X Encontro Brasileiro sobre Adsorção
27 a 30 de Abril de 2014
Guarujá - SP

HYBRID ADSORPTION/REACTION PROCESSES: SIMULATED MOVING BED REACTOR (SMBR) AND PRESSURE SWING ADSORPTIVE REACTOR (PSAR)

Alírio E. Rodrigues

Laboratory of Separation and Reaction Engineering, Department of Chemical Engineering, Faculty of Engineering, University of Porto
Phone: (351) 225081671 – Fax: 00 (351) 225081674 – Email: arodrig@fe.up.pt

ABSTRACT: Today's chemical engineering is represented by the diamond ChE=M2P2E with corners of Molecular, Materials, Process and Product Engineering. Process Intensification through the combination of reaction and sorption will be the focus of this presentation. Chromatographic reactors to be discussed here address various cases applied to different areas: i) green fuels (acetals) and solvents (ethyl lactate), and ii) hydrogen production from methane or ethanol steam methane reforming with carbon dioxide capture. These cases cover liquid phase processes as well as gas phase processes involving two technologies: Simulated Moving Bed Reactor (SMBR) for the first examples and Pressure Swing Adsorptive Reactor (PSAR) for the last example of Sorption Enhanced Reaction Process (SERP).Acetals are green fuels to be blended in diesel. In my laboratory we studied the synthesis of 1,1 diethoxyethane (DEE), 1,1-dimethoxymethane, acetaldehyde dibutyl acetal (DBE), glycerol acetal (GEA) and diethoxybutane (DEB). The synthesis involves equilibrium-limited reactions catalysed by acid resins which are also selective for water. The equilibrium is displaced towards the formation of acetal which is recovered in the raffinate stream of the SMBR. This technology was experimentally tested and patented. Recently, process re-intensification was proposed in the Simulated Moving Bed Membrane Reactor (PermSMBR)3, where two separation processes are included: SMB and Pervaporation. Sorption Enhanced Reaction Processes (SERP) for hydrogen production with CO2 sorption in situ follows the pioneer work done at Air Products and has been applied in our lab to the steam reforming of methane and ethanol, using hydrotalcite based sorbents.

KEYWORDS: Hybrid processes, Chromatographic reactors, Process intensification, SMBR, SERP