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Chemical Engineering Kinetics

It is a pleasure to welcome a new and important book, Professor Smith's "Chemical Engineering Kinetics," to the literature of chemical engineering. This book should increase the interest in this subject already generated by the well-known "Kinetics and Catalysis" of Hougen and Watson. In the past the appearance of certain books, such as Walker, Lewis, and McAdams's "Principles of Chemical Engineering" and Dodge's "Chemical Engineering Thermodynamics," has engendered in many readers a determination to explore more fully the corresponding fields. New and fruitful research ideas and programs have sprung up in many places as a direct consequence of these trail-blazing books.

Kinetics is a particularly promising field and one of such breadth and complexity that the opportunities for research are almost without limit. Theoreticians may engross themselves in mathematical problems just about as difficult as can be found in any field of endeavor. The measurement of phenomena, on the other hand, will occupy the experimentalist, safe in the realization that his results will be of immediate utility and also of ultimate value in bringing to fruition the mathematical and theoretical developments.

Kinetics as a branch of pure chemistry is old and extensively explored, although by no means exhausted. As a branch of chemical engineering, however, it is relatively new and bursting with vigor and opportunity. The difference between the purely scientific and engineering aspects of this field is not easy to establish, but it is probably largely one of the complexity of the systems. As an example, the chemical kinetics of a catalytic reaction may be established by relatively simple measurements under controlled conditions, of which the maintenance of isothermal operation is probably the most important. When one attempts to predict what will happen when this reaction is to be carried out in a full-scale catalytic converter, however, the problem is one of chemical engineering kinetics. The superimposition of heat transfer and mass transfer on the purely chemical rate consideration increases the difficulty enormously and invites the exercise of every kind of ingenuity and originality.

Another characteristic of chemical engineering kinetics is the growth and development of ideas always with the aim of complete understanding of a phenomenon. At first we may be content, though not satisfied, with a relatively simple "mechanism." This may leave certain observations unexplained, but, as time and thought progress, other ideas develop by which the original mechanism may be modified and improved. Typical of this progression is the problem of heat transfer or mass transfer in fixed beds. This was first explored theoretically and experimentally as a problem in which the resistance to transfer in the fluid phase was presumed to be governing. For many years this explanation of the behavior of fixed beds was considered reasonable and adequate. However, certain discrepancies disturbed workers in this field, and it was realized that the resistance in the solid phase could, in some cases at least, be important. A theoretical explanation of this problem was made with considerable success, and certain disagreements were clarified and resolved. Very recently, however, still another factor has come to the fore—that of longitudinal diffusion. It is now clear that certain anomalies probably can be explained only on the basis of the superimposition of longitudinal diffusion on the previously established fluid- and solid-diffusion problem. Thus another difficult problem begins to yield to the constant aim in chemical engineering for understanding as complete as is possible.

Chemical engineering kinetics is a subject of almost boundless promise for research, and it is to be hoped that Professor Smith's book will do much to excite further interest among all of us.

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