RESAERCH INTO MOLECULAR SEPARATIONS USING MEMBRANES AT IMPERIAL COLLEGE

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Organic liquids are ubiquitous in chemical science based industries, which range in scale from refining to pharmaceutical production. It is generally accepted that 40-70% of capital and operating costs in these industries are dedicated to separations; and a substantial fraction of this cost is related to processing of organic liquids, both as product streams and solvents. Membrane technology has the potential to provide game changing alternatives to conventional concentration and purification technologies such as distillation, liquid extraction, adsorption and chromatography. The obvious benefits of membrane processing have been apparent for many years, and have attracted research, development and commercialisation efforts from academic groups, end users, and membrane suppliers. In the last few years these efforts have resulted in Organic Solvent Nanofiltration (OSN) emerging as a new membrane technology.

This presentation will describe some key recent research activities in the Livingston group at Imperial College London into OSN. These include: (i) formation and function of new OSN membranes based on Polyetheretherketone (PEEK); Tthese have outstanding chemical resistance and can be applied to acidic and basic organic solutions at elevated temperatures; (ii) Formation of thin film nanocomposite (TFN) membranes embedding 50-150 nm MOF nanoparticles [ZIF-8, MIL-53(Al), NH_2-MIL-53(Al) and MIL-101(Cr) via interfacial polymerisation on top of a cross-linked P84 support. MOF nanoparticles were homogeneously distributed in the polyamide layer, and their presence was inferred by a combination of measurements. TFN membranes showed dramatically increased MeOH and THF permeances when compared to the same membranes with no MOFs added, without sacrificing rejection. A direct trend was observed between the MeOH permeance and the porosity of the MOFs, suggesting preferential flow paths provided by the MOF pores

Simulation and process design allied to validation using spiral wound module data allows the prediction of process performance. There are a growing number of applications of OSN to industrial separation problems, and two main areas will be highlighted, the purification of pharmaceutical API, and the formation of peptides and oligonucleotides using OSN technology.

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