ChE Graduate Seminar Series

Departmental Seminars Presented by Ph.D. Students

Washing Kinetics and Dynamics of Pollution Preventing Microemulsion and Biliquid Foam Inks

Sudheshna Moka (Advisor: Prof. A. N. Bhaskarwar)

22 August 2013, Thursday, 0400-0425 pm (15+10 mins), ChE Seminar hall

In an effort to reduce the pollution from the printing industry, there have been recent developments in the formulation of new vegetable oil based inks which eliminate the use of VOCs and can be washed by slightly alkaline water. Inks based on microemulsions have also been reported to reduce the pollution, while there are studies going on, on the use of biliquid foams. These are one step ahead in that they are washable by plain water. However the rate of washing or rather the 'emulsification' of these inks is a slow process and it is imperative to understand the washing kinetics of these inks in order to try and reduce the time taken for their washing.

A very interesting phenomenon has been observed while studying the washing kinetics of microemulsion inks. When a drop of this ink is dropped on the surface of water, it spreads instantly and breaks up forming a network pattern on the water surface. This behavior may be one of the first reported in microemulsions. The pattern formation is a beautiful problem in itself and it not only draws the attention of a curious researcher but also holds the key for innumerable potential applications. A thorough experimental as well as theoretical study of the various forces and factors that together result in such an amazing pattern formation can unlock the key to controlling the pattern formation which can then be harvested for many applications. Some of the key experimental findings and clues to possible theoretical explanations are presented.

Separation of Sulfur Compounds from Gasoline Fuel by Pervaporation

Manish Jain (Advisor: Prof. S. K. Gupta)

22 August 2013, Thursday, 0425-0450 pm (15+10 mins), ChE Seminar hall

Removal of sulfur compounds from petroleum products, particularly from transport fuels like gasoline and diesel, is a challenging task. In recent years, Pervaporation is being investigated for separation of sulfur compounds from different petroleum products. In this process sulphur compounds can be preferentially removed from the gasoline due to their higher affinity and quicker diffusivity in a membrane.

In this study, PDMS based spiral wound pervaporation membrane module has been used for removal of sulphur containing compound from different model compounds of gasoline. Typical sulfur components present in gasoline include mercaptans, sulfides and thiophene. Most of the mercaptans and sulfieds can be removed easily by traditional processes such as Hydrodesulfurization and Merox process. However, thiophene and its derivatives are heterocyclic compounds so they are less reactive and difficult to remove. Thus, Thiopheneshave been selected as the main model component for sulphur containing compounds. Experiments were conducted at different operating conditions(permeate pressure, feed flow rate, feed concentration and feed temperature) and the module performance was analysed by selectivity of thiophene and total recovery from retentate stream.

Variation of operating conditions along the module have been considered by developing a transport model by using material, energy and momentum balance along the module for both feed and permeate channel. The model was used for estimating the mass-transfer coefficients of different compounds in the membrane. Furthermore, the transport model was successfully validated for variety of experimental results.

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Thiophenes were successfully removed from different model compounds of gasoline. Results shows thatthe selectivity of thiophene and recovery were strongly dependent on molecular size and structure of the model compounds due to their different affinities and diffusivities in the membrane. Low permeate pressure, high feed temperature and high feed flow rate were found as the preferential operating conditions. Results also indicated that module performance declinedwith decrease inthiophene concentrationin the feed which may be due to increase in boundary layer resistance at the membrane surface and also decrease of membrane swelling.

Euler-Lagrange Simulations of Dispersed Gas-Liquid Flows in a Rectangular Bubble Column

Parul Tyagi (Advisor: Dr. Vivek V. Buwa)

22 August 2013, Thursday, 0450-0515 pm (15+10 mins), ChE Seminar hall

Bubble column reactors are involved in variety of chemical, biochemical and pharmaceutical processes. Extensive efforts have been made in last few decades to verify computational models capable of predicting the dynamics and time-averaged flow behaviour of dispersed gas-liquid flows in bubble columns using continuum (Euler-Euler) and discrete bubble (Euler-Lagrange) approaches. This work presents experimental and numerical investigations performed in a small rectangular bubble column to understand the role of bubble size-dependent drag and lift forces on dynamic and time-averaged flow properties of dispersed gas-liquid flow. Experiments were performed to measure instantaneous fluctuations and time-averaged profiles of gas volume fraction using “in-house” developed voidage probes. Images obtained using high speed camera were used to visualize the meandering motion of bubbles and to calculate bubble size and bubble rise velocity. Superficial gas velocity ranging from 0.16 - 0.73 cm/s was used throughout both in the experiments and simulations. Euler-Lagrange approach is found suitable to simulate the dispersed gas-liquid flow in a small rectangular column because gas volume fraction distribution predicted using coarse grid Euler-Euler simulations often lead to numerical diffusion, in particular to that of the gas phase. Most importantly, the use of Euler-Lagrange approach has allowed to introduce the bubble size distribution and to show how the bubble size-dependent drag and lift forces could affect the gas volume fraction distribution over the column cross-section. This study shows the effect of various important numerical parameters and schemes and the role of size-dependent drag and lift forces on the gas volume fraction distribution in bubble column. A detailed comparison of predicted instantaneous fluctuations in the gas volume fraction and time-averaged gas volume fraction profiles for each bubble size group with the measurements will be useful to establish the effect of bubble size distribution and size-dependent drag and lift forces on the dynamic and time-averaged flow behavior of dispersed gas-liquid flows.

0515 pm High Tea

CC
All ChE Faculty
Department N. B.
PhD Students (near biometric device)
Mr. Krishna (for audio/video help)
ChE office: refreshment arrangements
Ms. Tajinder: for information/coordination