EFFECT OF MICROEMULSION FORMATION ON OILY WASTEWATER TREATMENT BY USING FROTH FLOTATION TECHNIQUE

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ABSTRACT

The relationship between phase behavior and efficiency of froth flotation of ortho-dichlorobenzene removal was investigated. In this work, high selectivity for oil compared to water in the overhead froth was demonstrated. In order to determine the source of removed oil, the froth flotation experiment was performed with three systems; excess water-middle phases (w-m), excess water-oil phases (w-o), and excess water-middle-excess oil phases (w-m-o). The results showed that most of the oil removed came from the excess oil phase in Winsor Type III.

INTRODUCTION

Nowadays, the presence of organic contaminants derived from the chemical industry found in wastewaters and groundwater is a major concern (1). Halogenated organic compounds are not only found in many wastewaters, but also appear extensively in groundwater and soil as a result of the improper designs of hazardous waste disposal facilities, accidental spills, and leakage of underground storage tanks (2).

Froth Flotation is widely used in several separation processes (3 – 12). In flotation operation, air is sparged into the solution, and the particles of solids or droplets of oils adhere to the rising air bubbles. These particles or droplets adhered to the air bubbles are concentrated in the foam or froth at the top of the flotation cell, and are finally skimmed off.

The surfactant added tends to strongly adsorb at the air-water interface with the hydrophobic or tail groups in the air and the hydrophilic or head groups in the water. The hydrophobic region formed by the tail groups of the surfactant is compatible for dissolved organic solutes which tend to co-adsorb at the bubble surface. Polar regions of the solute molecule can interact with the surfactant head groups, affecting solute adsorption at the air-water interface (13).

A microemulsion is described as a transparent or translucent system formed spontaneously upon mixing oil and water with a relatively large amount of an ionic surfactant (14). In this study, an anionic surfactant was used to mix with nonionic surfactant instead of a cosurfactant (e.g. an alcohol of medium chain length). There are four types of microemulsions classified by Winsor (15). Winsor Type III microemlsion, one of the types of microemulsions, was focused in this work because the previous work (3) showed that the maximum percentage of oil removal was achieved when Winsor Type III was present. When middle-phase microemulsion or Winsor Type III is formed, ultralow oil-water interfacial tension (i.e. 10^{-3} mN/m) is observed. The optimum salinity at which equal volumes of brine and oil are solubilized in the middle-phase microemulsion is known as an optimum condition in the enhanced oil recovery (3). This condition corresponds to the maximum solubilizing power of surfactant and the minimum of interfacial tension (16).

EXPERIMENT

Materials

Sodium dodecyl sulfate (SDS) and nonylphenol ethoxylate ($NP(EO)_{10}$) were used in this study. SDS supplied by Henkel Co. was a commercial grade with a purity at least 90%. $NP(EO)_{10}$ with 99.9% purity was supplied by ICI Australia Operations Pty Ltd. Otho-dichlorobenzene (ODCB) from Fisher Scientific Co., with 99% purity was used as emulsified oil. Sodium chloride (NaCl), analytical purity grade, was obtained from Aldrich Chemical Co. Deionized water was used in all of experiments.

Methodology

In both the microemulsion formation and the froth flotation experiments, the surfactant concentration and salinity were expressed as percent by weight of the overall system which comprised water, oil, surfactants, and NaCl. The experiments were conducted at 30°C.

Phase behavior experiments

To investigate the phase behavior, surfactant solutions were prepared with different concentrations of each surfactant and of salt in a water phase. Then 5 mL of this aqueous solution was mixed with 5 mL of ODCB in a vial and sealed with a screw cap. The series of samples with different surfactant concentrations and salinities were well mixed by shaking and kept in a constant temperature of 30°C until equilibrium was reached as indicated by invariant phase volumes. The equilibrium time was about 4 weeks. The height and appearance of each phase were measured and observed.

Froth flotation experiments

The froth flotation apparatus used in this study was consisted of a cylindrical glass column with 5 cm inside diameter and 70 cm height. A constant flowrate of 250 mL/min of filtered air was introduced into the bottom of the column through the sintered glass disk having pore diameters of 16 – 40 μm. One liter of well mixed solution at 5% total surfactant concentration and 1/1 of ODCB/water volume ratio was immediately transferred to the column to study the selectivity of oil to water in the overhead froth. To study the source of oil removed, after reaching equilibrium in water bath at 30°C for 1 month, the solution consisted of 5% total surfactant concentration and 1/1 of ODCB/water was separated into middle (m), excess oil (o), and excess water (w) phases. Three systems of w-m phases, w-o phases, and w-m-o phases were prepared by using 1/1 volume ratio in each system. The foam overflown from the column was collected over different time intervals. After that, the foam was broken for analysis of the concentration of ODCB by using HPLC with a UV detector. The schematic diagram of froth flotation operation is shown in Figure 1.

RESULTS AND DISCUSSION

For a mixed surfactant system, a weight fraction of SDS (X_{SDS}) is defined as a weight of SDS divided by the total weight of surfactants ($NP(EO)_{10}$ and SDS).

Phase Behavior

Effects of type and concentration of surfactant

As shown in Figure 2, volume of water phase and oil phase slightly increases and decreases, respectively when SDS concentration increases from 1% to 9%. SDS is more hydrophilic and so it mostly dissolves in water resulting in solubilizing oil in the water phase. Under the studied conditions, the middle phase was not formed in the SDS system, so this system is Winsor Type I microemulsion. Figure 3 shows Winsor Type III microemulsion, middle phase, appears when $NP(EO)_{10}$, nonionic surfactant, was used instead of SDS since $NP(EO)_{10}$ has a proper balance between hydrophobicity and hydrophilicity for the ODCB system. A maximum relative volume of the middle phase microemulsion was achieved at 7% of $NP(EO)_{10}$.

Effect of mixed surfactant composition

As shown in Figures 4-8 for any given total surfactant concentration, the volume fraction of middle phase microemulsion in the mixed surfactant system is higher than that in the single $NP(EO)_{10}$ system. The mixed surfactant system showed the synergistic effect on microemulsion formation. At low total surfactant concentrations, 1% and 3%, water was almost insolubilized in the middle phase microemulsion. Therefore, a minimum interfacial tension cannot be achieved under these conditions.

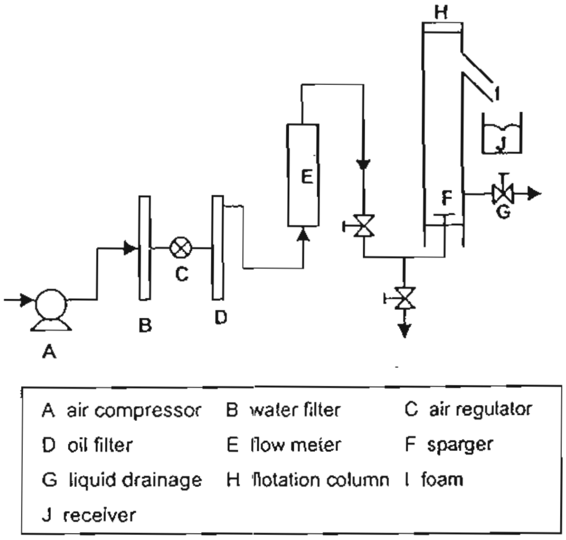

Fig.1. Schematic diagram of the froth flotation apparatus

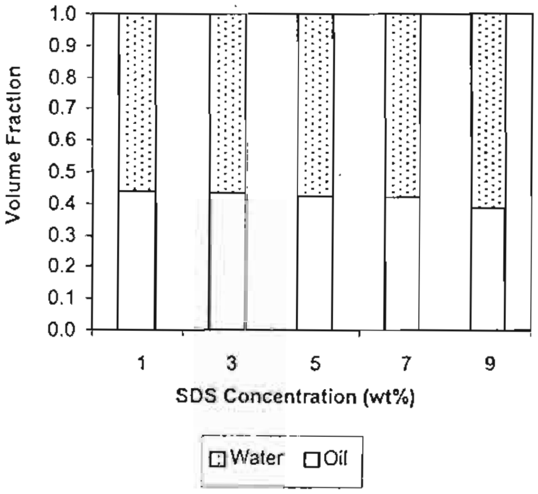

Fig.2. Volume fractions at different SDS concentrations with an initial ODCB/water volume ratio of 1/1

At a high total surfactant concentration of 5% and a SDS weight fraction of 0.5, approximately equal volumes of oil and water were solubilized in the middle phase, indicating a proper balance between hydrophobicity and hydrophilicity. However, at an extremely high total surfactant concentration of 7% or 9%, liquid crystal occurred (see Figures 7 and 8). As a result, 5% total surfactant concentration was selected for the froth flotation operation.

Froth Flotation Results

A total surfactant concentration of 5% with different SDS fractions was selected to run the froth flotation experiment because this system has the highest solubilization parameter for both oil and water as well as the lowest interfacial tension. Figures 9-11 show

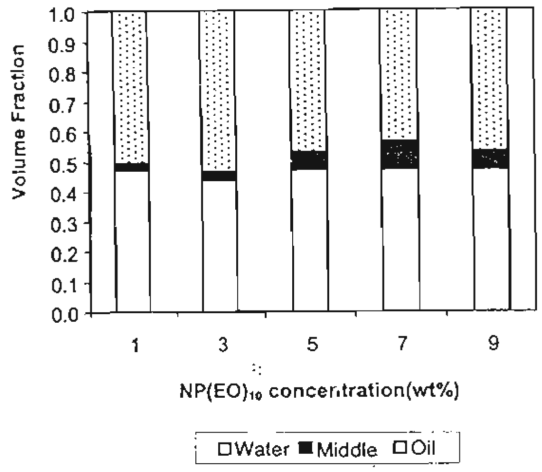

Fig.3. Volume fractions at different $NP(EO)_{10}$ concentrations with an initial ODCB/water volume ratio of 1/1

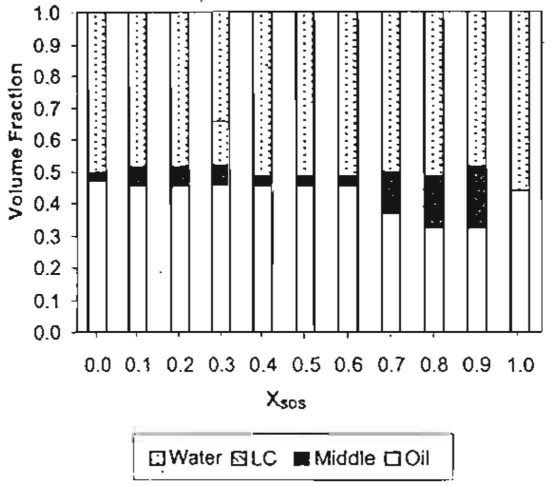

Fig.4. Volume fractions at different SDS fractions of 1% total surfactant concentration, and an initial ODCB/water volume ratio of 1/1

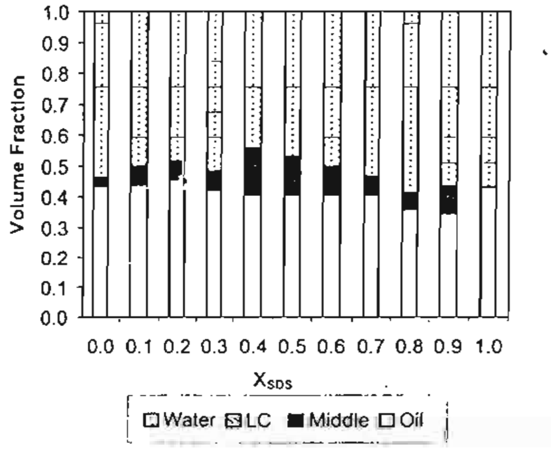

Fig.5. Volume fractions at different SDS fractions of 3% total surfactant concentration and an initial ODCB/water volume ratio of 1/1

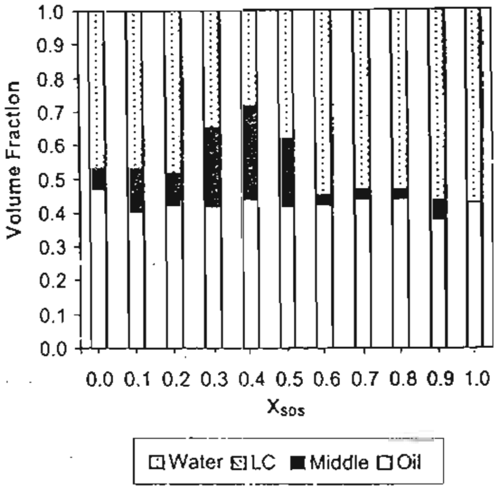

Fig.6. Volume fractions at different SDS fractions of 5% total surfactant concentration and an initial ODCB/water volume ratio of 1/1

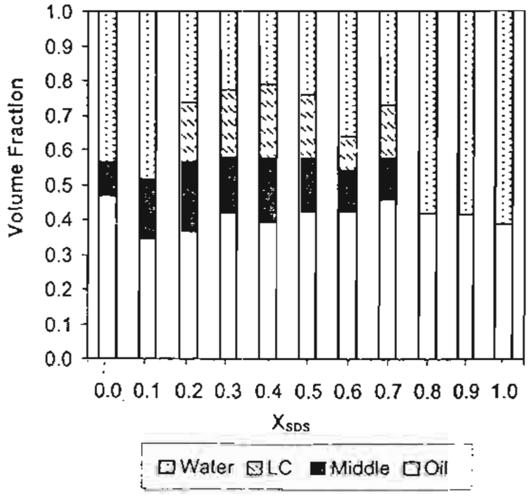

Fig.7. Volume fractions at different SDS fractions of 7% total surfactant concentration and an initial ODCB/water volume ratio of 1/1

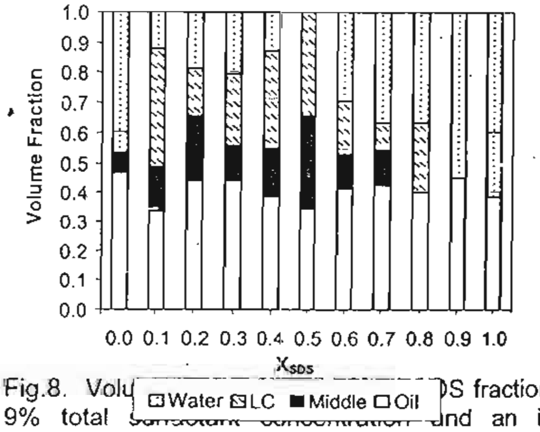

Fig.8. Volu[illegible]S fractions of 9% total surfactant concentration and an initial ODCB/water volume ratio of 1/1

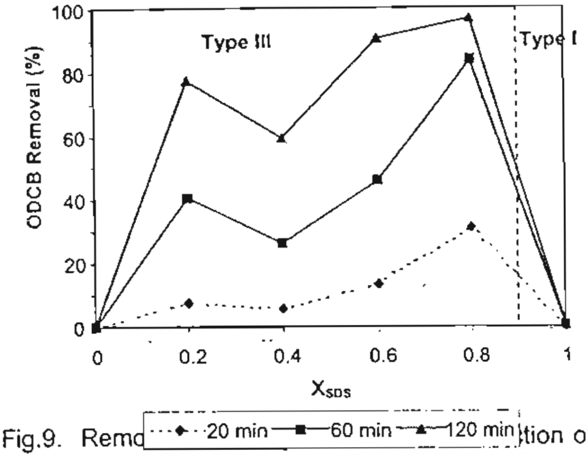

Fig.9. Remo tion of SDS fraction at different time of 5% total surfactant concentration and an initial ODCB/water volume ratio of 1/1

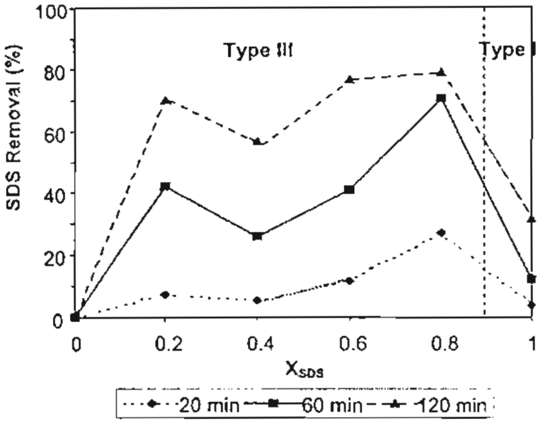

Fig.10. Removal efficiency of SDS as a function of SDS fraction at different times of 5% total surfactant concentration and an initial ODCB/water volume ratio of 1/1

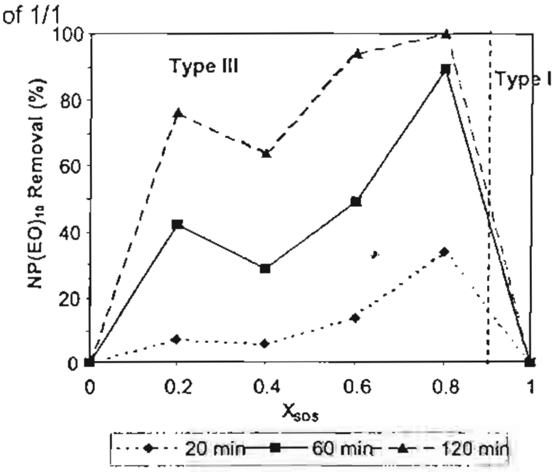

Fig.11. Removal efficiency of $NP(EO)_{10}$ as a function of SDS fraction at different times of 5% total surfactant concentration and an initial ODCB/water volume ratio of 1/1

the effect of SDS fraction on oil and surfactant removals for the system having 5% total surfactant concentration. In the Winsor Type III microemulsion region, increasing weight fraction of SDS tended to increase both oil and surfactant removals because the foam stability with anionic surfactants is generally higher than that with nonionic surfactants. The repulsive force among the head groups of anionic surfactant causes the foam more difficult to collapse as compared to foams formed by nonionic surfactants. In the Winsor Type III microemulsion regime, almost all ODCB and $NP(EO)_{10}$ can be removed from the solution as well as the maximum SDS removal of 80% after 120 minutes of operating time and at a SDS fraction of 0.8 as shown in Figures 9-11. This is because SDS is more hydrophilic than $NP(EO)_{10}$, and then SDS can adsorbs less at the air bubble-water interface than $NP(EO)_{10}$. Since the ultralow interfacial tension between oil and water can be observed in the Winsor Type III microemulsion regime, the maximum removals of ODCB, SDS, and $NP(EO)_{10}$ are expected to obtain in this region. An analogous behavior of oil and surfactant removals has been reported in the previous work (3). Hence, the stability of foam, as well as interfacial tension between liquid phases, are important in froth flotation operation. From the results of the phase study, the optimum condition is achieved at a SDS fraction of 0.5 as shown in Figure 6 while, as shown in Figure 9, the maximum ODCB removal is achieved at a SDS fraction of 0.8. This is because at a SDS fraction of 0.5, the system has low repulsive force between the head groups of surfactants leading to low foam stability compared to that at a SDS fraction of 0.8. From the results, it indicates that foam stability is also another important parameter that should be considered in flotation operation.

High efficiency of oil removal is not a sole factor for an effective flotation operation. The selectivity for oil compared to water in the overhead froth is also a vital factor for successive flotation. If oil and water are present in the overhead froth with the same proportion as in the feed solution, no separation of oil from water is achieved. The relative fractions of oil and of water in the foam phase at 5% total surfactant concentration and at 120 minute aeration time are shown in Figure 12. A higher selectivity for oil compared to water occurred in the Winsor Type III microemulsion regime not in the Winsor Type I microemulsion regime. This result supports the advantages of Winsor Type III microemulsion in flotation operation.

Under Winsor Type III microemulsion, the system consists of three phases of excess oil, excess water, and middle phases. It is very interesting to know what phase is a major source of oil removed. Hence, a solution with Winsor Type III microemulsion was separated then three systems: w-o phases, w-m phases, and w-m-o phases were prepared for flotation experiment. From Figures 13-14, ODCB removal from the w-o system is always higher than that from w-m system. The oil droplets in the Winsor Type III microemulsion phase are known in form of bilayer (17). The surface of the oil droplets in the middle phase becomes less hydrophobic than that in excess oil phase. Hence, the oil droplets in this middle phase are difficult to attach with the air bubbles as compared to those in the excess oil phase. Consequently, oil removal from the Winsor Type III microemulsion phase (middle phase) is lower than that from the excess oil phase.

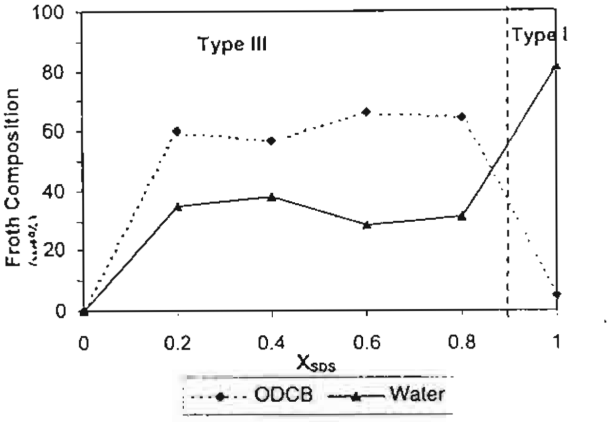

Fig.12. ODCB and water concentrations in foam fraction at different SDS fraction of 5% total surfactant concentration, an initial ODCB/water volume ratio of 1/1, and 120 min aeration time

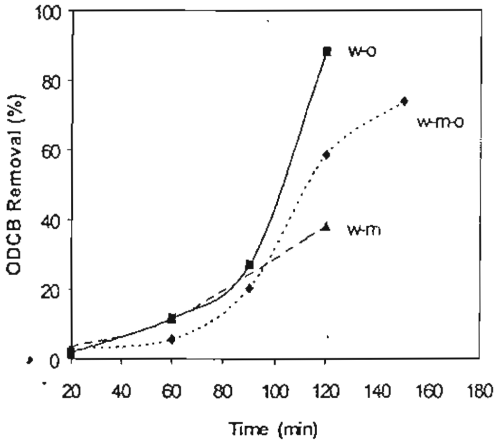

Fig.13. Comparison of ODCB removal of w-m, w-o, and w-m-o systems at different times of 5% total surfactant concentration, X_{SDS} of 0.2, and an initial ODCB/water volume ratio of 1/1

CONCLUSIONS

In previous work (3), the maximum oil removal from flotation process was observed under Winsor Type III microemulsion condition. Although, high oil removal is a necessary need for an effective flotation operation, but other factors should be also considered. From this work, for the system in Winsor Type III, more oil than water was indeed carried over with the foam. Then the separation between oil and water occurred in the overhead froth. To understand the mechanism of synergism between efficiency of flotation and Winsor Type III microemulsion, the source of oil removed was investigated. All studies in this work showed that most of oil removed in the overhead froth came from excess oil phase instead of middle phase.

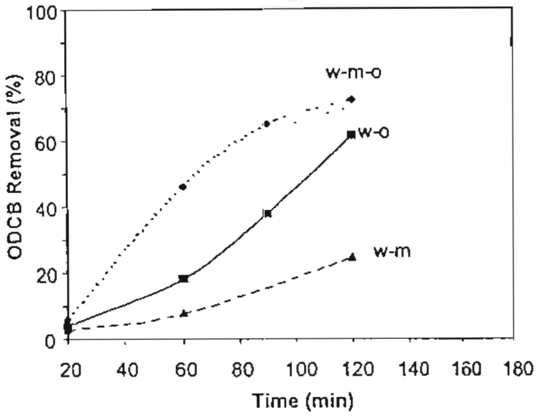

Fig.14. Comparison of ODCB removal of w-m, w-o, and w-m-o systems at different time of 5% total surfactant concentration, X_{SDS} of 0.4, and an initial ODCB/water volume ratio of 1/1

ACKNOWLEDGEMENT

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	Monday August 18, 2003	Tuesday August 19, 2003	Wednesday August 20, 2003	Thursday August 21, 2003
REGISTRATION	Foyer A 8:30-9:30			
(OWR)	Room A 9:30-10:00			
Plenary	Room A 10:00-10:40			
Workshop-I	Room A 11:00-17:40			
BioTech-I	Room B 11:00-12:40			
Separation-I	Room B 14:00-15:40			
BioTis	Room B 16:00-17:40			
BioTech-II		Room A 9:00-10:10		
Keynote		Room A 10:10-10:40		
Separation-II		Room B 9:00-10:40		
Microreactors-I		Room A 11:00-12:40		
Env. Tech.-I		Room B 11:00-12:40		
Energy-I		Room A 14:00-15:40		
Workshop-II		Room B 14:00-17:30		
Energy-II		Room A 16:00-17:40		
Microreactors-II			Room A 9:00-10:40	
Particle Tech.			Room B 9:00-10:40	
Chemical Reactor-I			Room A 11:00-12:40	
Env. Tech.-II			Room B 11:00-12:40	
Chemical Reactor-II			Room A 14:00-15:40	
Env. Tech.-III			Room B 14:00-15:40	
Catalysis			Room A 16:00-17:40	
Env. Tech.-IV			Room B 16:00-17:40	
Open Forum- Discussion			Room A 17:40-18:30	
Chemical Reactor-III				Room B 9:00-10:40
Uni. Lab Visit - Closing				University 11:00-12:40
Ref. Break (Morning)	10:40 – 11:00	10:40 – 11:00	10:40 – 11:00	10:40 – 11:00
Ref. Break (Afternoon)	15:40 – 16:00	15:40 – 16:00	15:40 – 16:00	
Lunches	12:40 - 14:00	12:40 - 14:00	12:40 - 14:00	
Welcoming Reception	19:30 - 22.30			
Symposium Banquet		19:30 – 22.30		

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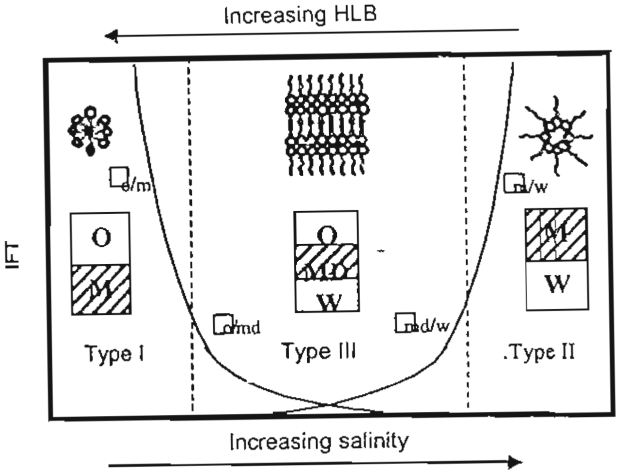

Fig.2. Relationship between phase behavior and IFT

objective of this work was to elucidate which character of type III microemulsion was responsible for oil separation in froth flotation operation.

EXPERIMENT

Materials

Sodium di-1,3-dimethylbutyl sulfosuccinate, AMA (80wt% in mixture of isopropanol and water) was supplied by CYTEX Corporation. Ethylbenzene (greater than 98% purrity) was selected as a light oil contaminant and purchased from Fluka Co. Sodium chloride (AR grade) was used as an electrolyte and purchased from Aldrich Chemical Company,Inc

Procedure

This experimental study was divided into two parts of microemulsion formation and froth flotation. All of the experiment, the concentrations of surfactant and electrolyte were expressed in weight percent of the aqueous solution.

For the microemulsion formation study, it was carried out in a series of 20-ml test tubes with screw caps. 5 ml of ethylbenzene (EB) and 5 ml of surfactant solution were added in flat bottom test tubes sealed with teflon screw caps. The surfactant solution contained different concentrations of AMA and NaCl. The mixed solution were well shaken and left in a water bath at 30 °C until equilibrium was reached (around 3 weeks). The heights of all phases formed were measured by using a cathetometer with 0.01 mm error. IFT of two phases at equilibrium was measured by using a spinning drop tensiometer (SITE 04, Krüss GmbH, Hamburg).

In the froth flotation study, the experiment was conducted in a batch mode at room temperature (30°C). A schematic diagram of an apparatus used in this study is shown in Fig. 3. The flotation column was a cylindrical glass tube of 5 cm I.D., and 70 cm in height. Two sets of one liter of the well-mixed solution were prepared at desired conditions as equilibrium and non-equilibrium systems. For the non-equilibrium system, after mixing equal volumes of ethylbenzene and surfactant solution, the mixture was suddenly transferred into the column while for the equilibrium system, the mixture was kept in a water bath at 30 °C for 3 weeks before it was transferred to the column. In flotation operation, air bubbles rising through the solution in the column were created by introducing compressed air through a sintered glass disk (40-60µm pore size) at the bottom of the column. The foam overflowed from the column and was collected over a desired period of time. In addition, an induced equilibrium system by shaking the mixture for 40 minutes was also investigated in comparison to the equilibrium and non-equilibrium systems.

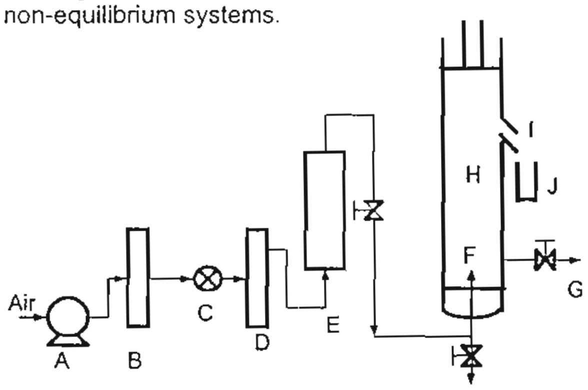

Fig.3. Schematic diagram of froth flotation apparatus (A-air compressor, B-water filter, C-air regulator, D-oil filter, E-flow meter, F-spager, GG-liquid drainage, H-flotation column, I-foam, and J-receiver).

The performance of froth flotation was determined by oil removal. The oil removal was calculated by the following formulation (1):

$$\text{Oil removal (\%)} = [(C_t - C_i)/C_i] \times 100 \qquad (1)$$

where C_t and C_i are the concentrations of oil (EB) in a solution at time t and zero, respectively. The concentration of ethylbenzene was determined by a GC-Headspace. The temperatures of the injector, oven, and detector were 150 °C, 100 °C, and 250 °C, respectively. A flow rate of N_2 carrier gas was fixed at 4 ml/min. The evaluation of all data was done with TCNavigator program.

RESULTS AND DISCUSSION

Microemulsion formation

In this experiment, low AMA concentrations were used to form microemulsion with ethylbenzene because of cost saving. The transformation of microemulsion's type of this system was achieved by salinity scan. As a result of low AMA concentrations, very small volumes of the middle phase were generated leading to difficulty in observing volume change of each phase. The phase behaviors of the studied system are not presented here since this work wants to emphasize the ultra low IFT of type III microemulsion. Fig. 4 shows IFT as a function of salinity at four different AMA concentrations.

From Fig. 4, a low IFT value is obtained in the salinity range of 2-4 % NaCl for various AMA concentrations of 0.3, 1, 2, and 3 %. The minimum IFT of each system was found around 3 % salt. At the optimum point found in the middle phase, IFT was around 10^{-2} mN/m and classified as an ultra-low IFT. The minimum IFT value of each AMA concentration is shown comparatively in Fig. 5. From the result, the lowest IFT was found at 1 % AMA but the minimum IFT value did not vary significantly with AMA concentration.

Froth Flotation Results

Effect of NaCl concentration

As shown in Fig. 6, for the non-equilibrium system at a constant surfactant concentration of 0.3%, dynamic EB removal of the system having 3 % NaCl is much higher than that of 2% NaCl. When the salinity was increased to 4 %, the separation was not achieved (no foam coming out from the column) even though the IFT at 4 % NaCl was significantly lower than 2 % NaCl. The higher the NaCl concentration, the lower the repulsive force between head groups of anionic surfactant is obtained. Consequently, the hydrophobic characteristic of foam surface increases leading to increase in oil attached to the air bubble. However, decreasing repulsive force decreases foam stability. Again, it can be explained that the foam stability becomes lower with increase salinity. Hence, the optimization between the hydrophobic characteristic of foam and the foam stability to obtain the maximum oil separation can be achieved by adjusting salinity.

For equilibrium system, the effect of NaCl concentration on oil removal is shown in Fig. 7. It was found that the system, which reached the equilibrium, used a shorter operation time and got a higher EB removal than the non-equilibrium system did. An increase in salinity decreased the oil removal as a result of salt effect.

Effect of surfactant concentration

From the phase behavior, type III microemulsion was formed at any AMA concentration and a minimum IFT was found at 3 % NaCl concentration. As mentioned before, a difference in surfactant concentration resulted in a different IFT value. Therefore, 0.3 to 3 % AMA concentrations were operated in froth flotation experiment to determine the relationship between IFT and froth flotation operation.

Fig. 8 showed the effect of AMA concentration on oil removal at different times. The highest oil removal

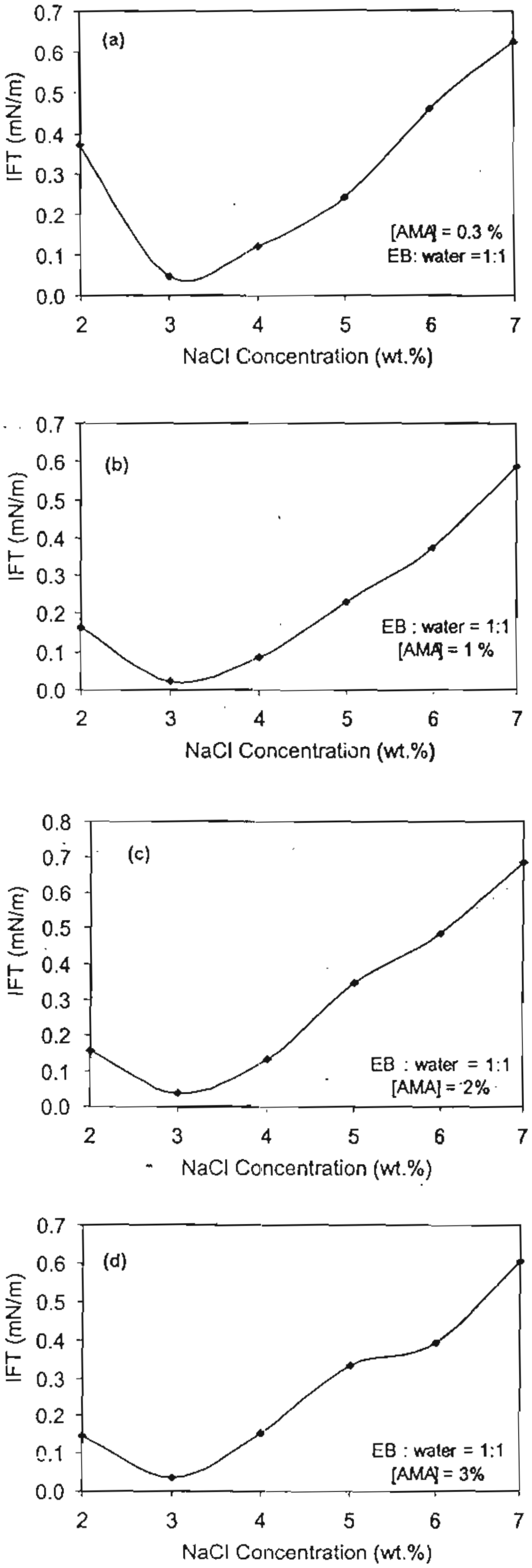

Fig.4. IFT of ethylbenzene-water system as a function of salinities at different AMA concentration

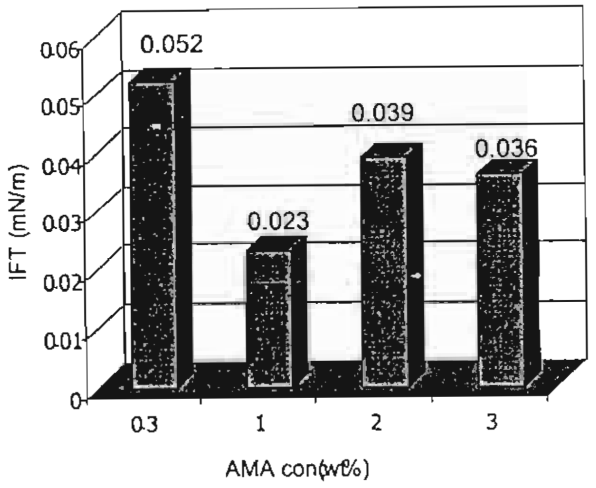

Fig.5. Comparison of Minimum IFT at different AMA concentrations with 3%NaCl concentration and an initial EB:water ratio = 1:1

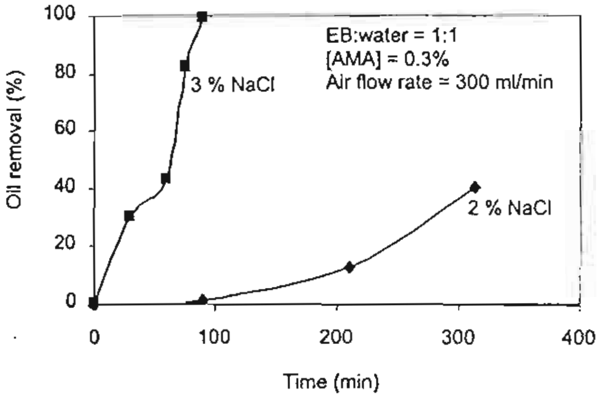

Fig.6. Dynamic removal efficiency of EB of non-equilibrium system at different NaCl concentration.

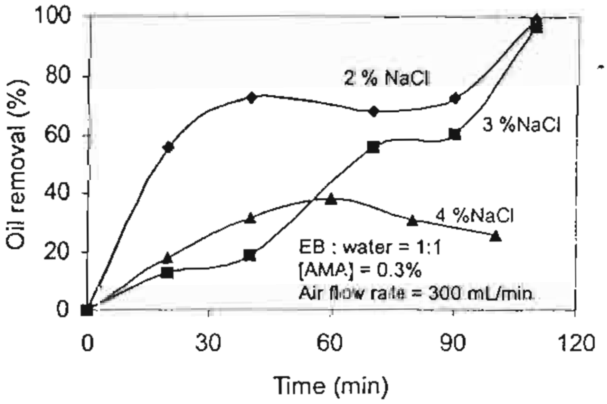

Fig.7. Dynamic removal efficiency of EB of equilibrium system at different NaCl concentration

was found in the system of 0.3 % AMA concentration with the shortest operation time when compared to other systems having higher AMA concentrations. This result deviates from the hypothesis that the maximum oil removal should be found at 1 %AMA due to the lowest IFT (0.023 mN/m). It can be explained that it may have other factors, which affect the operation of froth flotation. The foam ability and foam stability of froth are believed to involve the oil removal efficiency in froth flotation, which will be further studied in our future work.

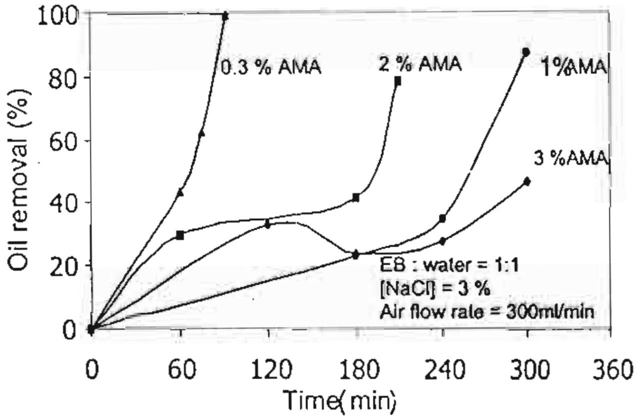

Fig.8. Dynamic removal efficiency of EB of non-equilibrium system at different AMA concentrations

Effect of equilibration time

As shown in Fig. 9, the oil removal of the non-equilibrium system is very much lower than those of both induced equilibrium and equilibrium systems. In addition, the non-equilibrium system took the longest operation time as compared to the other systems. It is because the foam production of the non-equilibrium system was lower than that of the induced equilibrium and the equilibrium systems as shown in Fig. 10. It is interesting to point out that to obtain a high oil removal efficiency, the system has to reach equilibrium. However, a well mixing with a short time may be sufficient to obtain a high oil removal efficiency as closed to that of the equilibrium system.

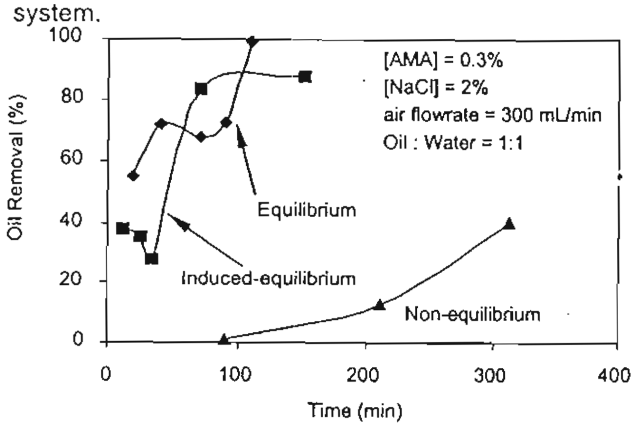

Fig.9. Effect of equilibration time on dynamic oil removal

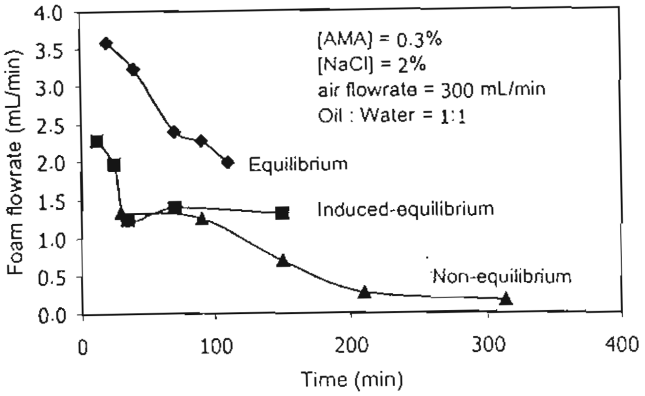

Fig.10. Effect of equilibration time on foam flow rate

CONCLUSIONS

This work has pointed out the ultra-low IFT enhancing the froth flotation efficiency. However, the result showed that the system providing the maximum oil removal did not correspond to the minimum IFT found in the middle phase obtained from the phase study. This result leads to a conclusion that the ultra-low IFT of a type III microemulsion is not a sole factor that affects flotation process. The equilibrium system was found to have a very much higher oil removal than that the non-equilibrium system. A short mixing time of 40 minute was long enough to move the system closed to its equilibrium. Foam stability and foam ability are other parameters should be taken into consideration for froth flotation operation.

NOMENCLATURE

AMA	sodium di-1,3-dimethylbuty sulfosuccinate
EB	ethylbenzene
GC	gas chromatography
HLB	hydrophilic-lipophilic balance
IFT	interfacial tension (mN/m)

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PRO 2: Processing and Applications of Specialty Oils

Joint session developed in conjunction with the Specialty Oils Applications Common Interest Group

Chairs: Nurhan T. Dunford, Oklahoma State University, USA; and Steve Gregory, Texas A&M University, USA

Room 2210A, Convention Center

1:55 **Opening Remarks.**

2:00 ***Salicornia bigelovii*: An Oilseed for Saline Agriculture.** F.J. Flider, Arcadia Biosciences/Seaphire International, USA.

2:20 **The Reintroduction of Castor as a Domestic Crop and the Uses of Castor Oil.** L. Browning, Castor Oil, Inc., USA.

2:40 **Pecan Oil—A Specialty Oil Opportunity.** T.O. Harwell, Prairie Harvest Farms, USA.

3:00 **Rice Bran "Emulsion" Extracts: Chemical and Functional Properties.** A. Proctor and M.A. Monsoor, Dept. of Food Science, University of Arkansas, USA.

3:20 **Tung Oil: Current Industrial Uses and Future Opportunities for Domestic and Foreign Production.** B. Hanson, Industrial Oil Products, USA.

3:40 **End.**

PCP 2: Current Research on Corn Protein Utilization

Chair: Milagros P. Hojilla-Evangelista, USDA, ARS, NCAUR, USA

Room 1204A, Convention Center

1:55 **Opening Remarks.**

2:00 **Current State and Challenges of Corn Product Research.** R. Shunk, National Corn Growers Association, USA.

2:20 **A New Method of Separating Ethanol Extracts of Corn.** L. Dickey and N. Parris, USDA, ARS, ERRC, USA.

2:40 **Improving Zein Films by Cross-linking.** J.W. Lawton, D.J Sesso, A. Biswas and J.L. Willett, USDA, ARS, NCAUR, USA.

3:00 **Adhesive Properties of Corn Zein Formulations o Glass Surfaces.** N. Parris and L. Dickey, ERRC, ARS, USDA USA.

3:20 **End.**

SOA 2: Processing and Applications of Specialty Oils

Joint session developed in conjunction with the Processing Division.

Chairs: Nurhan T. Dunford, Oklahoma State University, USA; and Steve Gregory, Texas A&M University, USA

Room 2210A, Convention Center

See Processing Division (PRO) above for programming.

S&D 2: Surfactants I

Chair: Jeffrey J. Scheibel, Procter & Gamble Company, USA

Room 1203B, Convention Center

1:55 **Opening Remarks.**

2:00 **Use of Cationic Surfactant to Remove Solvent-Based Ink from High-Density Polyethylene Surfaces.** J. Scamehorn D. Songsiri[2], J. Ellis[2], S. Osuwan[2] and S. Min[2], [1]Institute for Applie Surfactant Research, University of Oklahoma, USA, [2]Petroleum an Petrochemical College, Thailand.

2:20 **Kinetics of Surfactant Precipitation.** S. Soontravanic ***(Surfactant and Detergent Division Student Trave Award Winner)*** and J.F. Scamehorn, University of Oklahoma USA.

2:40 **New Alkylethersulfonates by Sulfoalkylation with AO Acid.** P. Berger, Oil Chem Technologies, Inc., USA.

3:00 **Novel Sulfonation Process of Fatty Acid Methyl Este Sulfonate (MES).** T. Nishio, S. Matoba, Y. Kimura, T. Ishikaw and I. Hama, Lion Corporation, Japan.

3:20 **Effect of Middle-Phase Microemulsion Formation o Ethylbenzene Removal by Using the Froth Flotatio Technique.** U. Yanatatsaneejit[1], A. Witthayapanyanon[1], S Chavadej[1], E.J. Acosta[2], J.F. Scamehorn[2] and D.A. Sabatini[2], [1]Th Petroleum and Petrochemical College, Chulalongkorn University Thailand, [2]University of Oklahoma, USA.

3:40 **Recent Advances in Structured Surfactant Technology** G.A. Smith[1], R. Smadi[1], P. Chadwick[2] and G. Holliday[3], [1]Huntsma Surface Sciences, USA, [2]Huntsman Surface Sciences, Europe [3]Huntsman Surface Sciences, Australia.

4:00 **End.**

Ether sulfonate surfactants prepared by the reaction of oxyalkylated alcohols, phenols and amines with olefin sulfonic acids of the structure shown will be discussed: R^1 [-(O-(R^2O)m-(R^3O)n-(R^4)]y where: R^1 = alkyl, alkenyl, amine, alkylamine, dialkylamine, trialkylamine, aromatic, polyaromatic, cycloalkane, cycloalkene, R^2 = C_2H_4 or C_3H_6 or C_4H_8, R^3 = C_2H_4 or C_3H_6 or C_4H_8, R^4 = linear or branched $C_7H_{14}SO_3X$ to $C_{30}H_{60}$ SO_3X when y =1, R^4 = linear or branched $C_7H_{14}SO_3X$ to $C_{30}H_{60}$ SO_3X or H when y>1 but at least one R4 must be linear or branched $C_7H_{14}SO_3X$ to $C_{30}H_{60}$ SO_3X, $m \geq 1$, $n \geq 0$. n + m = 1 to 30+, $y \geq 1$, and X = alkali metal or alkaline earth metal or ammonium or amine. These novel ether sulfonate surfactants have excellent surfactant properties including low surface tensions and CMCs, excellent wetting and foaming characteristics as well as electrolyte, hard water, pH and temperature tolerance making them suitable for a variety of applications as surfactants. The unique reaction allows for the synthesis of mono-alkyl ether sulfonates, polyalkyl ether sulfonates such as anionic gemini surfactants and oligomer ether sulfonates such as those derived from alkylphenol/formaldehyde resins. The synthesis of these materials will be discussed as well as examples of their application as surfactants for detergents, stain repellents, water-soluble corrosion inhibitors, herbicides and enhanced oil recovery.

Novel Sulfonation Process of Fatty Acid Methyl Ester Sulfonate (MES). T. Nishio, S. Matoba, Y. Kimura, T. Ishikawa and I. Hama, Lion Corporation, Japan. *Contact:* Taku Nishio, Lion Corporation, 13-12, Hirai 7-chome, Edogawa-ku, Tokyo 132-0035, Japan.

Methyl ester sulfonate (MES) has a high detergency in hard water and an excellent biodegradability that is derived from renewable natural fats and oils. MES should become a cheaper alternative surfactant of linear alkylbenzene sulfonate (LAS). However, MES production technology is very problematic compared with other surfactant production technologies. The main problems in the production are MES's bad coloring (dark brown) and the generation of undesirable by-products such as disodium salt. In the conventional production process, manufacturers use acid bleaching in which methyl ester sulfonated acid is bleached with hydrogen peroxide under the existence of a large amount of methanol to suppress the hydrolysis of MES. This process is very complicated because additional systems of methanol recovery and an organic peroxide decomposition are necessary. Therefore, a novel MES process was developed. The technical points of this process are as follows. First, the acid color can be enhanced with the use of the color improving agents and methyl ester with a low iodine value. As a result of the improvement, neutralized paste bleaching that has a lower bleaching effect than acid bleaching can be used. Furthermore, the process becomes very simple, environmentally friendly, and basically safe because the methanol recovery system does not need to be used and no organic peroxide is generated. Second, a novel vessel sulfonation reactor can be developed instead of the film sulfonation reactor. This change will alllow the color improving agent to be used effectively. In this process, methyl ester with various carbon chain lengths can be used as raw materials. The MES compound can also be obtained for laundry detergent powder using a dry neutralization of low-color methyl ester sulfonated acid produced during this process.

Effect of Middle-Phase Microemulsion Formation on Ethylbenzene Removal by Using the Froth Flotation Technique. U. Yanatatsaneejit[1], A. Witthayapanyanon[1], S. Chavadej[1], E.J. Acosta[2], J.F. Scamehorn[2] and D.A. Sabatini[2], [1]The Petroleum and Petrochemical College, Chulalongkorn University, Thailand, [2]The University of Oklahoma, USA. *Contact:* Ummarawadee Yanatatsaneejit, Chulalongkorn University, 299/27 Soi Ladpraw 94, Ladpraw Road, Wanghonglang, Bangkok 10310, Thailand.

This study showed the relationship between surfactant phase behavior and efficiency of flotation of ethylbenzene in a continuous mode of operation. The phase behavior related to surfactant composition and salinity was performed with 3 anionic surfactants: sodium dihexyl sulfosuccinate (Aerosol MA), dioctyl sodium sulfosuccinate (Aerosol OT), and branched alcohol propoxylate sulfate sodium salt (Alfoterra). It was hypothesized that the maximum efficiency of froth flotation corresponds to the ultralow interfacial tensions between oil and water in the Winsor Type III microemulsion. Aerosol MA at 1 wt.% and 3 wt.% of NaCl exhibited the minimum interfacial tensions (2.2×10^{-2} dyne/cm). The effects of foam height, air flow rate, electrolyte concentration, equilibration time, and hydraulic retention time on the efficiency of froth flotation will be discussed.

Recent Advances in Structured Surfactant Technology. G.A. Smith[1], R. Smadi[1], P. Chadwick[2] and G. Holliday[3], [1]Huntsman Surface Sciences, USA, [2]Huntsman Surface Sciences, Europe, [3]Huntsman Surface Sciences, Australia. *Contact:* George Smith, Huntsman Surface Sciences, 7114 N. Lamar Blvd., Austin, Texas 78752, USA.

Structured surfactant technology (SST) is well established especially in Europe where liquid detergents do not need to be clear and isotropic. SST is capable of delivering actives which are incompatible in aqueous solution. In a structured liquid, the soluble surfactant system is salted out of aqueous solution as a suspended lamellar phase. The particle size is typically around 10 µm with a bilayer spacing around 50 A. The suspended surfactant spherulites interact to give rise to a yield stress that is capable of suspending insoluble particles such as STPP or zeolite. Recent work has identified other types of structured surfactant systems. In aqueous solution, sucrose has been used to structure surfactants. The resulting system is optically clear and highly birefringent under polarized liquid. The system is believed to be consist of a extended bilayer with spacing around 200 A. The spacing is large enough to appear optically transparent but still give rise to a yield stress capable of suspending insoluble ingredients. It has also been found that anhydrous structured surfactant systems are possible. Surfactants are dissolved in a suitable nonionic surfactant and then forced out of solution by ionic crosslinking. The anhydrous nature of the systems allows for the use of ingredients which are incompatible with water such as peroxygen bleaches. Performance of structured surfactant technology in laundry, liquid dish and hard surface cleaning has been examined. When properly formulated, structured systems shows better cleaning performance than conventional isotropic systems and do not require hydrotropes or other formulation aids.

Tuesday Morning

S&D 3: Surfactants II

Chair: Albert Joseph, Dow Chemical Co., USA

Study of Simultaneous Removal of an Organic Solute and a Metal Ion from Aqueous Solution by Surfactant/Polyelectrolyte Aggregates in Colloid-Enhanced Ultrafiltration. N. Komesvarakul[1] (Ralph H. Potts Memorial Fellowship Award Winner), L. Do[1], T. Nguyen[1], J.F. Scamehorn1 and H. Gecol[2], [1]The University of Oklahoma, USA, [2]University of Nevada, USA. *Contact:* Napaporn Komesvarakul, The University of Oklahoma, School of Chemical Engineering & Materials Science and Institute for Applied Surfactant Research, 100 E. Boyd, Energy Center, T-335, Norman, OK 73019, USA.

The colloid-enhanced ultrafiltration (CEUF) technique is used for the simultaneous removal of a phenolic solute and a metal ion; in this study specifically dichlorophenol (DCP) and Mg^{2+}. These compounds are often found in pulp and paper mill wastewater effluent. Surfactant/polymer mixtures with an excess of polyelectrolyte are used as colloid solutions forming net negatively charged complexes. The organic solute can solubilize in the surfactant/polymer aggregates and the metal ion can bind onto the aggregates. In this application of CEUF, the colloids are ultrafiltered from the solution with the solubilized chlorinated phenol pollutant and the bound metal ion. The effects of the metal concentration and polyelectrolyte concentration on the organic solute removal are discussed. Semiequilibrium dialysis is used to deter-

3. **Liquid Chromatography of Phospholipids Using Mixed Retention and Detection Modes.** N. Danielson, M. Wandstrat, A. Kijak, and J. Cox, Miami University, USA.
4. **Emulsifying Properties in Relation to the Quality of Egg Yolk Lecithin.** H. Narabe, Y. Shigematsu, and H. Kobayashi, Q.P. Corporation, Japan.
5. **Physicochemical Properties of Positively Charged Liposomes.** A. Inagaki, T. Ohkubo, H. Sakai, and M. Abe, Tokyo University of Science, Japan.
6. **Effect of Highly Purified Fatty Acids on Membrane Properties of Liposomes.** H. Sakai, H. Sasakura, T. Ohkubo, M. Suzuki, and M. Abe, Tokyo University of Science, Japan.

PRO-P: Processing Posters

Chair: F. Karaosmanoglu, Istanbul Technical University, Turkey.

1. **Preparation and Properties of Microcapsule by Using Electrocapillary Emulsification Method.** K. Tanaka, A. Nakayama, T. Kondo, H. Sakai, and M. Abe, Tokyo University of Science, Japan.
2. **Membrane Processing of Ethanol-Extracted Corn Oil.** J. Kwiatkowski and M. Cheryan, University of Illinois, USA.
3. **Effect of Physical Refining on Chemical and Sensory Attributes of Coconut Oil.** M. Torres-Gonzalez[1], O. Angulo-Guerrero[2], R. Oliart-Ros[2], and L. Medina-Juarez*[3], [1]Instituto Tecnologico de Colima, Mexico, [2]Instituto Tecnologico de Veracruz, Mexico, [3]Universidad de Sonora, Mexico.
4. **Modeling the Tocopherol Adsorption on Bleaching of Soybean Oil.** L. González-Tovar, J. Noriega-Rodríguez, J. Ortega-García, N. Gamez-Meza, and L. Medina-Juarez, Universidad de Sonora, Mexico.
5. **Hexane Removal from Oil Mixtures Using Liquid CO_2 and Analyzed via SFC.** S. Taylor and F. Eller, USDA, ARS, NCAUR, USA
6. **Effect of Physical Refining on Quality of High-Oleic Safflower Oil Produced in Mexico.** J. Ortega-García, J. Noriega-Rodríguez, L. Medina-Juarez, N. Gamez-Meza, and O. Dennis*, Universidad de Sonora, Mexico.
7. **Column Fractionation of Canola Oil Deodorizer Distillate Using Supercritical Carbon Dioxide.** O. Guclu-Ustundag and F. Temelli*, University of Alberta, Canada
8. **Phospholipid Molecular Species of Cottonseed Expander Oil.** M. Kuk and J. Bland, USDA, ARS, SRRC, USA.
9. **Kinetic Modelling of Glycerolysis in Supercritical Carbon Dioxide Media.** P. Moquin[1], F. Temelli[1], J. King[2], and M. Palcic[1], [1]University of Alberta, Canada, [2]Los Alamos National Laboratory, USA.
10. **How Chemical Interesterification Is Initiated: Nucleophilic Substitution or α-Proton Abstraction?** L. Liu, ConAgra Foods, Inc., USA.
11. **Impact of Impurities on Thermal Energy Storage Properties of Biobased Phase Change Materials.** S. Lopes and G. Suppes, University of Missouri at Columbia, USA.
12. **Influence of the Refining Process on Pesticides Residues Removal.** X. Page-Xatart-Pares, J. Laur, C. Birot, J. Arnaud, and F. Lacoste, ITERG, France.
13. **Hydrogenation of Vegetable Oils with Minimum *trans* and Saturated Fatty Acid Formation over Novel Generation of Pd-Catalysts.** A. Boulmerka ***(Processing Division Student Excellence Award Winner),*** J. Arul, and K. Belkacemi, Universite Laval, Canada.
14. **Removal of Organic Environmental Pollutants from Fish Oil by Short-Path Distillation.** H. Breivik[1] and O. Thorstad*[2], [1]Hydro Pronova a.s., Norway, [2]Pronova Biocare a.s., Norway.
15. **A Comparison of Commercial Nickel Catalysts Effects on *trans* Fatty Acids Formation during Hydrogenation of Soybean Oil and Optimization of Process.** H. Safafar[1], H Nikoopour[2], and M. Babaee[2], [1]ORDC, Iran, [2]National Nutrition and Food Technology Research Institute, Iran.

PCP-P: Protein and Co-Products Posters

Chair: M. Hojilla-Evangelista, USDA, ARS, NCAUR, USA.

1. **The (-)-Gossypol-2,4-Pentanedione (1:2) Inclusion Complex.** M. Dowd[1] and E. Stevens[2], [1]USDA, ARS, SRRC, USA, [2]Dept. of Chemistry, University of New Orleans, USA.
2. **Effect of Hydrophilic Zein Films on the Growth of Tomato Plants and Evaporative Water Loss.** N. Parris and D. Douds USDA, ARS, ERRC, USA.
3. **Emulsification Capacity Properties of Protease-Modified Soy Protein Substrates.** S. Jung, P. Murphy, and L Johnson, Iowa State University, USA.
4. **Effect of Extraction Solvent on Composition of Oil anc Meal Obtained from Cottonseed.** P. Wan, M. Dowd, and A Waggoner, USDA, ARS, SRRC, USA.
5. **Effects of Flour Sources on Acrylamide Formation and Oi Uptake in Fried Batters.** F. Shih, S. Boue, K. Daigle, and B. Shih USDA, ARS, SRRC, USA.
6. **Construction of Green Fluorescent Protein Fusion Proteir to Investigate the Transduction Mechanism of TAT Proteir Transduction Domain.** S. Liu, R. Fu, H. He, J. Chen, and P. Rao Fuzhou University, China.
7. **Lesquerella Fendleri Protein Fractionation and Properties** Y. Wu, USDA, ARS, NCAUR, USA.
8. **Refunctionalization of EE Meals by Novel Means.** H. Wang L. Johnson and T. Wang, Iowa State University, USA.
9. **The Effect of Heat Treatment and pH on the Thermal anc Rheological Properties of *Lupinus Albus* Flour Meal.** A Mohamed, S. Peterson, and G. Biresaw, USDA, ARS, NCAUR, USA.

S&D-P: Surfactants and Detergents Posters

Chair: M. Saint Victor, Cognis Corporation, USA.

1. **Phase Behaviors of Highly Purified Polyglycerine Fatty Aci Esters.** T. Nakamura[1], M Kikuchi[2], T. Ohkubo[2], and M. Abe[2], [1]T Hasegawa Co. Ltd., Japan, [2]Tokyo University of Science, Japan.
2. **Stabilization of Oil/Hydrophobic Polymer/Wate Surfactant-Free Emulsions with Heat Treatment.** T. Umeda K Kamogawa[2], T. Ohkubo[1], H Sakai[1], and M. Abe[1], [1]Toky University of Science, Japan, [2]Ministry of Education, Culture, Sport Science, and Technology Japan.
3. **Preparation of Emulsions with Hydrophobic Silic Particles as an Emulsifier.** K. Ikemoto, T. Ohkubo, M. Koishi, H Sakai, and M. Abe, Tokyo University of Science, Japan.
4. **Stabilization of Surfactant-Free Styrene Emulsions by th Addition of Hexadecane.** D. Tsutsui[1], K. Kamogawa[2], Ohkubo[1], H. Sakai[1], and M. Abe[1], [1]Tokyo University of Scienc Japan, [2]Ministry of Education, Culture, Sports, Science, an Technology, Japan.
5. **Solution Properties of a Novel Fluorinated Hybri Surfactant with a Sulfate Headgroup.** C. Sun, Y. Kondo, N Yoshino, T. Ohkubo, H. Sakai, and M. Abe, Tokyo University Science, Japan.

⑥ **Light Oil Removal from Wastewater by Middle Phas Microemulsion and Froth Flotation.** A. Witthayaponyanon[1], Yanatatsaneejit[2], J. Scamehorn[1], D Sabatini[1], and S. Chavade [1]Oklahoma State University, USA, [2]Chulalongkorn University, Thailan but also decreased interfacial tension between water and normal alkanes remarkably. By utilizing this advantage, we could spread the droplet of the hybrid surfactant aqueous solutions with larger density on the surface of benzene with lower density.

The aggregation behaviors of F8H3OS and F6H5OS in water have been investigated by light scattering and fluorescence spectrum measurements. The micelle size and aggregation number of F8H3OS were 2.8 nm and 30, respectively, which are smaller than those of normal hydrocarbon surfactants. For F6H5OS, surfactant molecules formed larger aggregates whose size is from 10 nm to 900 nm. Aggregation states of the hybrid surfactants in aqueous solutions were investigated in more details by fluorospectroscopy in which pyrene(Py) and fluorocarbon-substituted pyrene (PyCORf) were employed as probes of polarity in hydrophobic environment. Unlike hydrocarbon surfactants for which the fluorescence intensity ratio of the first (I1) and third band (I3) bands decreased dramatically at cmc and settle down to a plateau, the ratio of I1/I3 for the hybrid surfactant aqueous solutions decreased even at higher concentration (above the cmc), indicating that aggregation behaviors of the hybrid surfactants vary even at higher concentration range.

Furthermore, we have measured the diffusion coefficient of sucrose (Ds) in hybrid surfactant aqueous solutions by NMR: Two different values of Ds have been determined in F8H5OS solutions. Due to its high hydrophilicity, sucrose can not be solubilized in the hydrophobic core of micelles, so we think the different values of Ds in F6H5OS solutions indicated different diffusion rates of sucrose in the internal water phase of vesicles and the bulk solution. In other words, with increasing concentration, F6H5OS forms vesicles and some of sucrose molecules are incorporated in the internal water phase.

Light Oil Removal from Wastewater by Middle Phase Microemulsion and Froth Flotation. A. Witthayapanyanon[1], U. Yanatatsaneejit[2], J. Scamehorn[3], D. Sabatini[3] and S. Chavadej[4], [1]Oklahoma State University, United States, [2]The Petroleum and Petrochemical College,Chulalongkorn University, Thailand, Thailand, [3]Oklahoma State University, United States, [4]The Petroleum and Petrochemical College, Chulalongkorn University, Thailand, Thailand. *Contact:* Anuradee Witthayapanyanon, Oklahoma State University, 202 W.Boyd St. Room 334, Norman, Okiahoma 73019-1024, United States.

Abstract: In the previous work (1-7), the maximum oil removal occured when type III microemulsion was formed. In order to elucidate which character of type III microemulsion was responsible for froth flotation. Ultra low interfacial tension (IFT) is focused in this work.Effect of surfactant concentration, electrolyte concentration and equilibration time on oil removal were investigated. These three effects linked between IFT and oil removal. The results showed that ultra low IFT enhanced the flotation efficiency. However, the system providing the maximum oil removal did not correspond to the minimum IFT found in the middle phase obtained from phase study. It led to conclude that ultra low IFT was not the sole significant factor in flotation operation. Foam stability and foam ability are other parameters that should be taken into consideration further.

Production of O/W Emulsions Stabilized by β-lactoglobulin-Pectin Membranes. D. Guzey, H. Kim and D. McClements, University of Massachusetts Amherst, United States. *Contact:* Demet Guzey, University of Massachusetts Amherst, Department of Food Science, Amherst, Massachusetts 01003, United States.

Abstract: Previously a novel technology was developed to produce O/W emulsions stabilized by chitosan-lecithin membranes (Ogawa *et al.*, 2003) and β-lactoglobulin-pectin membranes (Moreau *et al.*, 2003) using a two-stage process. The main driving force for adsorption of the polymer onto the primary emulsion droplets was reported as the electrostatic attraction between the charged groups on the polymer and the oppositely charged groups on the colloidal particle. In this study the optimum preparation conditions (pH, ionic strength, mechanical agitation) for biopolymer adsorption onto the droplets in primary emulsions to form kinetically stable secondary emulsions were investigated.

A primary emulsion was prepared by homogenizing 10 wt% corn oil with 90 wt% aqueous emulsifier solution (0.5 wt% β-lactoglobulin, pH 3 or 7) with a high-speed blender followed by 5 passes at 5000 psi through a two-stage high-pressure valve homogenizer. This emulsion was mixed with aqueous pectin solution (2 wt%, pH 3 or 7), NaCl solution and buffer solution to yield secondary emulsions with the composition of 5 wt% corn oil, 0.45 wt% β-lactoglobulin, 0.2 wt% pectin and 0 or 100 mM NaCl. The pH of the secondary emulsions was then adjusted to pHs ranging from 3 to 8. Primary and secondary emulsions were treated with ultrasound waves to disrupt any flocculated droplets (30 seconds at 20 kHz and 40% amplitude). Emulsions were then stored for 24 hours at ambient temperature prior to analysis. The zeta potential of emulsions was determined using a particle electrophoresis instrument. The particle size distribution of the emulsions was measured using a laser light scattering instrument. Creaming stability was reported as % Serum which is defined as the height of the serum layer divided by the height of the emulsion in a test tube.

Secondary emulsions were more stable than primary emulsions at intermediate pHs. Secondary emulsions prepared at pH 7 had smaller droplet diameters (0.35 to ~6 μm) than those prepared at pH 3 (0.42 to ~18 μm) across the whole pH range studied, and also had smaller diameters than the primary emulsions (0.35 to 13.6 μm). Ultrasound treatment reduced the droplet diameter of both primary and secondary emulsions and lowered the rate of creaming. The presence of salt screened the charges and thus the electrostatic interaction between biopolymers. Secondary emulsions were more stable to the presence of 100 mM NaCl at low pHs (3 to 4) than primary emulsions.

The results of this study show that stable emulsions can be prepared by engineering their interfacial membranes using the electrostatic interaction of natural biopolymers, especially at intermediate pHs where proteins normally fail to function. This technology can be utilized to produce emulsions containing functional ingredients encapsulated within biopolymer layers.

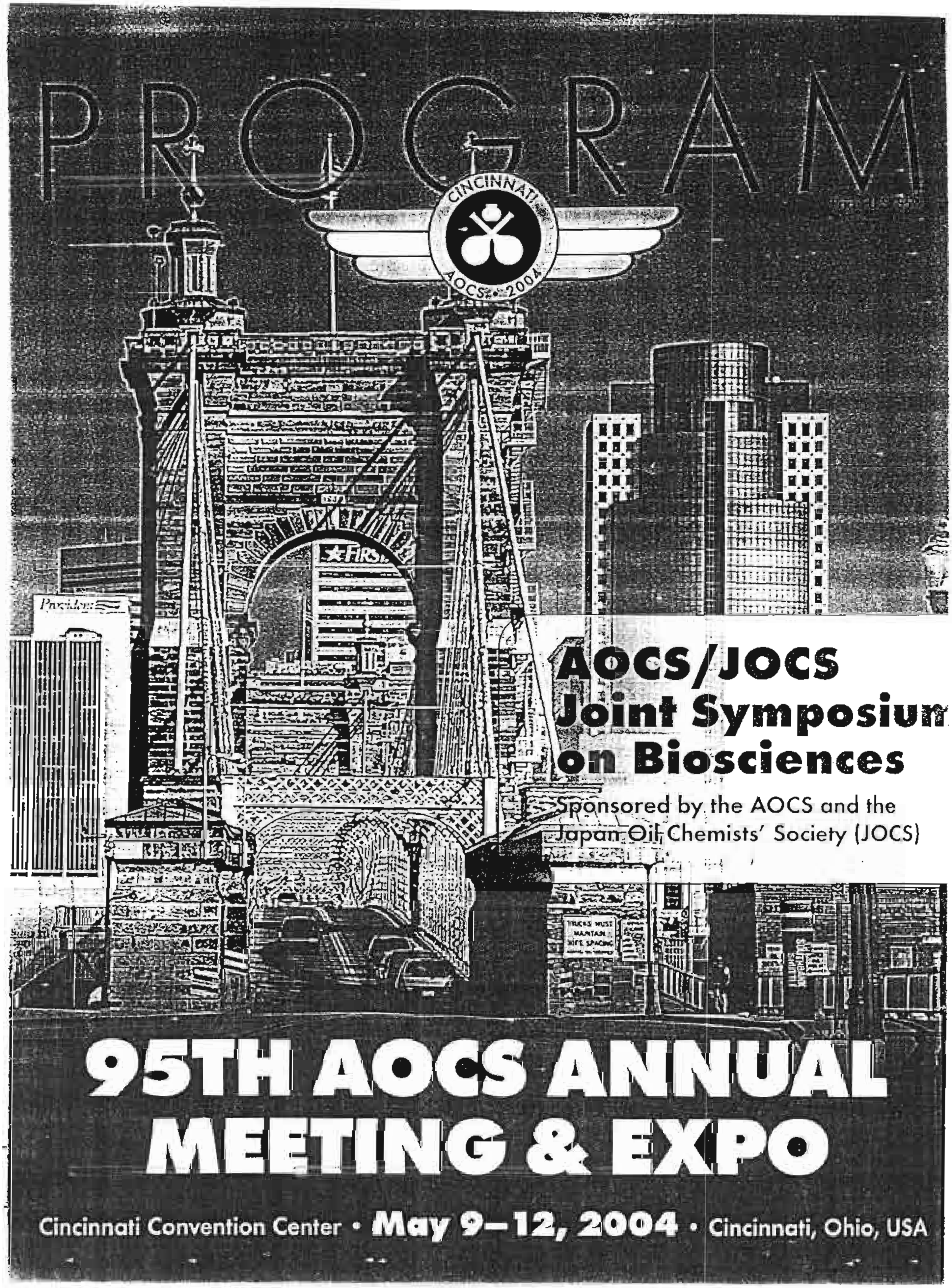
Application of Cationic Surfactant and Modified Silicone Combination System to Fabric Softener. J. Yokoyama, E. Hashimoto, H. Yamazaki, H. Miyasaka and T. Mukaiyama, LION Corporation, Japan. *Contact:* Jun Yokoyama, LION Corporation, 13-12, Hirai 7-chome, Edogawa-ku, Tokyo 132-0035, Japan.

Abstract: Silicones are well known as functional materials. Especially they have been used as lubrication materials to reduce the friction between fibers in the textile manufacturing industry. Though they are expected to provide high performances to domestic fabric softener, there are few products that contain silicone. So, we investigated the performances and the physicochemical properties of the new liquid fabric softeners that were formulated with modified silicone and cationic surfactant combination system. Polyoxyalkylene modified silicone (PMS) and dialkyl dimethyl ammonium chloride (DAA) were used in the experiments.

The softener showed high performances concerning softness, anti-staticity, wrinkle reduction, easy ironing, re-wettability and so on. From the adsorption experiment, PMS showed quite low adsorption ability by itself, but it was improved drastically under co-existence of DAA. The aggregation structure in the dispersion and the adsorbed structure onto a model surface were investigated by several methods such as DLS, ESR, AFM, XRD, DSC and so on. As the result, PMS was suggested to exist in the vesicle structure formed by DAA.

And we also conducted these experiments on triethanol amine origin esterquat (TEQ)/PMS combination system. As the result, TEQ /PMS combination showed smaller particle size and lower viscosity of the dispersion in comparison with DAA / PMS.

Removal of Toluene from Nonionic Surfactant Coacervate Phase from a Cloud Point Extraction by Vacuum Stripping. S. Kungsanant[1], B. Kitiyanan[1], S. Osuwan[1] and J. Scamehorn[2], [1]The



PROGRAM

AOCS/JOCS Joint Symposiun on Biosciences

Sponsored by the AOCS and the Japan Oil Chemists' Society (JOCS)

95TH AOCS ANNUAL MEETING & EXPO

Cincinnati Convention Center • **May 9–12, 2004** • Cincinnati, Ohio, USA

Joint session developed in conjunction with the Specialty Oils Applications Common Interest Group.

PRO 4/SOA 4: Processing of Specialty Oils

Chairs: J.W. King, Los Alamos National Laboratory, USA; F.T. Orthoefer, Consultant, USA; and P.M. Sonkul, Mumbai University, India (Student Co-Chair).

Room 243, Convention Center

7:55 **Opening Remarks.**

8:00 **Biological Activity of Micronutrients in Vegetable Oils: Impact of Oil Processing.** R. Nicolosi[1] and F. Orthoefer[2], [1]American Society for Nutritional Sciences, USA, [2]Food Science and Technology, LLC, USA.

8:20 **High Phytosterol Oils from Corn Fiber and Barley.** R.A. Moreau[1], A.-M. Lampi[2], and K.B. Hicks[1], [1]USDA, ARS, ERRC, USA, [2]University of Helsinki, Finland.

8:40 **Hibiscus Seed Oil Compositions.** R.A. Holser[1] and G. Bost[2], [1]USDA, NCAUR, Food and Industrial Oils Research Group, USA, [2]The Village Botanica, Inc., USA.

9:00 **Nutraceutical Composition of Avocado Oil (Crude, Virgin and Refined) through the Operations for Its Industrial Production.** J. Simental[1,2], H. Escalona[2], and M. Estarrón[2], [1]Universidad de Guadalajara, Mexico, [2]Centro de Investigación y Asistencia en Tecnología y Diseño del Estado de Jalisco, Mexico.

9:20 **HPLC-ESI-MS/MS Analysis of Novel Brazilian Food Oils.** S. Segall[1], W. Artz[2], D. Raslon[1], V. Ferraz[1] and J. Takahashi[1], [1]Universidade Federal de Minas Gerais, Brazil, [2]University of Illinois, USA.

9:40 **Extraction and Processing of Nut-Oils and -Products Using Compressed Fluids.** J. King, Los Alamos National Laboratory, USA.

10:20 **End.**

PCP 4: Vegetable Proteins as Meat Analogs

Chairs: R. Shukla, Archer Daniels Midland Co., USA; and N. Parris, USDA, ARS, ERRC, USA.

Room 204, Convention Center

7:55 **Opening Remarks.**

8:00 **Contribution of Vegetable Proteins to Water-Holding and Texture of Meat Products.** T. Lanier, North Carolina State University, USA.

8:20 **High-Moisture Extrusion of Protein to Create Unique Meat Analogs.** R. Egbert and M. Matlock, Archer Daniels Midland Company, USA.

8:40 **A Review of Research on TSP from Extruded-Expelled Soybean Flour at Iowa State University.** D. Myers, Iowa State University, USA.

9:00 **High-Moisture Extruded Soy Proteins and Their Potential.** Y. Li, The Solae Company, USA.

9:20 **How to Make Soy Meat Analogs.** M. Riaz and M. Barron, Texas A&M University, USA.

9:40 **Break.**

10:00 **Soy Protein as Carbohydrate Replacement in Conventional Foods.** S. Rittmanic, Protient, Inc., USA.

10:20 **Novel Applications for Soy Proteins.** B. Govindarajan, Legacy Foods, USA.

10:40 **Textured Soy Protein—Field to Plate Technology.** W Wijeratne, Insta-Pro International, USA.

11:00 **Development of Meat Analog Using Peanut Flour and Soy Protein Isolate Mix.** B. Wang and E. Parmer Jr., Tuskegee University, USA.

11:20 **Development of Peanut-Based Meat Analogs.** I. Goktepe and M. Ahmedna, North Carolina A&T State University, USA.

11:40 **End.**

S&D 4: General Detergents

Chair: J. Shi, Procter & Gamble Co., USA.

Room 202, Convention Center

7:55 **Opening Remarks.**

8:00 **Industrial Home Laundry Closed Loop Cleaning Process.** J. Scamehorn[1], E. Tucker[1], H. Gecol[2], N. Komesvarakul[1], L. Serventi[1], K. Raney[3], and S. Capps[3], [1]The University of Oklahoma, USA, [2]University of Nevada at Reno, USA, [3]Shell Chemical LP, USA.

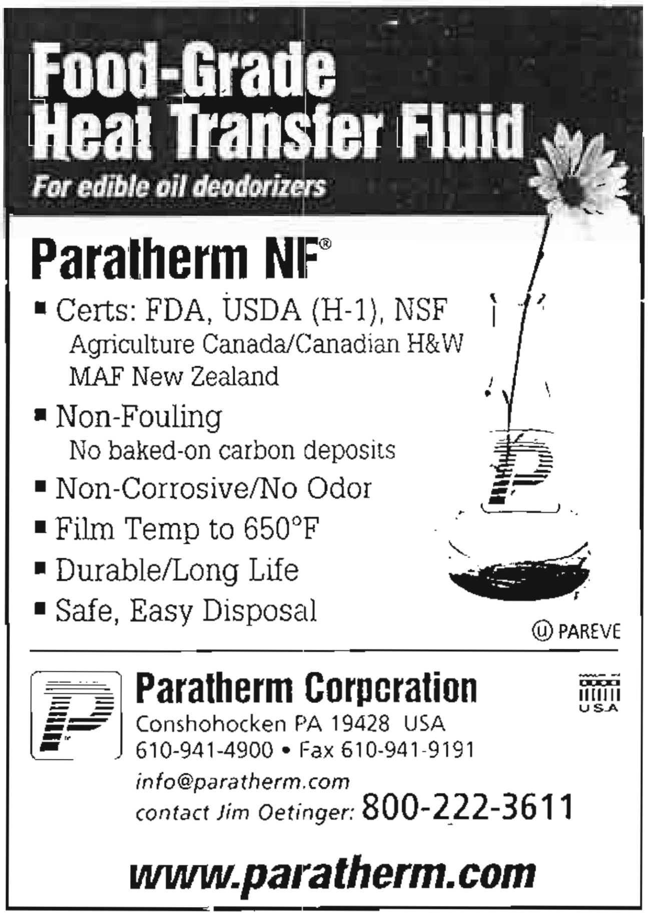
8:20 **E(quivalent) HLB? Emulsion Inversion Studies as a Tool for Surfactant Characterization.** I. Johansson and I. Voets, Akzo Nobel Surface Chemistry AB, Sweden.

8:40 **Polyetheramine Derivatives: Physical Chemical and Performance Properties.** G. Smith, Huntsman Surface Sciences, USA.

9:00 **Synergism of Cationic and Anionic Surfactant Mixtures with Asymmetric Head Groups.** A. Fuangswasdi[1], A. Charoensaeng[1], E. Acosta[2], S. Khoodhiar[1], K. Osathaphan[1], J. Scamehorn[2], and D. Sabatini[2], [1]Chulalongkorn University, Thailand, [2]University of Oklahoma, USA.

9:20 **Evaluation of Silicones for Fabric Mechanical Reinforcement.** B. Henault[1] and M. Severance[2*], [1]Dow Corning S.A., Belgium, [2]Dow Corning Corporation, USA.

9:40 **Break.**



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10:00 **Softening Performance and Physicochemical Properties of Gemini-Type Cationic Surfactants and Their Complexes with Anionic Surfactants.** H. Imai, H. Miyasako, H. Konto, and M. Fujiwara, Lion Corporation, Japan.

10:20 **Stabilization of Cationic Polymers in Anionic Formulations.** M. Crossman, Alco Chemical, USA.

10:40 **Enzyme Stability in Liquid Detergent.** M. Stoner[1] ***(Ralph H. Potts Memorial Fellowship Award Winner)***, D. Dale[2], and T. Randolph[1], [1]University of Colorado, USA, [2]Genencor International, USA.

11:00 **Polymers for Improved Soil Removal.** H. Koch, Sasol, Germany.

11:20 **Absorption of Aqueous Aroma Chemicals on Fabric Substrates.** H. Liu[1], K. Obendorf[1], M. Leonard[2], T. Young[2], and M. Incorvia[2], [1]Cornell University, USA, [2]International Flavors & Fragrances, USA.

11:40 **Effect of Interfacial Tension and Foam Characteristics on Diesel Removal in Froth Flotation Operation.** U. Yanatatsaneejit[1] ***(Surfactants and Detergents Division Student Travel Award Winner)***, S. Chavadej[1], P. Rangsunvigit[1], and J. Scamehorn[2], [1]Chulalongkorn University, Thailand, [2]University of Oklahoma, USA.

12:00 **End.**

S&D 4.1: Claim Substantiation and Brand Building in Detergents

Chairs: N. Prieto and R. Deinhammer, Novozymes North America, Inc., USA.

Room 213, Convention Center

7:55 **Opening Remarks.**

8:00 **Building Brands through Technology Innovation.** R. Swift, Procter & Gamble Co., USA.

8:20 **Solving the Consumer Riddle Before We Are Asked.** M. Boe-Lee, N. Diaz, and H. Keiserman, Unilever Home & Personal Care-NA, USA.

8:40 **Developing Claims Benefits from Detergent Ingredient Innovations.** J. Houston, Colin A. Houston & Associates, Inc., USA.

9:00 **Brandbuilding with Enzymes.** S. Troff, Novozymes A/S, Denmark.

9:20 **A Lever, a Fulcrum, a Place to Stand—and Good Timing.** G. VanBuskirk, Clorox Services Company, USA.

9:40 **Advertising in 20 Minutes.** B. Cutler, Baker & Hostetler LLP, USA.

10:00 **Break.**

10:20 **Building Brands with Oxygen-Based Bleach Technology.** G. Reinhardt, Clariant GmbH, Germany.

10:40 **Launching a Car Care Revolution: Mr. Clean AutoDry.** P. Vinson, M. Kreuzer, B. Barger, J. Powell, and K. Kern, Procter & Gamble Co., USA.

11:00 **Performance Evaluation for Brand Building.** P. Sosis, Argeo Inc., USA.

11:20 **Sure It Cleans, but What Else Can It Do?** T. Germain, McIntyre Group, Ltd., USA.

11:40 **Brandbuilding in the Laundry Category.** T. Gatzulis, The Dial Corporation, USA.

12:00 **Panel Discussion.**

12:20 **End.**

Joint session developed in conjunction with the Processing Common Interest Group.

SOA 4/PRO 4: Processing of Specialty Oils

Chairs: J.W. King, Los Alamos National Laboratory, USA; and F.T Orthoefer, Consultant, USA.

Room 243

Please refer to PRO 4/SOA 4 Session above for programming.

WEDNESDAY AFTERNOON

AOCS/JOCS JOINT SYMPOSIUM ON BIOSCIENCES

BIO 5: Single-Cell Oils

Chairs: S. Shimizu, Kyoto University, Japan; and S. Bloomer, Land O'Lakes Inc., USA.

Room 200, Convention Center

1:55 **Opening Remarks.**

2:00 **Model Studies for the Production of Transgenic Single Cell Oils.** T. Aki[1], Y. Michinaka[1], T. Shimauchi[2], T. Nakajima[2], S Kawamoto[1], S. Shigeta[1], and K. Ono, [1]Hiroshima University, Japa and [2]Idemitsu Technofine Co., Japan.

2:20 **A Perspective on Single-Cell Oil.** E. Hammond and B. Glat Iowa State University, USA.

3:00 **Polyunsaturated Fatty Acids Production by Labyrinthulids.** T. Nakahara, T. Yokochi, and Y Kamon, Nation Institute of Advanced Industrial Science and Technology, Japan.

3:20 **The Development and Commercialization of PUFA-Ric SCO.** D. Kyle, Advanced BioNutrition Corporation, USA.

4:00 **Operation of n-4 and n-7 Pathways for th Polyunsaturated Fatty Acid Biosynthesis in a Mutant c an Arachidonic Acid-Producing Fungus, *Mortierell alpina* 1S-4.** E. Sakuradani, M. Naka, H. Kanamaru, Y. Ioka, M Nojiri, J. Ogawa, and S. Shimizu, Division of Applied Life Science Graduate School of Agriculture, Kyoto University, Japan.

4:20 **Wax Ester Production from *n*-Alkanes by *Acinetobacter* s Strain M-1.** T. Ishige, Y. Sakai, and N. Kato*, Kyoto University, Japa

4:40 **Production and Applications of a Vegetarian Hig Quality DHA-Oil by Fermentation.** T. Kiy, Nutrinova Nutritio Specialties & Food Ingredients GmbH, Germany.

5:00 **End.**

EAT 5: General Edible Applications Technolog

Chair: G. List, USDA, ARS, NCAUR, USA.

Room 214, Convention Center

1:55 **Opening Remarks.**

2:00 **The Yield Stress and Elastic Modulus of a Fat and Thei Relationship to Structure.** A. Marangoni ***(Timothy L Mounts Award Winner)***, University of Guelph, Canada.

2:40 **Zero *trans* Margarine Oils Formulation by Chemic Esterification and Blending.** S. Mirzaee Ghazani, Margari Co., Iran.

3:00 **Adsorbent Treatment of Frying Oils and the Impact o Health and Nutrition.** B. Cooke, The Dallas Group of Americ Inc., USA.

3:20 **End.**

Effect of Interfacial Tension and Foam Characteristics on Diesel Removal in Froth Flotation Operation. U. Yanatatsaneejit[1], S. Chavadej[1], P. Rangsunvigit[1] and J. Scamehorn[2], [1]Petroleum and Petrochemical College, Chulalongkorn University, Thailand, Thailand. [2]University of Oklahoma, United States. *Contact:* Ummarawadee Yanatatsaneejit, Petroleum and Petrochemical College, Chulalongkorn University, Thailand, Chula Soi 12, Phyathai Road, Pathumwan, Bangkok 10330, Thailand.

Abstract: Froth flotation is a surfactant-based separation process which can remove emulsified oil from water. There are several advantages such as low space requirement, high removal efficiency, flexibility for various pollutants at different scales, and low cost. To achieve higher performance for froth flotation, the combination of ultra-low oil–water interfacial tensions and stable foam production must be achieved. To get the ultra-low interfacial tensions, Winsor's type III microemulsion is formed in oily wastewater before transferred to the froth flotation cell. In this study, diesel fuel is used as the model oil and branched alcohol propoxylate sulfate sodium salt with 14–15 carbon hydrophobe and 4 PO groups (Alfoterra 145-4PO) are used as the surfactant. The effect of surfactant concentration, salinity, oil to water ratio, air flow rate, and equilibration time on performance of the froth flotation operation will be discussed.

Wednesday Morning

S&D 4.1: Claim Substantiation and Brand Building in Detergents

Chairs: R. Deinhammer and N. Prieto, Novozymes North America, Inc., USA.

Building Brands Through Technology Innovation. R. Swift, Procter & Gamble Company, United States. *Contact:* Ron Swift, Procter & Gamble Company, 5299 Spring Grove Ave., Cincinnati, Ohio 45217, United States.

Abstract: In the increasingly competitive world of branded products, the importance of technology fit with brand character is becoming more evident. It is no longer enough to offer a product upgrade that has a technical, claimable or even consumer noticeable benefit. In the environment of price and profit pressure, growing brands innovate with technologies that offer benefits specifically tuned to the product equity or the direction of the product equity. This benefit "tuning" offers greater differentiation in an effort to reduce commoditization of brands and categories.

Solving the Consumer Riddle Before We Are Asked. M. Bae-Lee, N. Diaz and H. Keiserman, Unilever Home & Personal Care–NA, United States. *Contact:* Myongsuk Bae-Lee, Unilever Home & Personal Care–NA, 45 River Rd, Edgewater, New Jersey 07020, United States.

Abstract: Unilever is a consumer packaged goods company dedicated to meeting the everyday needs of people everywhere. Connecting to the consumer is our passion. We are on a continuous quest to obtain the consumer insights that will guide product innovations that anticipate future consumer expectations. However, consumer insights are complicated and constantly changing, in part due to trends like cultural infusion and escalating product choices. Our challenge is to deliver products that consumers will feel connected to, be delighted with, and experience real benefits from. Predicting what consumers will want tomorrow is today's challenge.

Developing Claims Benefits from Detergent Ingredient Innovations. J. Houston, Colin A. Houston & Associates, Inc., United States. *Contact:* Joel Houston, Colin A. Houston & Associates, Inc., 20 Milltown Road, Brewster, New York 10509, United States.

Abstract: As detergents have developed, a series of technical achievements allowed product performance to accelerate and marketers found that performance claims enhanced sales effectively and differentiated products one from another. Early performance additives were FWA and protease enzymes. In the 1980's, tremendous attention was placed on low temperature oxygen based bleaches while in the nineties attention shifted to improved color and fabric care. This paper will examine the linkage between performance and product claims and look at where detergent claims are and where they appear to be headed.

Brand-Building with Enzymes. S. Traff, Novozymes A/S, Denmark. *Contact:* Stig Traff, Novozymes A/S, Smoermosevej 25, Bagsvaerd 2880, Denmark.

Abstract: A key challenge for the detergent industry is to push new innovations for their brands in order to build consumer preference and to counter the commoditization of products. This need is probably more out spelled today than ever before.

A great many parameters are involved in the detergent brand-building process. But very basically it is about identifying and delivering value to the specific brand and keeping the specific brand top-of-mind within the target group, in order to trigger the target group's initial purchase, trial and re-purchase.

Any detergent formulation contains some basic ingredients, but those basic ingredients are usually not the ones which differentiate one specific detergent from another at the consumer level. The ingredient specialties—like enzymes—play a key role in supporting detergent product innovation and brand differentiation.

Our prediction for the future is that new enzymes will continuously be core for generating novel claims and for efficient detergent brand-building. This presentation will exemplify the above by discussing some of the latest enzyme developments.

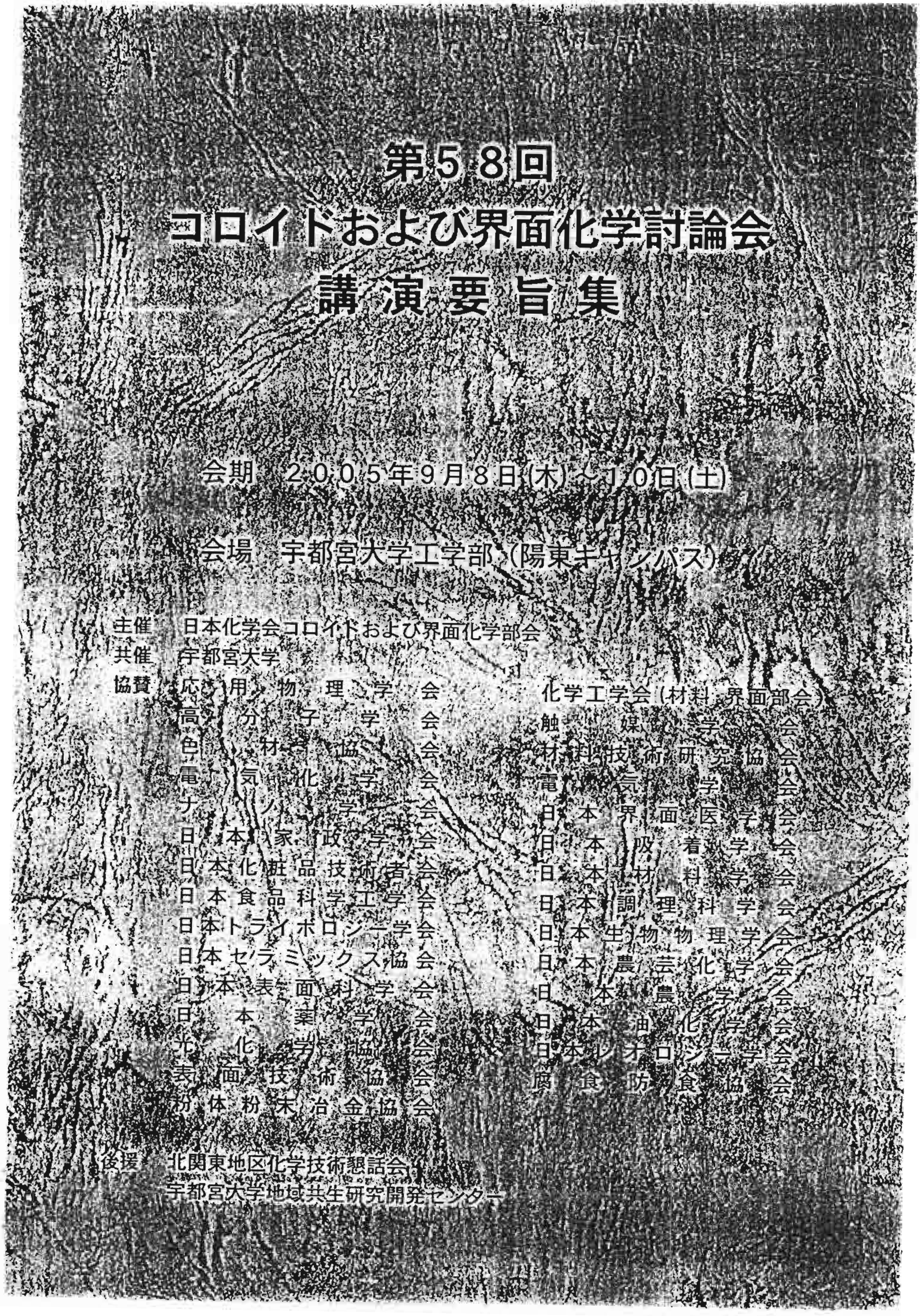
A Lever, a Fulcrum, a Place to Stand—and Good Timing. G. van Buskirk, Clorox Services Company, United States. *Contact:* Gregory van Buskirk, Clorox Services Company, 7200 Johnson Drive, Pleasanton, California 94506, United States.

Abstract: The prescription of Archimedes for being able to move the world neglected a key factor, which centuries later has been found by numerous product development companies to be vital—the significance of timing. The identification of key consumer needs, the ability to bring together the appropriate technology, and a key brand name on which to build the product have become the price of entry—and can be wasted for lack of good fortune. Is a product ahead of its time, lost in the crowd, or in the right place at the right time? What influence can seemingly disparate events have? Case histories will be presented, which illustrate the importance, in rewards and consequences, of this elusive factor.

Advertising in 20 Minutes. B. Cutler, Baker & Hostetler LLP, United States. *Contact:* Barry Cutler, Baker & Hostetler LLP, Suite 1100, 1050 Connecticut Avenue, N.W., Washington, District of Columbia 20036, United States.

Abstract: The use of truthful advertising is critical to fair competition in free markets. However, there are many misconceptions about advertising rules among marketers and lawyers alike. Many of these involve notions that advertising turns heavily on technicalities, such as that words that are strictly true are permitted, even if they create a misleading impression and that a consumer "testimonial" is legal so long as the speaker "really believes it." In fact, advertising law turns more on common sense and on determining what the "net impression" of the ad will be to the typical consumer. This presentation will cover, with examples, how to determine what the meaning of an ad is and how to determine what proof ("substantiation") is needed to prove that the ad claims are true.

Building Brands with Oxygen-Based Bleach Technology. G. Reinhardt, Clariant GmbH, Germany. *Contact:* Gerd Reinhardt, Clariant GmbH, Industriepark Hoechst, Frankfurt 65926, Germany.



第５８回
コロイドおよび界面化学討論会
講演要旨集

会期　２００５年９月８日（木）～１０日（土）

会場　宇都宮大学工学部（陽東キャンパス）

主催　日本化学会コロイドおよび界面化学部会
共催　宇都宮大学
協賛　応用物理学会
高分子学会
色材協会
電気化学会
ナノ学会
日本家政学会
日本化粧品技術者会
日本食品科学工学会
日本トライボロジー学会
日本セラミックス協会
日本表面科学会
日本薬学会
光化学協会
表面技術協会
粉体粉末冶金協会
化学工学会（材料界面部会）
触媒学会
材料技術研究協会
電気学会
日本界面医学会
日本吸着学会
日本材料学会
日本調理科学会
日本生物物理学会
日本農芸化学会
日本農学会
日本油化学会
日本レオロジー学会
腐食防食協会

後援　北関東地区化学技術懇話会
宇都宮大学地域共生研究開発センター

第58回 コロイドおよび界面化学討論会
講演要旨集
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Book of Abstracts
The 58th Divisional Meeting on Colloid and Interface Chemistry
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2F05 カルボン酸リチウム長繊維／炭化水素集合体の安定性（産総研）○坂口 豁

2F06 陰イオン性界面活性剤ーシリカ前駆物質複合体の形成過程（横国大院環境情報）○平澤俊和・カルロス ロドリゲス・荒牧賢治・アルトロ ロペスキンテーラ・坂本一民・國枝博信

座長 荒牧 賢治（11:00－12:10）

2F07 コロイド粒子により誘起される界面活性剤メソ構造の形態変化（お茶大人間文化）○菅沼有希子・今井正幸・馬渡理奈

2F08 酸化チタン膜上におけるポルフィリンJ会合体の可逆的配向変化と円二色性（阪大院工）○藤井祐介・塚原保徳・和田雄二

2F09 【依頼講演】分子スイッチによるリポソームソーティングの制御（奈良先端大院物質創成科学）○大槻理志・佐々木善浩・菊池純一

9月10日(土)

分子集合体の科学と技術

座長 坂口 豁（9:00－10:00）

3F01 SDS-牛血清アルブミン複合体の段階的成長（岡山理大工）○渡辺えみ・森山佳子・金沢優子・竹田邦雄

3F02 両性と陰イオン性界面活性剤の混合系における牛血清アルブミンの構造変化（岡山理大工）○AZAIMA RAZALI・岩本千賀・塊場勝仁・森山佳子・竹田邦雄

3F03 オリゴ（p-フェニレンビニレン）とポリエチレンオキシドから成るT字型ロッド-コイル分子の合成と自己集合性（徳島大工）○原田俊彦・平賀範之・森 健・南川慶二・田中正己

座長 竹田邦雄（10:00－11:00）

3F04 荷電デンドリマー溶液における多体相互作用ー分子動力学シミュレーション（岐阜大工）○寺尾貴道

3F05 アルキル部構造異性を利用したポリ（N-アシルデヒドロアラニンアルキル）水溶液の相転移温度の精密制御（徳島大工）○福島 功・小林 徹・森 健・南川慶二・田中正己

3F06 互いに構造異性な α,α-ジアミドビニルポリマー水溶液の相転移に関する研究（徳島大院工）○別府 卓・森裕紀・森 健・南川慶二・田中正己

座長 尾関寿美男（11:00－12:00）

3F07 界面活性剤水溶液中における高分子層の表面挙動（東京都立大理）○吉田早苗・藤井政俊・加藤 直

3F08 混合非イオン界面活性剤固体が形成する水和ゲルの構造（横国大院環境情報）○弓場三彩子・池田直哲・佐藤高彰・國枝博信

3F09 長鎖アミド誘導体の分子認識能とゲル化能（東理大工界面科研）○伊藤怜三・近藤剛史・河合武司

座長 河合武司（13:00－13:50）

3F10 【依頼講演】極限環境微生物の培養担体としての多孔質セルロース（海洋研究開発機構）○出口 茂・津留美紀子・辻井 薫・伊藤 進・掘越弘毅

3F11 新機能性 NIPA-PMDP ゲルの合成とキャラクタリゼーションおよびその機能（北大電子研）○厳 虎・辻井 薫

座長 出口 茂（13:50－14:30）

3F12 磁場下での化学架橋ゲルの挙動;膨潤度の増加と磁場誘起体積相転移（信大理）○大塚伊知郎・尾関寿美男

3F13 細胞間情報伝達物質の高分子ゲルシートへのトラップに基づくクオーラムセンシング制御（宇都宮大工）○加藤紀弘・諸星知広・田中 徹・中川翔太・池田 宰

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国際シンポジウム (International Symposium)

P001 What is the Stable Form of a Charged Bubble Suspended in Air? (Utsunomiya Univ., Japan) ○ IWASAKA, Tomomi・YONEMURA, Denjirou・YODA, Hidehiko・SUEZAKI, Yukio・KATO, Teiji

P002 Synthesis and Characterization of Rambutan-like Poly(methyl methacrylate)/Polyacrylonitrile Composite Latex Particles (Gunma Univ., Japan) ○ SHI, Shan・KURODA, Shin-ichi・KUBOTA, Hitoshi

P003 Synthesis and Characterization of Polyelectrolyte Grafted Charged Colloidal Particles using Block Copolymer as an Emulsifier (Department of Polymer Chemistry, Graduate School of Engineering, Kyoto Univ., Japan) ○ MOHANTY, Sundar Priti・HARADA, Tamotsu・MATSUMOTO, Kozo・MATSUOKA, Hideki

P004 Recovery of Mixed Surfactants from Water using Multi-Stage Foam Fractionator (Petroleum and Petrochemical College, Chulalongkorn Univ., Thailand) ○ TRIROJ, Manutchanok・CHAVADEJ, Sumaeth・MALAKUL, Phomthong・SCAMEHORN, John

P005 Diesel Removal from Wastewater by Froth Flotation with Colloidal Gas Aphon (Petroleum and Petrochemical College, Chulalongkorn Univ., Thailand) ○ANGKATHUNYAKUL, Panita・CHAVADEJ, Sumaeth・RANGSUNVIGIT, Pramoch・SCAMEHORN, John

P006 Detergency of Oily Soil by Microemulsion at Low Salinity (Petroleum and Petrochemical College, Chulalongkorn Univ., Thailand) ○ RATCHATAWADKUL, Pantipa・CHAVADEJ, Sumaeth・KITIYANAN, Boonyarach・TONGCOMPOU, Chantra・SCAMEHORN, John

P007 Synthesis and Properties of a Novel Surfactant Modified with Cycloamylose (Tokyo University of Science, Japan) ○ WONGTRAKUL, Paveena・ICHIGE, Hidetoshi・OYAIZU, Kenichi・YUASA, Makoto・OHKUBO, Takahiro・SAKAI, Hideki・ABE, Masahiko

P008 Direct Observation of PFPE Lubricant Molecules by Cryo-AFM under Ultrahigh Vacuum (Utsunomiya Univ, Hitachi Ltd., Japan・JEOL) TORITA, Naoyuki・NAKAKAWAJI, Takayuki・AMO, Mina・IIMURA, Ken-ichi・KATO, Teiji・SATO, Tomoshige

P009 Interfacial Tension Studies of Crown Ethers at Air/Water and Hexane/Water Interfaces (Bu-Ali Sina Univ., Iran・Kyushu Univ.) ○ SAEID, Azizian・KASHIMOTO, Kaoru・MATSUDA, Takashi・ARATONO, Makoto

一般シンポジウム

P010 AOT 逆ミセルナノ液滴中における銅イオンの水和構造解析（東理大理工）○安藤一行・大久保貴広・酒井秀樹・阿部正彦

総合セッション

P011 超臨界二酸化炭素逆ミセルの会合形態に及ぼす温度/圧力/水添加量の影響（弘前大理工・東理大理工・日大理工・産総研）○鷲坂将伸・小池大輔・酒井秀樹・越智健二・吉澤 篤・阿部正彦・大竹勝人

P012 透明導電性ガラスの作成と色素増感太陽電池への応用（福島工専物質工）○黒澤雄樹・鈴木大将・酒巻健司

P013 高極性オイルを用いた界面化学的乳化（富士写真フイルム先進コア技術研）○西見大成

P014 規則性マクロ多孔体を有する白金金属粒子の調製法（産総研・コンパクト化学プロセス）○峯 英一・白井誠之

P015 原子間力顕微鏡によるマイカ表面上のタンパク質分子の吸着状態の観察（筑波大数理物質）○木村繁人・栗田忠史・寺島 浩・高野 薫

P016 生体環境下で機能するPEG/オリゴカチオン安定化クレイナノ粒子の調製と評価（筑波大学際物質科学研究セ）○佐藤嘉秀・山田嘉明・高橋唯仁・長崎幸夫

005

Diesel Removal from Wastewater by Froth Flotation with Colloidal Gas Aphon

Ms. Panita Angkatbunyakul*
Sumaeth Chavadej*, Pramoch Rangsunvigit*, and John F. Scamehorn**

* *The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok, Thailand*
** *Institute of Applied Surfactant Research, University of Oklahoma, Norman, Oklahoma*

Froth flotation is a surfactant-based separation process suitable for treating dilute oily wastewater. From previous work, ultra low interfacial tension alone cannot be used as the sole criterion for froth flotation operation, as foam stability is also important in the process. In this work, it was hypothesized that foam stability can be enhanced by colloidal gas aphron (CGA). The objectives of this work were to study parameters affecting CGA formation and to determine the optimum conditions for maximum diesel removal in the froth flotation operation. Branched alcohol propoxylate sulfate sodium salt (Alfoterra 145-5PO) was used to form microemulsions with diesel oil. The effects of surfactant concentration, salinity, air flow rate, stirring time and stirring speed of CGA formation on foam characteristics and froth flotation performance were investigated. The CGA enhanced oil removal in the froth flotation operation because of higher foam stability and foam ability.

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Abstracts

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column, preferably separating them within a single chromatographic run. To identify unknowns in complex sample, MS compatible chromatographic conditions are required. Although a variety of HPLC columns are available and have been used for surfactant analysis, none provide optimal separation for anionic, nonionic, cationic, and amphoteric surfactants under the same and MS compatible chromatographic conditions.

In this paper, chromatographic methods were developed to separate anionic, nonionic, cationic, and amphoteric surfactants on a single column, using a simple and MS compatible mobile phase system, and within a single chromatographic run. The stationary phase provides multimode separation mechanism, and exhibits ideal selectivity and excellent peak shapes for different types of surfactants. The mobile phase system consists of ammonium acetate and acetonitrile. It is found that mobile phase ionic strength and pH are two important parameters for method optimization. Surfactant analysis of a series of consumer products, including laundry detergents, fabric softeners, mouthwashs, liquid soaps, shampoos, will be demonstrated on this new column.

Removal of Aromatic Contaminants from Wastewater by Continuous Cloud Point Extraction in a Multi-Stage Rotating Disc Contactor. Phanphat Taechangam*[1], Somchai Osuwan[1], Thirasak Rirksomboon[1], and John Scamehorn[2], [1]*The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok, Thailand*, [2]*Institute for Applied Surfactant Research, University of Oklahoma, Norman, Oklahoma, USA*.

Cloud Point Extraction (CPE) has been successfully scaled up to continuously remove aromatic contaminants from a wastewater stream in a multi-stage rotating disc contactor (RDC). This work mainly focuses on the improvement in the efficiency of this cloud point extraction unit for toluene removal from the wastewater stream by using t-octylphenolpolyethoxylate nonionic surfactant. When the nonionic surfactant solution has a temperature higher than the certain temperature known as cloud point, phase separation occurs. The micellar rich phase, or coacervate phase, and the micellar dilute phase are formed. Toluene contained in the wastewater will solubilize into the surfactant micelles and concentrate in the coacervate phase during the phase separation so that the dilute phase containing less concentration of toluene can be released to the environment as treated water. In this contribution, the optimal condition has been determined by varying the wastewater and surfactant feed flow rates, rotating disc speed, and operating temperature. It was observed that up to 99% of toluene extraction can be accomplished at the following conditions: 18.2 ml/min of wastewater flow rate; 1.47 ml/min surfactant flow rate; 100 rpm rotating disc speed; 40°C operating temperature; and, 100 ppm of toluene concentration in the wastewater feed. However, the detailed study will be performed further to achieve the highest efficiency of the operating unit. The effect of concentrations of toluene in the wastewater feed on the cloud point extraction is discussed in this paper. It was found that the cloud point extraction performance decreased as the concentration of toluene in the wastewater feed increased. Finally, it was noted that the entrainment of surfactant to the dilute phase also had to be a concern.

The Oily Treatment by Continuous Froth Flotation: Foam Characteristics. Sunisa Watcharasing*[1], Sumaeth Chavadej[1], and John F. Scamehorn[2], [1]*The Petroleum and Petrochemical College, Chulalongkorn University, Bangkok, Thailand*, [2]*School of Biological, Chemical and Materials Engineering, University of Oklahoma, Oklahoma, USA*.

Froth flotation is one of surfactant-based separation processes which is suitable for treating dilute oily wastewaters. The objective of this study is to investigate the relationship between both the low IFT and foam characteristics to the efficiency of cutting oil removal by continuous froth flotation process. Single surfactant systems (branched alcohol propoxylate sulfate, sodium salt, Alfoterra 145-5PO and sodium dodecyl sulfate, SDS) and a mixed surfactant system (Alfoterra 145-5PO and sodium bis-2-ethylhexylsulfosuccinate, AOT) are used to form microemulsions with cutting oil. In froth flotation experiment, the effects of surfactant concentration, salinity, air flux, foam height, and hydraulic retention time (HRT) on the oil removal will be studied. To obtain a better understand of flotation process, ability of foam formation and foam stability will be studied. In addition, the dynamic surface tension and interfacial tension will be measured.

Toluene Removal from Nonionic Surfactant Coacervate Phase Solution by Vacuum Stripping. Suratsawadee Kungsanant*[1], Boonyarach Kitiyanan[1], Thirasak Rirksomboon[1], Somchai Osuwan[1], and John F. Scamehorn[2], [1]*The Petroleum and Petrochemical College, Chulalongkorn University, Pathumwan, Bangkok, Thailand*, [2]*Institute for Applied Surfactant Research, University of Oklahoma, Norman, OK, USA*.

Cloud point extraction (CPE) is an aqueous-aqueous phase extraction induced by addition of nonionic surfactants above their cloud point to water. It is critical to the economics of the process to recover the surfactant for recycle from the coacervate (concentrated surfactant solution) from the extraction column. This study utilized a continuous bench-scale flash vacuum column to strip out toluene from a coacervate phase containing t-octylphenolpolyethoxylate. The column was a differential stripper packed with glass Raschig rings and operated under rough vacuum. The equilibrium vapor-liquid partition coefficient for the toluene in the coacervate phase was measured and used to evaluate transfer unit properties in the co-current flash vacuum stripping. The apparent Henry's constant in the coacervate phase is lower than that in water due to partitioning of toluene in surfactant micelles. The liquid loading rate increases with decreasing fractional removal of toluene. The value of mass transfer coefficient increases significantly as harder vacuum is used, particularly at pressures lower than 70 torr. Effect of liquid distributor design on the mass transfer coefficient is also discussed.

S&D 2.1: Industrial Applications of Surfactants, Part I

Chairs: M. Rosen, Surfactant Research Institute, Brooklyn College, City University of New York, USA; and T.-C. Jao, Afton Chemical Corporation, USA

Characterizing the Behaviour of Individual Ethylene-Propylene Copolymers in Solution Using Fluorescence. M. Zhang and J. Duhamel*, *University of Waterloo, Waterloo, ON, Canada*.

The behaviour of individual ethylene-propylene (EP) copolymers in solution is investigated. The study focuses on maleated EP copolymers where the succinic anhydride is used to covalently attach a fluorescent probe onto the polymer, typically 1-pyrenemethylamine, which results in the formation of succinimide moieties. Taking advantage of the sensitivity of fluorescence, polymer solutions containing as little as 0.02 g/L of EP copolymer were studied. In apolar solvents, the polar succinimides aggregate and the level of aggregation between the pyrenyl pendants can be determined. Since the polar succinimide linkers drive the associations in an apolar solvent, the fraction of aggregated pyrenes reflects the level of aggregation between succinimides. Interestingly, adding an aromatic compound such as toluene to the apolar solvent melts the associations between the succinimide moieties. This fluorescence-based procedure can also be used to determine the distribution of maleic anhydride distributed along a maleated EP copolymer. Based on the expertise developed with the above systems, the study of the crystallization of individual EP chains was undertaken in toluene. A semi-crystalline and an amorphous EP copolymers were maleated and labelled with pyrene. Fluores-

第５９回
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講演要旨集

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会期　２００６年９月１３日(水)～１５日(金)

会場　北海道大学　高等教育機能開発総合センター

主催　日本化学会コロイドおよび界面化学部会
共催　北海道大学21世紀ＣＯＥプログラム「バイオとナノを融合する新生命科学拠点」

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後援　（財）花王芸術・科学財団　（財）札幌国際プラザ

子膜構造(山形大工・埼玉大理)○藤森厚裕・星沢裕子・舛屋諒介・増子徹・中原弘雄

3G13 高分子ナノシートによる自己保持型薄膜の作製について(東北大多元研)三ツ石方也・○遠藤洋史・宮下徳治

H 会場

9 月 13 日(水)

シンポジウム 4 (光ー分子強結合反応場形成を目指して)

座長 武井孝(11:00ー12:10)

1H01 【依頼講演】光ー分子強結合反応場の形成・制御(北大電子研・JST-CREST)○三澤弘明

1H02 感熱応答性高分子のパルスレーザー誘起相分離(北大院理)○坪井泰之・吉田康弘・岡田健作・喜多村昇

1H03 ランダム構造を用いた光反応場への応用(北大電子研)○藤原英樹・笹木敬司

座長 山田淳(13:10ー14:20)

1H04 【依頼講演】金属ナノ粒子の精密構造制御と光物性(筑波大院数理物質科学)○寺西利治

1H05 酸化チタン単結晶表面における銀ナノ粒子の析出と多色フォトクロミズム(東大生研)○立間徹・松原一喜

1H06 球状メソポーラスシリカ粒子/チタニアナノシート複合薄膜の作製と光誘起電子移動(名大院工・豊田中研)○小林由佳・由井樹人・矢野一久・山田有理・岡崎健一・福嶋喜章・高木克彦・鳥本司

座長 三澤弘明(14:20ー15:10)

1H07 【依頼講演】高規則ポーラス構造によるナノ・マイクロ空間の形成と光機能化(首都大都市環境)○益田秀樹・西尾和之

1H08 単分子膜リソグラフィによるナノオブジェクトの自在空間配置(京都大学大学院工学研究科材料工学専攻)○杉村博之

座長 岡崎健一(15:30ー16:40)

1H09 【依頼講演】電場増強金ナノ構造の化学的設計と光エネルギー変換への応用(九大院工)○山田淳

1H10 局所増強電場による少数分子の検出・制御(北大院理)高瀬舞・沢井良尚・○村越敬

1H11 構造敏感な単層カーボンナノチューブの光応答を利用した集積法の開発(科学技術振興機構・北大院理)○武田憲彦・村越敬

I 会場

9 月 13 日(水)

国際シンポジウム

座長 阿部正彦(09:30ー10:50)

1I01 [Invited] Advanced Surfactant Microemulsions: Technology Development/Application (The University of Oklahoma, USA) ○SABATINI, David. A.

1I02 [Invited] Continuous Froth Flotation to Remove Cutting Oil from Wastewater (Chulalongkorn University, Thailand) ○ CHAVADEJ, Sumaeth; LAPEE-A, Alweeya; WATCHARASING, Sunisa; RANGSUNVIGIT, Pramoch; SCAMEHORN, John

1I03 Foaming Properties of Mono and Diglycerol Fatty Acid Esters in Different Nonpolar Oils (Yokohama National University, Japan) ○ SHRESTHA, Lok; KATO, Hiroyuki; TAKASE, Yoshihiko; ARAMAKI, Kenji

座長 Jin Jian(10:50ー11:50)

1I04 Strategies to Control the Properties and Placement of Phosphonate Inhibitor in Oil Reservoir (University of Michigan, Michigan, USA; Chulalongkorn University, Thailand; Tokyo University of Science, Japan) ○ TANTAYAKOM, Veerapat; FOGLER, Scott H.; CHAVADEJ, Sumaeth

1I05 Formation of Wormlike Micelle in a Mixed Amino-Acid Based Anionic Surfactant and Cationic Surfactant Systems (Yokohama National University, Japan) ○ SHRESTHA, Rekha; SHRESTHA, Lok; ARAMAKI, Kenji

1I06 Effects of Additives on the Internal Dynamics and Properties of Reverse Micellar Formulations (Panjab University, India) MEHTA, S.K.; SHWETA, Sharma

座長 高草木達(13:00ー14:40)

1I07 Formation of Viscoelastic Micellar Solution in Nonionic Fluorinated Surfactant Solution (Yokohama National University, Japan) ○ SHARMA, Suraj Chandra; ACHARYA, Durga P.; ARAMAKI, Kenji; KUNIEDA, Hironobu

1I08 Free-Standing Inorganic Thin Films Prepared by Dried Foam Films (National Institute for Materials Science, Japan) ○JIN, Jian; ICHINOSE, Izumi

1I09 Convectional, Sedimentation and Drying Dissipative Structures of Colloidal Dispersions (Yamagata University, Japan) ○OKUBO, Tsuneo

1I10 Dispersion Stability of Colloids in Supercritical Fluids (Japan Agency for Marine-Earth Science and Technology, Japan) ○GHOSH, Swapan; DEGUCHI, Shigeru; TSUJII, Kaoru; HORIKOSHI, Koki

1I11 Fractality controlled porous silica with a designed template method (Hokkaido University, Japan) ○ MAYAMA, Hiroyuki; TSUJII, Kaoru

座長 大塚俊明(14:40ー16:10)

1I12 Spontaneous Formation of Fractal Structures on a Wax Surface and Its Super Water-Repellency (Hokkaido University, Japan; CREST-JST) ○ FANG, Wenjun; MAYAMA, Hiroyuki; TSUJII, Kaoru

1I13 [Invited] Plasma Electrolytic Oxidation of Aluminum (Korea Institute of Machinery and Materials, Korea) ○ MOON, Sung-Mo; PARK, Pyung-Youn; JEONG, Yongsoo

1I14 Micropatterning and Area Selective Metallization on Anodic Oxide Film of Aluminum by Laser Irradiation (Hokkaido University, Japan) ○ JHA, Himendra; KIKUCHI, Tatsuya; SAKAIRI, Masatoshi; TAKAHASHI, Hideaki

1I15 Corrosion Prevention of Steel by using Conductive Polypyrrole Coating (Hokkaido University, Japan) ○ KOWALSKI, Damian; UEDA, Mikito; OHTSUKA, Toshiaki

座長 阿部竜(16:10ー17:50)

1I16 [Invited] Hydrogen Storage on Modified Graphite: Effect of Metal Loading and Milling Time (Chulalongkorn University, Thailand) ○ RANGSUNVIGIT, Pramoch; JANNATISIN, Visara; SUTTISAWAT, Yindee; KITIYANAN, Boonyarach; KULPRATHIPANJA, Santi

1I17 Photocatalytic Degradation of Dye Using Nano-TiO_2 Immobilized on Activated Carbon (Burapha University, Thailand) ○NGAOTRAKANWIWAT, Pailin

1I18 Preparation and elastico-luminescence of highly crystalline nanoparticles of europium-doped strontium aluminate (National Institute of Advanced Industrial Science and Technology, Japan) ○LI, Chengzhou; IMAI, Yusuke; ADACHI, Yoshio; NISHIKUBO, Keiko; TERASAKI, Nao; SAKAI, Kazufumi; YAMADA, Hiroshi; XU, Chao-Nan

1I19 [Invited] Preparation and Characterization of Surfactant-modified Polymeric Films for Potential Use in Biomedical Applications (Chulalongkorn University, Thailand) RUJIRAVANIT, Ratana; PORNSUNTHORNTAWEE, Orathai; WONGPANIT, Panya; CHAVADEJ, Sumaeth

9 月 14 日(木)

国際シンポジウム

座長 Olaf KARTHAUS (09:00ー10:20)

2I01 [Invited] Friction and Lubrication of Hydrogels (Hokkaido University, Japan) ○GONG, Jian Ping; OSADA, Y

2I02 [Invited] In-situ Investigation of Molecular Diffusion in Hydrogels (ICCAS, CAS, China) ○XU, Jian; WENG, 1102

Continuous Froth Flotation to Remove Cutting Oil from Wastewater

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Pramoch Rangsunvigit*, and John F. Scamehorn**

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Froth flotation, a surfactant-based separation process, is suitable for treating dilute oily wastewaters. The objective of this study was to investigate the relationship between the ultra-low interfacial tension (IFT) and the efficiency of cutting oil removal from water using continuous froth flotation process. Branched alcohol propoxylate sulfate sodium salt(Alfoterra 145-5PO) and sodium bis(2-ethylhexyl) sulfosuccinate (AOT) were used for microemulsion formation with cutting oil. Surfactant concentration, salinity, and oil-to-water ratio were varied in the microemulsion formation experiments in order to determine the compositions required to obtain the ultra-low IFT conditions which were selected for running froth flotation experiments. For the froth flotation experiments, the effects of surfactant concentration, salinity, foam height, air flow rate, hydraulic retention time (HRT), and adding polyelectrolyte on the oil removal were investigated. From the results, the maximum oil removal efficiency of the froth flotation process was found not to correspond to the minimum IFT of the system. Interestingly, foam stability was revealed experimentally to be another crucial factor affecting the performance of forth flotation. Sodium dodecyl sulfate SDS) was added to improve both foamability and foam stability in the continuous froth flotation operation. The system with 0.1 wt.% SDS, 5 %wt.% NaCl, 0.15 L/min air flow rate, 30 cm foam height and 60 min HRT gave a maximum oil removal of 96 %.