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Editorial

A range of topics are covered in this special issue of the Journal on the Theme of Environmental Processes. Any title containing the word environmental could suggest a wide constituency of interests but here we see a range of high quality scientific contributions of direct interest to chemical and process engineering activities. The quality and scope of the papers signal very clearly a positive and in-depth approach to the scientific and technological agenda surrounding environmental issues in chemical engineering.

The chemical and process industries are often perceived as significant creators of pollution and this is frequently over-emphasised relative to the enormous and manifold benefits which the industry has brought society. The environmental impact of chemical engineering should not always be seen in terms of pollution and discharges but rather should also be viewed by the enormous positive contribution made over many years of large scale process product manufacture. This has been in areas including health-care, efficient energy production, packaging, soaps and detergents, production of engineering materials for transport systems, fibres, and so forth. The responsible approach to the vast majority of environmental matters adopted by chemical engineering practitioners over very many years in these industries is underlined by the forward thinking agenda of research which is funded and supported.

The requirement of best available technology for environmental management of processes is now widely adopted in the legislative requirements of many countries. Implicit in the fulfilment of this requirement is investment in research and the chemical and process sector is generally a leader with regard to their receptiveness to new ideas and innovations in both cleaner technology and novel environmental treatment technology. In this respect, the chemical and process industries, because of their capital intensive nature, have an added incentive for understanding better fundamentally how their processes and equipment perform, since it is not always feasible to consider implementation of a brand new idea or concept. Therefore in this special issue we have no difficulty whatsoever in including some examples of fundamental research which is on-going around the world in process industry related topics.

The work on adsorption described by *Dr. Anna Wolborska* into fundamental diffusional mechanisms and modelling falls into this category and describes a novel analysis of the initial portion of breakthrough curves exhibited by fixed bed adsorbers for removal of pollutants from aqueous solutions. The technique throws significant light on some of the transport phenomena regulating adsorption rate at this point in the cycle.

We also include work dealing with novel systems for separation and recovery of effluent products. Despite the major thrusts to adopt newer and cleaner technologies, where this is feasible, there is still tremendous interest in novel waste-water treatment concepts and techniques. Despite the long term desirability to move along the continuum of treatment reduction minimisation zero waste generation there is still a major role for research and development into treatment techniques even if these still produce a waste stream requiring either further treatment or disposal.

There is also interest in the many examples of novel treatment systems being developed which involve the separation and recovery of useful and valuable by-products. We have included five papers which, though quite different in individual theme, describe and explore commercially untried new treatment techniques. For example the use of ultrasonics to reduce the toxicity of waste by pre-oxidation prior to biological treatment is one such novel process described in the paper by *Gonze et al*. The paper by *Scott et al*. also underlines the potential for extraction of value from waste streams using a novel approach. They describe an electrochemical engineering development to produce sulphuric acid from SO_2 derived from flue gas streams by a novel enhanced electrochemical oxidation process. The electrochemical technique overcomes the fundamental problem of elemental sulphur production at the cathode of the reactor. This is achieved by innovative engineering design of the cathode. Adding value by implementation of novel waste treatment and recovery technology is an increasing feature of process industry improvements. Though no financial appraisal of the technique is given, there must be significant potential here given the size of the market for flue gas desulphurisation. The paper also highlights the importance of high intensity processing for environmental applications.

Lipnizki et al. review the potential of pervaporation as another novel separation technique for not only the removal of contaminants from liquids but also as a means of purification and concentration into recyclable form. The mechanism and fundamentals of this process are comprehensively reviewed and the relevant diffusional and mass transfer mechanisms summarised. In addition to providing an effective recycle technique, pervaporation itself is a

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technique which operates effectively at ambient temperature and pressure and does not involve significant requirement of costly reagents. Thus it is likely that this technique would show a favourable cost comparison against other more conventional separation technologies for effluent treatment.

Another example of an effective intensified treatment technique is described in the paper by *Pankhania et al*. who presents research on a novel membrane bioreactor which is designed to effect the efficient use of pure oxygen in a continuous aerobic treatment process for waste-water treatment. This technique was made possible by the bespoke manufacture of a membrane which fulfils the complex requirements of narrow wettability limits necessary for efficient gas/liquid contact. The membrane must also be robust and be resistant to microbial and proteinaceous fouling. The high cost associated with the use of pure oxygen in waste treatment processes sometimes precludes its use, however in the techniques described in this paper the amount of unused oxygen leaving the process appears to be very small when compared with conventional aeration based biological treatment processes.

In the fifth paper dealing with novel treatment and separation systems *Luo et al*. describe another entirely novel approach to industrial waste-water treatment using a combination of electrophoresis and solvent extraction for the removal of dye components from effluent. The use of highly selective solvent extraction techniques for water treatment is often rejected because of the potential pollution risk due to the presence of the solvent. The technique described considerably reduces the amount of solvent required without prejudicing the degree of separation achieved.

A major review paper on wet-air oxidation by *Kolaczkowski et al*. is included. There have been a number of reviews in this field recently but many have focused on the suitability of the process for treating specific effluents. The review here focuses on developments in reactor design, discussing the balance between reaction kinetics and mass transfer in full scale systems. The review highlights the need for caution when laboratory scale data are extrapolated for the design of full scale units. The appropriate expressions for heat and mass transfer rates in wet-air oxidation equipment are developed and their importance in more accurate scale-up calculations is underlined.

The special issue is concluded with two papers on quite disparate but nevertheless very important topics in relation to the environment. A paper by *Riazi et al*. dealing with modelling of oil spill dispersion is included. This is a very important and complex field where there is pressing need for quantitative and accurate predictive models for determining post-spill effects in order to ensure that the environmental impact of such events can be assessed objectively. Here a continuum mechanics approach combined with a degree of empiricism is adopted, treating oil spill disappearance as a problem of interfacial fluid transport processes. The final paper reviews the current and future status of multistage flash distillation for desalination. Despite this being a relatively mature technology this paper shows clearly that there is still significant value to be gained by further research. Results of this study of the process fundamentals suggest that significant improvements in thermal performance are available by eliminating heat losses in the brine reject stream. The paper is included in this environmental issue to emphasise that improvement in thermal efficiency is strongly linked with environmental efficiency.

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