

RESAERCH PROJECTS 2008

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The Department of Chemical Engineering at Imperial College in London is rated by the periodic Research Assessment Exercise as the top research department in Chemical Engineering in the UK, and **Separations Engineering and Technology** is a highly active research focus area in the Department. AGL leads a group of around 15-20 Post-Docs-PhD -Visitors/MSc/Final Year Students in this area. The group is funded by a combination of industry (mainly pharmaceutical and fine chemical companies), UK Research Councils and European Community sources, and is a part of the NanoMemPro European Network of Excellence in Membrane Science and Technology. Projects typically involve both experimental and theoretical (computer modeling based) research.

1. Organic Solvent Nanofiltration - Materials Synthesis, Membrane Formation Membrane Engineering

Solvent resistant nanofiltration membranes can discriminate between molecules in the MW range 200-1000. Building membranes which have the required nanostructure to effect these separations is an ongoing challenge. Projects in this area include:

- Development of new OSN membranes (polymeric and ceramic) and comparison of their performance with commercially available materials;
- Fundamental experimental and modeling studies of the transport mechanisms through OSN membranes;
- Membrane engineering including design and fabrication of membrane modules.

2. Organic Solvent Nanofiltration – Applications

Organic Solvent Nanofiltration (OSN) is changing the way reactions and separations are approached in the chemicals/fine chemicals/pharmaceuticals industry, where energy intensive distillation processes and complex solvent work-ups are the traditional norm.. We work on:

- Recycle of catalysts, and integration of reaction and separation in membrane reactors
- Solvent operations such as solvent exchanges and fractionation
- Structured chemical reactors
- Novel separation process flowsheets and development of membrane processes as (continuous) alternatives to traditional separations (distillation, chromatography)

3. Membrane Separations in Bioprocess Technology

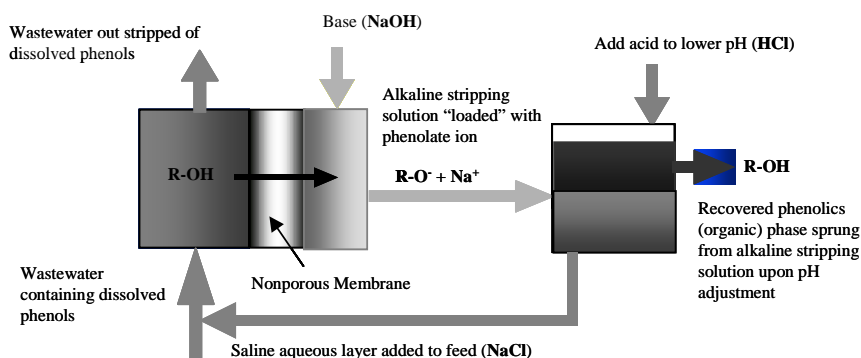
Ongoing projects involve:

- Biotransformations using either whole cells or enzymes are coupled to separation of products from these reactions using membranes permeable to products and reactants.
- Extraction of specific species from fermentation systems using selective, non-porous membranes and molecular recognition. Examples include removal of organic acids from fermentations, and recovery of high value natural products produced by algal fermentations.

4. Technology for Peptide and Oligonucleotide Production

A new generation of drugs based on biomolecules (peptides, oligonucleotides) will come to market in the next 20 years. The technology for manufacturing many of these materials is based on solid phase synthesis and involves cumbersome separations. This project area focuses on developing new processes for the chemical manufacture of biomolecules, based around improving the separation processes that are central to their synthesis and integrating these with reaction processes.

5. Membrane Aromatic Recovery System (MARS)



The MARS process recovers organic compounds which possess acid or base functionality (organic acids and bases, AAB) by extracting them across a non-porous membrane and concentrating them as ionised salts prior to recovery through pH adjustment. The process is thus able to recover and re-use materials which in most other technologies, such as biodegradation, are destroyed. Research areas include:

- Developing new membranes including composite membranes based on porous supports covered with a thin separating layer which are able to improve the efficiency of extraction;
- Developing new applications of the process, ie to separations of mixtures of organics and to recovery of amino acids and other molecules

6. High Value Natural Products – Extraction and Purification

Over the past decade there has been an enormous increase in consumers' expectation, knowledge and understanding of the quality, safety and efficacy of many products, including food, cosmetics and medicines. In particular, there has been a strong consumer preference for products made from natural rather than synthetic sources (i.e. plant, animal or microbial sources). There is a popular belief that products derived from natural materials are inherently good and better than their synthetically manufactured equivalents. This manifests itself as a rapidly growing consumer demand for natural remedies and organic products. A new area of research in the AGL group is the development of extraction and purification technologies for recovery of high value natural products using a combination of extraction and membrane fractionation.

7. Membrane Processes for Desalination

The supply of fresh water is critical to life, and as the earth's population grows there is an increasing demand for technologies to provide fresh water. We are investigating membranes and membrane processes for water production via desalination.