הטכניון - מכון טכנולוגי לישראל

TECHNION - ISRAEL INSTITUTE OF TECHNOLOGY

הפקולטה להנדסה כימית
ע"ש וולפסון
The Wolfson Department of Chemical Engineering

Wolfson Department of Chemical Engineering Seminar

Lecture Hall 6, Wolfson Department of Chemical Engineering,

20th April, 2016 at 13:30

Elad Dor

Supervisors Prof. S. Brandon and Prof. Emeritus A.Marmur

Separation process based on surface tension

The need for effective, stable and economically viable separation processes for non-soluble mixtures is on the rise as the production rate of chemical products is increasing while environmental regulations are becoming tighter. Conventional separation processes such as fractional distillation or membrane-based methods are expensive since the energy, in the form of heat or applied pressure, is invested in the entire solution. As an alternative approach, surface tension based membrane separation involves a membrane in which the material surface tension is determined in order to achieve separation. These membranes will reject one (or few) of the mixture components while allowing one component to pass through. The penetration of the desired component into the membrane is favored and therefore the required pressure difference is very moderate. The separation process may thus be addressed in an effective and economical way.

Most of the work published in this area is experimental and lacks a theoretical basis and may therefore be limited in its relevance. In order to cope with this problem, the fundamental mechanism of surface tension based membrane separation should be explored. The accepted model for this separation, denoted as drop model, is focused on transfer of single drops through the membrane. We explored this accepted model and expanded it by considering a membrane whose (two) surfaces exhibit different surface energy values, by adding gravity effects, and by investigating the impact of non-ideal (chemically heterogeneous) surfaces on the process. Our analysis shows that this drop model fails to explain surface tension based separation. In addition, we discovered that the equilibrium drop location between two fluids "moves" in contradiction to the pressure gradient. Physical and mathematical explanations were derived for this surprising phenomenon.
As a consequence of the drop model's unrealistic nature, an alternative theoretical model for surface tension based separation was derived. According to this model, the membrane is coated with a thin liquid layer which absorbs and rejects liquid drops. The concept of this model was examined and demonstrated. According to this alternative model, additional experimental observations such as drop enlargement and separation in the presence of surfactant can be easily explained.

Refreshments served at 13:15