Chemical and Petroleum Engineering

SEMINAR NOTICE

Laurence Weatherley

Chemical & Petroleum Engineering
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Laurence Weatherley is the Albert P Learned Distinguished Professor of Chemical Engineering at the University of Kansas. Weatherley received his PhD from the University of Cambridge in Chemical Engineering for research on ion exchange kinetics in macroporous resins. Research interests extend to intensification of liquid-liquid processes, and to enzyme immobilization involving novel ion exchange resins and other recently developed polymers. He has published over 250 research papers, articles, conference papers and other contributions. Prior to coming to the US in 2004, Dr Weatherley held positions in the British nuclear industry, and at universities in Scotland, Ireland, and New Zealand. Dr Weatherley is a chartered professional engineer (UK), is a Fellow of the Institution of Chemical Engineers, United Kingdom, and is a Fellow of the Institution of Professional Engineers of New Zealand. He also holds a visiting Professorship at the Lodz University of Technology, Poland. Dr Weatherley sits on the editorial boards of Chemical Engineering and Processing, and the Chemical Engineering Journal. He was executive co-editor of the Chemical Engineering Journal for 10 years until 2010. In May 2020, his recent book, Intensification of Liquid – Liquid Processes was published by Cambridge University Press.

Electrically intensified reactions at liquid-liquid interfaces

Abstract

The chemical industry in the United States contributes about 26% of national GDP and is involved in the production of 94% of all manufactured goods. 10% of all US energy use goes to separation of chemicals by distillation. So one of the major quests for chemical engineers is how can we intensify chemical separation processes and make them more efficient. Are there other alternatives to distillation? The chemical and process industries worldwide include many different products and processes ranging from bulk hydrocarbon liquids, solvents, fertilizers, and polymers, through to highly sophisticated low-volume, high value products such as fibers, personal care products, pharmaceuticals, vaccines, antibiotics, anti-cancer compounds, high performance coatings, nuclear fuels, and electronic materials. A common theme for nearly all of these is a need for product separation and purification. This talk is about separation and reactions involving two non-miscible liquids. The talk will be in six parts: (i) Process Intensification. (2) Dispersions in liquid-liquid systems and the role of electric fields. (3) Interfacial disturbance by electric fields. (4) Electric Fields, Interfaces and Immobilized Enzymes. (5) Enhancement of phase transfer catalysis using electric fields. (6) Conclusions.

Process intensification is the development of small, highly efficient methods of processing which take up less space, use smaller amounts of hazardous chemicals, and are suited to the application of new "green" chemistry such as exploitation of new equipment technology, catalysts, and renewable resources. The talk will focus on liquid–liquid systems which are important for chemical separation, and for hosting chemical reactions. The ability to produce intensified dispersions in a liquid-liquid system using electrical fields will be demonstrated. The application to an enzymatic hydrolysis reaction in an oil /aqueous system will be discussed. The role of how electrically induced disturbances at the boundary between the two liquids can contribute to process intensification is also summarized. Enhanced rates of extraction and reaction occurring across or at the boundary are demonstrated thus providing an example of process intensification. In some cases, rates can be up to ten times faster than if there is no electrical field involved. We have developed modelling tools to predict performance of an electrospray reactor, also to model visual disturbance patterns at a liquid-liquid interface and corresponding mass transfer rates. Simulations based on rigorous numerical solutions of the controlling equations were successfully validated with experimental data. The potential for electrically induced enhancement of other reaction systems involving liquid-liquid interfaces such as in the case of phase-transfer catalysis is highlighted. Overall, our approach has the potential to develop smaller equipment using less energy to improve reaction and separation performance.

Tuesday, March 9th | 1:00 – 1:45PM

Zoom Meeting: 998 8566 6254 | Passcode: 560824