Scientific Highlights

Heterogeneous Structure in Gas–Solid Riser Flows

Gas–solids riser flows can be found in many industrial applications, including fluidized catalytic cracking, circulating fluidized bed combustion, polymerization, chemical synthesis, and vertical pneumatic transport of solids. In a gas–solids riser flow, the hydrodynamic flow characteristics of both gas and solids phases can be strongly heterogeneous, represented by the nonuniform distributions of solids concentration and phase velocities in both the axial and radial directions. Recent measurements by electric capacitance tomography reveal that, under certain operating conditions, the solids concentration distribution in the dense and acceleration regimes of gas–solid riser flows exhibits a strong heterogeneous structure, with the solids concentration near the centerline much higher than that in the annular surrounding flows within the same cross-section. C. Zhu et al. propose a mechanistic model to investigate the formation and distribution of these heterogeneous structures in riser flows. Model simulations are validated by direct comparisons against measurements in solids concentrations as well as in the pressure drop along the riser, which shows a fairly good agreement.
AIChE J. **2008**, *54*, 1459–1469

Fungal Mycelia Show Lag Time before Re-Growth on Endogenous Carbon

Filamentous fungi play important roles in health care and agriculture as prominent pathogens of both humans and crops. Fungi are also used prevalently in the bioprocess industry to produce a host of various products. In many, if not all, of these situations fungi are likely to experience nutrient limitations or even starvation. Numerous previous studies have shown that carbon starvation can alter both the morphology and physiology of filamentous fungi in submerged cultures. To better understand the effects of starvation, M. R. Marten et al. used a parallel plate flow chamber to study individual fungal mycelia when subjected to a step change in glucose concentration. The authors report the presence of a finite "lag time" in starved mycelia during which they ceased to grow/extend while switching from growth on exogenous carbon to regrowth on endogenous carbon. This lag time precedes other morphological or physiological changes such as change in growth rate vacuolation and decreased hyphal diameter.
Biotechnol. Bioeng. **2008**, *100*, 458–465

Impact of Nano-Topography on Bacterial Attachment

The mechanisms of bacterial attachment to surfaces have been the focus of intense research over the last few decades. Theoretical approaches such as thermodynamic theories have revealed some of the physico-chemical aspects of bacterial adhesion, such as the influence of surface charge and surface tension on the longrange cell-substratum interactions and the effect of surface hydrophobicity in the short-range interactions. However, the bacterial attachment process has a complex dependence on a number of factors relating to both the substratum and bacterial cell surface properties. The roughness of the substrate is known to play a significant role in the attachment process, particularly when the surface irregularities are comparable to the size of the bacteria and can provide shelter from unfavorable environmental factors. According to this scenario, roughness on a scale much smaller than the bacteria would not be expected to influence the initial attachment. To test this hypothesis, E. P. Ivanova et al. investigated the impact of nanometer scale roughness on bacterial attachment using as-received and chemically etched glass surfaces.
Biotechnol. J. **2008**, *3*, 536–544

Feasibility of New Pressure Swing Batch Distillation Methods

Distillation is the separation method most frequently applied in the chemical industry, which is based on the difference of volatility of the components of a liquid mixture. For the separation of the two components forming an azeotrope a special distillation method must be applied such as the pressure swing distillation (PSD), extractive or heteroazeotropic distillation. The PSD is the least studied from these three methods. Batch distillation (BD) has always been an important part of seasonal, uncertain or low capacity and high-purity chemicals' production. It is a process of key importance in the pharmaceutical and several other industries and in the regeneration of waste solvent mixtures. The main advantage of BD over continuous is that a single apparatus can process many different liquid mixtures. P. Lang et al. investigated the pressure swing distillation in different batch column configurations by feasibility study and rigorous simulation calculations. Besides studying the well known batch configurations the authors also suggest two novel configurations such as double column batch rectifier (DCBR) and double column batch stripper (DCBS).
Chem. Eng. Sci. **2008**, *63*, 2856–2874

Sorptive Potential of Beach Sand to Remove Ni(II) Ions

The presence of heavy metals in the aqueous environment can be detrimental to a variety of living species. Therefore, the elimination of heavy metals from water and wastewaters is important to protect public health. Most of the heavy metal ions are toxic to living organisms. The heavy metal level in drinking water, wastewater and the water used for agriculture must be reduced to at least the lowest permissible concentrations. Since nickel is among the most toxic elements, it is necessary to develop a method to lower its presence in contaminated media to innocuous quantities. Ni(II) ions are also known to arise from corrosion products in the cooling systems of nuclear power plants. S. I. H. Taqvi et al. investigated the potential to remove Ni(II) ions from aqueous solutions using sea beach sand, a carbonate-quartz mineral. A pseudo-first order Lagergren equation

was used to test the adsorption kinetics. Other kinetic models, e.g., the Morris-Weber and Reichenberg equations, were used to calculate the rate constant of intraparticle diffusion and the fate of the diffusion process, respectively.
Clean **2007**, *36*, 366–372

Biodegradation of Methyl Ethyl Ketone and Methyl Isopropyl Ketone

The removal of volatile organic compounds (VOCs) from a polluted air stream using a biological process is highly efficient and has low installation and operational/maintenance costs. Biofiltration technology offers environmental advantages: it does not generate undesirable by-products by converting many organic and inorganic compounds into harmless oxidation products. Biofiltration involves the passage of a polluted air stream through a packed bed containing microorganisms immobilized within a biofilm attached to the bed-packing material. Contaminants are transferred to the interface between the gas and the biofilm and are subsequently absorbed into the biofilm. W.-C. Chan et al. investigated biodegradation of methyl ethyl ketone (MEK) and methyl isopropyl ketone (MIPK) in a composite bead biofilter. Both the microbial growth rate μ and the biochemical reaction rate coefficient k_d could be affected with increasing inlet concentration. For the microbial growth process, an inhibitory effect of almost the same sensitivity for the two ketone compounds and the μ value of MEK was more pronounced than that of MIPK in the inlet concentration range of 100 to 300 ppm.
Eng. Life Sci. **2008**, *8*, 167–174

A Diffusion Based Model for Intermittent Drying of Rough Rice

Cereals are harvested at high moisture content and drying is an important post harvest operation prolonging the storage life of them by preventing deterioration. Drying process traditionally employs continuous drying at same air temperature. Many researchers have investigated the continuous drying characteristics of rough rice and empirical or semi empirical correlations for the prediction of the drying rate have been performed more or less success. Intermittent drying is an alternative drying method and offers some advantages over the continuous form of drying. Drying produces moisture gradient within the grain and hence the drying rate decreases. However, a tempering period allows the moisture within the grain to diffuse to the external surface and therefore drying rate increases again. The thermal efficiency of such process is higher, because the thermal energy required reduces. O. Hacihafizoglu et al. simulated intermittent drying behavior of single layer rough rice with a moisture content of between 22 and 24 % on the dry basis by means of a liquid diffusion model based on a prolate spheroid geometry.
Heat Mass Transfer **2008**, *44*, 905–911

Experimental Validation of a FE Model of a Human Cadaveric Tibia

Finite Element (FE) models can be used to evaluate new and modified designs of joint prostheses and fixation devices. Using the FE models as opposed to conducting experiments has the advantage of testing new implants during the design stage, even before producing a prototype of the device. It also enables the evaluation of stresses and strains generated within the bone or at interfaces between bone and orthopaedic components. These are difficult, if not impossible, to measure experimentally. Furthermore, since it is possible to explore the sensitivity of model results to changes in design features, poorly performing designs can be eliminated during the FE testing phase and more costly physical experiments need only be performed on the best designs. H. A. Gray et al. create FE models of a human cadaveric tibia, both intact and implanted with a unicompartmental knee replacement, and validate the models against results obtained from a comprehensive set of experiments. FE models were created based on computed tomography (CT) scans of the cadaveric tibia.
J. Biomech. Eng. **2007**, *130*, 031016, 1–9

Top-Spray Fluid Bed Coating: Relative Droplet Size and Drying Force

In the production of solid enzyme products, coating of the enzyme formulation onto inactive filler cores in fluid beds is a common process. The desired product consists of unagglomerated individual carrier particles each coated homogeneously with a layer of enzyme containing matrix. If formulation or process conditions are incorrectly chosen, either excessive agglomeration or excessive spray drying of the feed may happen. In both cases a poor product quality is achieved and in any case, control of agglomeration is essential during scale-up. Often product and process properties are optimised in small- and medium-scale fluid beds and then transferred to production-scale. A. D. Jensen et al. performed top-spray fluid bed coating scale-up experiments in three scales in order to test the validity of two parameters as possible scaling parameters: The drying force and the relative droplet size. The aim was to be able to reproduce the degree of agglomeration as well as the mechanical properties of the coated granules across scale.
Powder Technol. **2008**, *184*, 318–332

Dry Sliding of Plasma-Sintered Iron

Powder metallurgy is increasingly used in the production of mechanical parts. Sintered parts are now mainly used in applications where static or alternating loads are encountered. In order to favor their use in applications where contact loads are present, a complete understanding of the tribological behavior of these materials is needed. The role of the surface treatments needed to improve their wear resistance also has to be understood, since the residual porosity will noticeably decrease their mechanical strength. H. C. Pavanati et al. sintered samples of unalloyed iron in the presence of an abnormal glow discharge using the confined anode-cathode configuration in order to allow surface enrichment of the sample with atoms from the cathode. In order to evaluate the wear resistance and surface damage to the samples, dry sliding wear tests were carried out using a block-on-ring system with applied normal loads of 25-150 N. A large scatter in the experimental results was observed for the unnitrided samples.
Wear **2008**, *265*, 301–310

Reported by Leena Kruse

