tuntrakoon
	Jantana Yahuafai
	Jiradej Manosroi
	H0009
	H0003, H0004
	H0006, H0007
	H0043
	H0010
	H0041
	H0037, H0038
	H0003
	H0042
	H0046
	H0004
	H0015
	H0016
	H0045
	H0032
	H0016
	H0016
	H0036
	H0035
	H0005
	H0039
	H0042
	H0042
	H0046
	H0020
	H0011, H0017
	H0018
	H0013, H0014
	H0047
	H0009
	H0015
	M
	Mahmood Amiry-Moghaddam
	Maneerat Ekkapongpisit
	Maria Goretti Apriyani
	Mathurose Ponglikitmongkol
	H0044
	H0015
	H0013, H0014
	H0033

## Section H- MEDICAL SCIENCE

A	
Adisak Wongkajornsilp	H0023
Alan Townshend	H0006
Anake Kijjoa	H0021
Apichat Suwas	H0032
Aranya Manosroi	H0012, H0013 H0014, H0019 H0020, H0021 H0036
	H0010
	H0019
Aurasorn Saraphanchotiwitthaya	H0022
B	
Boonsom Liawruangrath	H0003, H0004 H0005, H0006 H0007
Boonyong Punantapong	H0041
Budsapapat Natwong	H0025, H0027 H0028, H0029
Bungorn Sripanidkulchai	H0030 H0010
C	
Jiraporn Ungwitayatorn	
John Korth	
K	
Kampol Taywadithip	
Kanlayanee Sriklung	
Kanyawim Kirtikara	
Khantichat Khankasikam	
Korakot Thathang	
Krisanadej Jaroensutasinee	
Kuncoro Foe	
Kwanjai Kanokmedakul	
L	
Lalana Kongkaneramittra	
Lukkana Suksanpaisan	
M	
Mahmood Amiry-Moghaddam	
Maneerat Ekkapongpisit	
Maria Goretti Apriyani	
Mathurose Ponglikitmongkol	



## Section I- ENVIRONMENTAL SCIENCE & TECHNOLOGY

	<b>A</b>			
Akaradet Mingmuang		I0015	Komkrich Pimpukdee	I0017
Amonrat Sawat		I0021	Komkrich Pimpukdee	I0019
Apichat Imyim		I0048	Kongsak Pattarit	I0036
Arpapan Satayavibul		I0053	Krisanadej Jaroensutasinee	I0009, I0010
	<b>B</b>		Kumthorn Thirakhupt	I0011, I0012
Benjalak Karnchanasest		I0053		I0034
Benjamas Paibulkichakul		I0014		
Boonsong Taparuk		I0056	Lamfa Pootipan	I0047
	<b>C</b>		Linda Pengsuwan	I0038
Chaichart Dhamgrongartama		I0007		
Chairote Yaiprasert		I0011	Maleeya Kruatrachue	I0002
Chaiwat Kongmanklang		I0058	Mallika Panyakapo	I0001
Chakrit Surain		I0045	Mullica Jaroensutasinee	I0010
Chalarmrij Wantawin		I0038		
Chalee Paibulkichakul		I0014	Nantaporn Nanta	I0038, I0057
Chanawat Nitawichit		I0018	Naraporn Hanwajanawong	I0038
Chanon Koonnon		I0007	Narongsak Pimpunchat	I0050, I0051
Chartchai Chaitragul		I0007		
Chuchart Thiengtham		I0007	Narongsak Puanglarp	I0052
Chuleekorn Chooklin		I0005	Nipawan Adisornvorawoot	I0034
Chutima Kukusamude		I0059, I0058		
	<b>D</b>		Ongsa pongpitakduamlong	I0038
Darawan Thongbutre		I0037	Orawan Wirunvedchayan	I0040
Dirakrit Buavait		I0001	Ornanong Boonklong	I0010
Duangkamon Jiraroj		I0016		
Duangmanee Machimawong		I0021	Paitip Thiravetyan	I0049
	<b>F</b>		Pajaree Thongsanit	I0003
Fuangfa Unob		I0016	Pakawan Kamonchaivanich	I0004
	<b>J</b>		Pakpoom Ratjiranukool	I0042
Jarurat woranisaraku		I0038	Panittha rithiprad	I0042
Jatuporn Bavornkraisri		I0007	Passakorn Srijew	I0021
Jeremy R. Mason		I0035	Patana Teerapornchaisit	I0013
Jiemjai Kreasuwan		I0040, I0039	Penprapa Bualouy	I0058, I0059
		I0042, I0045	Phatthraphol Imkrajang	I0057
		I0046, I0044	Phornsuang Markmanee	I0003
		I0041, I0043	Piamsak Menasveta	I0013
Jinda Yuenyongchaiwat		I0048	Pimpaporn Patima	I0034
Jirapon Luamduppang		I0021	Pimpimol Konginda	I0041
Jirasak Threeprom		I0047	Pitsamai Chairatu-tai	I0013
Jittiporn Chantarojsiri		I0051	Piyawan saimanophan	I0013
John Middleton		I0007	Poonsuk Pothiruckit-Prachyanusorn	I0021
	<b>K</b>		Pongsri Paopuree	I0035
Kanatawan Aungsakul		I0009	Praneet Damrongphol	I0001
Kanitta Netsuwan		I0043	Prawit Nuengmatcha	I0002
Kanjana Nhusin		I0056		I0021
Kannika Rukkid		I0006	Ratana Mahachai	
Kanya Kerdbsiri		I0056	Royol Chitradon	I0058, I0059
Karnjana Saengprapai		I0050		I0050, I0051
				I0052
	<b>R</b>			

Surapan Kanjanawong	J0019
Suraphol Sribunsong	J0024, J0022
	J0023
Surasing Chaiyakun	J0014, J0015
Suvit Punnachaiya	J0002, J0003
Suwit Kawikitwitcha	J0021
Suwit Phethuayluk	J0028

**T**

Tarinee Nampitch	J0004
Terdthai Vatanatham	J0004
Toru Hayashi	J0026

**W**

Wannee Srinuttrakul	J0007
Watcharapong Hinjit	J0022, J0023
Weerachai Phutdhawong	J0019
Werapong Goedsin	J0017
Wiriya Kongratana	J0021
Wisansart Satana	J0011, J0012

**Y**

Yutthana Tirawanichakul	J0025, J0026
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## Section K- SCIENCE COMMUNICATION & EDUCATION

A		R	
Anun Teeraburanapong	K0005	Ratchapak Chitaree	K0009, K0019
Apisit Tongchai	K0024		K0021
Arun Chanchaichaovivat	K0010, K0008	Rattanaporn Pichedrujirot	K0006
Assawin Ranusawud	K0019, K0021		S
B		S	
Bhinyo Panijpan	K0007	Sailom Gerdprasert	K0010
C		K0010, K0013	
Chaiyapong Ruangsawan	K0009, K0004	Saksri Supasorn	K0013, K0012
Chernchok Soankwan	K0022, K0009	Sanoe Chairam	K0022
	K0011, K0019	Sawat Supboon	K002
	K0021, K0024	Somkiat Phornphisuthimas	K0010, K0008
	K0004	Sonthi Phonchaiya	K0012, K0013
Choksin Tanahoung	K0011	Srisavakon Dangsaart	K0014
Chularuk Kaveevivithchai	K0010	Sumalee Sonamthiang	K0018, K0017
D		Supaporn porntrai	K0008, K0010
Decha Suppapittayaporn	K0024	Supot Seebut	K0014
Duangduen Suwanjinda	K0008, K0010	Sura Wuttiprom	K0009
J		Surachai Nopparatjamjomras	K0019, K0021
Jiraporn Thanpaew	K0007	Surin Monchan	K0002
Jongdee To-im	K0008, K0009	T	
	K0010	Thammanoon Ditcharoen	K0014
Joompot poomsripanon	K0008, K0010	Theerayut Charnnuwong	K0004
K		Thidarat Sroyjak	K0004
Kanitha patharakitti	K0006	U	
Kanlaya Naruedomkul	K0017	Umpol Jairuk	K0011
Kanokpoj Areekul	K0005	Unchada Phuapaiboon	K0022
Kantarat Wuttisela	K0013	V	
Kanyupha Jittivadhna	K0009	Virapong Saeng-Xuto	K0016
Karntarat Wuttisela	K0012	W	
Karnyupha Jittivadhna	K0007, K0010	Wanchai Noiwong	K0012, K0013
Kulthida Nugultham	K0013, K0012	Warit Werapun	K0001
Kwan Arayatanikul	K0019, K0021	Wasna Jaturonrusmee	K0006
M		Wunnee Kissanajakrawat	K0011
Manat Boonprakop	K0009	Y	
Mani Payormyong	K0022	Yutthana Tiravanichkul	K0001
N			
Narumon Emarat	K0016		
P			
Nattinee Mophan	K0022, K0009		
Numtip Rattanawongchaiya	K0011, K0019		
	K0021, K0024		
	K0012		
	K0017, K0018		
Paradorn Pakdeevanich	K0001		
Pattawan Narjaikaew	K0011		
Pintip Ruenwongsa	K0007		
Pitakpong Kompusda	K0007		
Puchong Kijaumnajsuk	K0005		

## Section L – CHITIN – CHITOSAN

	<b>A</b>			
Akamol Klaikherd		L0015	Nispa Seetapan	L0002
Anan Tongta		L0023, L0024	Niwat Kaewpradap	L0030
Ananya Tribumrungsuk		L0033	Nuntiya Chieplaem	L0023
	<b>B</b>			<b>O</b>
B. Thavornyutikarn		L0019	Ondee, T	L0040
Benjawan Sutthachai		L0025	Oraphin Chaikumpollert	L0021
Boonchoo Mahapon		L0018		<b>P</b>
Boonlom Thavornyutikarn		L0020	P. Nuengsigkapian	L0011
	<b>C</b>		P. Sriamornsak	L0011
Chanikan Kantahan		L0024	Panee Wathanaoran	L0033
Chantaraporn Phalakornkule		L0016	Panida Asavapichayont	L0010
Chantiga Choochottiros		L0009	Pannee Sribuathong	L0001
Chaveewan Rakdee		L0021	Patana Thavipoke	L0032
Chudapak Kaseamchochoung		L0016	Pawadee Methacanon	L0008
Chureerat Prahsarn		L0004	Paweeena Uppanan	L0020
	<b>H</b>		Pensee Nuengsigkapian	L0010
Hathairat Jeerathawatchai		L0039	Pichan Sawangwong	L0023
Hunsa Punnapayak		L0015	Pimpan Chumningan	L0001
	<b>J</b>		Piyabutr Wanichpongpan	L0032, L0037
J. Muensoongnoen		L0019		L0038, L0039
J. Nunthanid		L0011	Piyaporn Chaipongratana	L0033
Jaruporn Nhungam		L0033	Pornprasart, R	L0040
Jindarat Pimsamarn		L0024	Pornsak Sriamornsak	L0013, L0022
Jirawat Krewraing		L0020	Porntip Wongkaew	L0031
Jurairat Nunthanid		L0010, L0013	Pranee Lertsutthiwong	L0016
	<b>K</b>		Praneet Opanasopit	L0010, L0022
K. Pilakasiri		L0019	Puengprayoonpong, U	L0036
Kan Chantrapromma		L0037		<b>R</b>
Kanokporn Burapapat		L0013	Rangrong Yoksan	L0009, L0027
Katanchalee Mai-ngam		L0001, L0002		L0029
Khantong Soontarapa		L0018, L0025	Raphat Petchniyom	L0038
Kowit Piyamongkala		L0006	Rath Pichyangkura	L0034, L0015
Krisana Siralertmukul		L0028		<b>S</b>
Krisda Suchiva		L0021	S. Limmatvapirat	L0011
Krissana Auynirundronkul		L0015	Sameela Yuttawat	L0022
Kwunchit Oungbho		L0030	Sanchai Santithanes	L0022
	<b>L</b>		Sangobtip Pongstabodee	L0006, L0005
Lertsupsuree, C		L0040	Santhana Nakapong	L0034
	<b>M</b>		Sappawinyoo, N	L0040
M. Luangtana-anan		L0011, L0010	Sasithorn Sae-ieo	L0022
Mongkol Sukawattanasinit		L0015	Satit Puttipipatkhachorn	L0013, L0030
Montira Nopharatana		L0024	Siripong Congchoo	L0037
	<b>N</b>		Somlak Kongmuang	L0003
N. Sangjun		L0019	Somsak Damronglerd	L0005
Nartaya Thirawong		L0013	Sontaya Limmatvapirat	L0010
Niran Sappawinyoo		L0038	Sopa Pisawongprakarn	L0031
			Suchada Piriyaprasarth	L0022
			Supawan Tantayanon	L0035
			Supida Tubtimthep	L0034

Supinya Thipvichai	L0003
Supot Hannongbua	L0028
Suppajit Sukkunta	L0032
Supreedee Sungkarak	L0030
Surapich Loykulnant	L0021
Suwabun Chirachanchai	L0027, L0029 L0009
Suwalee Chandrakrang	L0028, L0033
Suwipa Tangsombutpaiboon	L0022
<b>T</b>	
Tanasait Ngawhirunpat	L0010
Temsiri Wangtaveesab	L0008
Thararat Supasiri	L0033
Thawatchai Paechamad	L0003
Thipwimon Kerd-im	L0005
Thitima Maneekul	L0015
<b>V</b>	
Varawut Tangpasuthadol	L0035, L0026 L0008
Vipavee Hoven	L0026
<b>W</b>	
W. Janvikul	L0019
Wanichpongpan, P	L0036, L0040
Wanida Janvikul	L0020
Wanvimol pasanphan	L0027
Wanwilai Daronkaisom	L0022
Warayuth Sajomsang	L0035
Wasinee Prakobkij	L0015
Werasak Udomkichdecha	L0028
Wichianchai, I	L0036
William H.Daly	L0035
Wiwat Ruenglertpanyakul	L0039
<b>Y</b>	
Yaowamand Angkitpaiboon	L0026
Yaowapha Waiprib	L0023
Yaowapha Waiiprib	L0024
Yompakdee, K	L0036

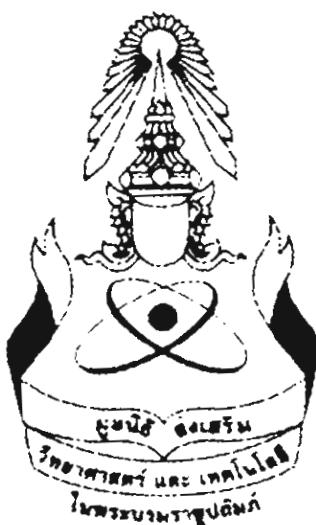
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41. บริษัท บางกอก ไฮแลป จำกัด
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43. บริษัท เมคไทย กรุงเทพอุปกรณ์คอมพิวเตอร์ จำกัด
44. บริษัท แมง เทคโนโลยี จำกัด 1992 จำกัด
45. บริษัท ไบโอลอจิคัล จำกัด
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49. บริษัท พาราไซแอนติพิค จำกัด
50. พิพิธภัณฑ์ภาพมุมกว้าง กรุงเทพมหานคร
51. บริษัท เพอร์กินแอลเมอร์ จำกัด
52. บริษัท เพาเวอร์ สเตอร์ คอมมูนิเคชัน เทคโนโลยี จำกัด
53. บริษัท มองได้เทคโนโลยี (ประเทศไทย) จำกัด
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55. บริษัท เมทัชีโน่ จำกัด
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64. บริษัท เวลต์กิ๊ก จำกัด
65. บริษัท เวลต์ไวร์ด เทคโนโลยี จำกัด
66. บริษัท ไวท์กรุ๊ป จำกัด (มหาชน)
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