

## PREFACE

The Frontier Report of the National Research Council analyzed chemical engineering activities on three scales: the microscale of atomic and molecular events, the mesoscale of process equipment, and the macroscale of entire systems. The traditional home of chemical engineers has been in the mesoscale of unit operations and reaction engineering and, more recently, in the microscale of transport phenomena and chemical kinetics. Increasingly, our attention is drawn to macroscale problems: chemical plant safety, environmental impact of hazardous chemicals and even carbon dioxide, manufacturing productivity and world competition, and the introduction of products with innovative properties. The chemical engineers have to address the “big picture,” or someone else who does not have the knowledge and expertise of chemical processing will make decisions that may be costly and unwise or even counterproductive.

There are three chapters in this volume, two of which address the microscale. Ploehn and Russel address the “Interactions Between Colloidal Particles and Soluble Polymers,” which is motivated by advances in statistical mechanics and scaling theories, as well as by the importance of numerous polymeric flocculants, dispersants, surfactants, and thickeners. How do polymers thicken ketchup? Adler, Nadim, and Brenner address “Rheological Models of Suspensions,” a closely related subject through fluid mechanics, statistical physics, and continuum theory. Their work is also inspired by industrial processes such as paint, pulp and paper, and concrete; and by natural systems such as blood flow and the transportation of sediment in oceans and rivers. Why did doctors in the Middle Ages induce bleeding in their patients in order to thin their blood?

The remaining chapter is in the macroscale, where Englund addresses “Opportunities in the Design of Inherently Safer Chemical Plants.” He carefully points out that there is no such thing as an *inherently safe* chemical plant, since there is always risk, but we can make chemical plants *inherently safer*. The major and minor chemical plant accidents in the past years are constant reminders of the importance of this topic. The day will come when this topic will move from industrial good practice to university research,

then to undergraduate electives, and eventually to mandatory undergraduate education. If we do a good job, we will earn the respect of the public, who will then become less suspicious of our motives and methods.

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