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Editorial

This special issue of Adsorption Journal consists of papers primarily dealing with the topic of pressure swing adsorption (PSA). They were presented at the Annual Meeting of the American Institute of Chemical Engineers (1996, Chicago).

About forty years of research and development in the area of PSA for gas separation have produced a process technology of remarkable flexibility. Commercial units have been designed to produce many types of highly purified products, like hydrogen, oxygen, nitrogen, branched/linear hydrocarbons, carbon dioxide, carbon monoxide, methane, and dry air. Research efforts continue at a brisk pace to this day, and new applications appear every year as new adsorbents and PSA process cycles are developed. Two of the papers in this issue investigate the performance of relatively new process cycles.

Numerical simulation of PSA processes has played a significant role in the development of this technology. It is now possible to simulate the relatively complex, non-isobaric, non-isothermal, non-steady-state PSA process steps and describe the performance of an industrial PSA unit. This tool has found widespread use in the design and diagnosis of PSA units. Research efforts directed towards the simulation tools are often focused on ways to increase the efficiency of the numerical algorithms or to improve the physical description of the system (e.g., multicomponent adsorption equilibria, heat and mass transfer mechanisms in packed columns, etc.). Three of the papers in this issue address these topics.

In the first paper, A. Serbezov and S.V. Sotirchos (University of Rochester) theoretically investigate the rate of macropore diffusion of multicomponent adsorbates in non-isothermal adsorbent pellets. By considering only a single adsorbent pellet rather than an entire adsorbent column, the mathematics are simplified and the effect of different boundary conditions can be ascertained.

In the second paper, S. Nilchan and C.C. Pantelides of Imperial College describe an alternative computer algorithm that can be used to generate cyclic steady-state profiles of an adsorption column. Previously this has been accomplished by simulating repetitive adsorption/regeneration steps of the PSA process until the overall column performance reaches a cyclic steady-state. The proposed method is claimed to be more efficient than the conventional approach when one is interested in optimizing the performance of the adsorption system.

The third paper by S.J. Doong and P. Prospner of The BOC Group describes theoretical simulation and experimental verification of the effect of asymmetrical bed flows on PSA performance. PSA's inherently involve two or more columns operated in parallel. Thus, if one column receives more regeneration gas than the other, then the overall performance of the system will be affected. The authors show that this imbalance can also produce asymmetric temperatures in large beds, which leads to even more significant performance variations.

The fourth paper by Y. Liu and J.A. Ritter (University of South Carolina) describes simulations of a solvent vapor recovery PSA unit. This represents a relatively new PSA application which could become widely utilized in the future as air quality regulations become more stringent. The authors find that the PSA performance depends on the magnitude of the adsorbate heat capacity and the external column heat transfer coefficient. Best performance is observed during isothermal operation, but adiabatic operation does not yield the worst results, as one might initially expect. The unique properties of vapor-based systems (steep isotherms, high heats of adsorption) appear to produce effects different than those observed in gas-based systems.

The final R&D Note by Z. Zhang, J. Guan and Z. Ye (South China University of Technology) describes work in progress with a rapid pressure swing adsorption process used to separate carbon dioxide from nitrogen. This approach incorporates a relatively small cycle time and a bed of small-diameter adsorbent particles in order to significantly increase the overall bed productivity.

We hope that the papers contained in this special issue will spur the conception of new ideas and inspire future research and development in the ever-changing field of PSA. We would like to thank Dr. Kent Knaebel for suggesting the concept of this issue and helping us to bring it together.

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