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Mass transfer in a horizontal rotating cylinder with applications to the oxygenation of blood, Landino, Enrique, J. G. McCreary, W. A. Thompson, and J. E. Powers, **A.I.Ch.E. Journal, 12,** No. 1, p. 117 (January, 1966).

Key Words: A. Testing-8, Evaluating-8, Effectiveness-9, 8, 7, Performance-9, 8, 7, Feasibility-9, Operation-9, 8, Characteristics-9, 6, Dimensions-9, 6, Oxygenator-9, 10, Blood Oxygenator-9, 10, Rotating Cylinder-9, 10, Mass Transfer-4, 8, Oxygenation-4, 8, Absorption-4, 8, 10, Oxygen-1, 9, Blood-1, 5, Theory-10, Experiment-10, Equations-10, Calculations-10, Analysis-10, Theoretical-0.

Abstract: A horizontal rotating cylinder blood oxygenator has been developed. The formulation of a mathematical model to aid in the development of this apparatus is reported in this study. The theoretical model is used to evaluate the effectiveness of the oxygenator and to test the effects of cylinder dimensions and operating parameters on the performance of the oxygenator. Results of experimental tests of the oxygenator with a carbon dioxide-water system and one in vivo test on a dog are compared to the mathematical calculations.

Forced convection mass transfer: Part III. Increased mass transfer from a flat plate caused by the wake from cylinders located near the edge of the boundary layer, Thomas, David G., **A.I.Ch.E. Journal, 12,** No. 1, p. 124 (January, 1966).

Key Words: A. Mass Transfer-8,9,7, Convection-8,7, Forced-0, Naphthalene-1,9, Hydrocarbons-1,9, Boundary Layers-9, Laminar-0, Air-5, Wires-6,9, Cylinders-6,9, Promoters-6,9, Turbulence-6,9, Velocity-6, Spacing-6, Locations-6, Tollmein-Schlichting Waves-6, Rates-7, Wind Tunnel-10, Sublimation-10.

Abstract: Enhanced rates of mass transfer in the wake region behind detached cylindrical turbulence promoters were investigated with the naphthalene sublimation technique. The effects of the free stream velocity and the location of the cylinders relative to the flat plate mass transfer surface were observed. The differences between the rate of mass transfer behind one and behind two cylinders, possible effects of Tollmein–Schlichting waves, were also studied. These studies were conducted in a once-through wind tunnel.

Tracking function approach to practical stability and ultimate boundedness, Paradis, W. O., and D. D. Perlmutter, **A.I.Ch.E. Journal, 12,** No. 1, p. 130 (January, 1966).

Key Words: A. Stability-8,9, Practical Stability-8,9, Liapunov Stability-9,8, Asymptotic-0, Ultimate Boundedness-8,9, Systems-9, Independent-0, Chemical Process-9, Van der Pol Equation-9, Defining-8,4, Predicting-8,4, Testing-8,4, Analysis-8,4, Tracking Function Analysis-10,8, Tracking Functions-10,8, Liapunov Analysis-10,8, Isoclines-10, Limit Cycles-9.

Abstract: A graphical method of analysis is presented for studying the practical stability and ultimate boundedness of autonomous second-order systems. It is argued that these measures of stability are in many cases more germane to design than Liapunov stability. The method incorporates much of the geometric character of a Liapunov analysis, but it is shown that a Liapunov function, relatively difficult to obtain, can be replaced by a set of easily postulated scalar functions which collectively yield the required stability information. Examples which demonstrate the use and effectiveness of the method are given.

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input to a computer, particularly thermodynamics and fluid mechanics data, have yet to be identified or even significantly investigated.

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Advances in Chemical Engineering, Thomas B. Drew, John W. Hoopes, Jr., and Theodore Vermeulen, Editors, Giles R. Cokelet, Assistant Editor. Academic Press, New York and London (1964). Volume 5. 317 pp, $14.00.

In common with the preceding volumes of this series, this book contains a series of separate articles on topics of current interest in chemical engineering. I think that the subjects have been well chosen and that the book should be valuable for anyone already working or starting to work in the fields considered.

Professor J. F. Wehner of the Department of Chemical Engineering at the University of Notre Dame has written the first article, "Flame Processes—Theoretical and Experimental." He is concerned principally with laminar, one-dimensional situations; turbulent and diffusion flames are not reviewed. Since flames are, in essence, integral, nonisothermal reactors, the interpretation of experimental results in terms of basic kinetics offers well-known difficulties. To introduce the subject, a review is given of the theory of the structure of one-dimensional laminar flames. Although some equations are given, the discussion is largely qualitative in nature. A succeeding section is devoted to the experimental determination of temperature and composition profiles. Here free radical concentrations inside a flame are shown graphically, and it seems to me that a little more description of possible ways these concentrations were measured would have been helpful.

The review on flame processes continues with a discussion of the stabilization of flames, ignition, and the transition to detonation. The last part of the article is descriptive and is concerned with the burning of solid propellants and chemical synthesis in flames. This last subject, which might interest many chemical engineers, is covered lightly.

"Bifunctional Catalysis" has been reviewed by J. H. Sinfelt of Esso Research and Engineering Company. This article is perhaps the one of most interest to the classical chemical engineer. The large amount of work which is necessary to obtain basic data on the kinetics of a moderately com-

plex industrial process is brought out in this discussion. This work is, of course, the essential basis of any subsequent simulation of a process such as the catalytic reforming of naphtha. Some of the various reactions of catalytic reforming take place on the metal sites and some on the acid sites of the usual bifunctional catalyst used for this process. The interpretation of a large quantity of experimental data so that the kinetics of individual reactions may be obtained is well described in this part of the book. The work of Weisz, who showed that the typical dehydrogenation and isomerization reactions can be obtained over a finely divided mixture of platinum catalyst and silica-alumina catalyst as well as over the usual bifunctional mixture, plays an important role in the analysis. After the various individual reactions have been isolated from the overall reforming process, an interesting discussion is given of the kinetic data for each of these reactions. These data have often been obtained by studying the reactions of the pure individual hydrocarbons and are interpreted by the conventional concepts of adsorption, surface complex formation, degree of surface coverage, poisoning by adsorbed products, and other familiar ideas. In this way a rational picture of the overall process is obtained, so that a practical use can be made of the many kinetic studies described.

The succeeding article, "Heat Conduction or Diffusion with Change of Phase," by S. G. Bankoff of Northwestern University, is a detailed review of the solution of a class of partial differential equations. These problems are characterized by a requirement such as phase equilibrium at a moving boundary. This article is twice as long as either of the preceding ones and includes more than three hundred equations. In spite of the details given, this discussion is probably not self-contained for readers who are not already competent in this special field. The interested general reader will probably need to study the mathematics related to the transformation of variables in a less concentrated form before being able to profit from this chapter. The review appears to be relatively complete and covers exact solutions, analytical approximation methods, and analog and digital computer solutions.

Professor G. D. Fulford of the University of Birmingham, England, has written a review, "The Flow of Fluids in Thin Films." The flow of such films is usually classified as smooth laminar, wavy laminar, or wavy turbulent. The waves may arise because of gravity effects or capillary effects. Most of the treatment of smooth laminar flow is limited to two dimensions, but some consideration is included on end effects, which require a three dimensional treatment. The criteria of stability with respect to the formation of waves or turbulence are presented. Much of the analysis of turbulent flow is given in terms of velocity distributions based on methods analogous to those of von Kármán and Deissler. A good review of the experimental work in the field is given. As an appendix there is a chronological list of papers on film flow and related topics, and I found this an appealing innovation. Only brief treatments were given in the text of the effect of the flow of an adjacent gas stream, and horizontal films were not covered.

The final article of the book is "Segregation in Liquid-Liquid Dispersions and its Effect on Chemical Reactions," by Professor K. Rietema of the Department of Chemical Engineering of the Technical University of Eindhoven, Netherlands. This interesting section begins with an introduction to the idea of segregation in reactors and its relation to residence time distribution. Reactors are characterized by a strong degree of segregation of two phases or by the strong interaction of the phases. The interaction can occur by a mechanism of diffusion or by a mechanism of coalescence and redispersion. After the basic concepts have been formulated, the principles are applied to reactors of various types for reactions of various orders. Continuous stirred-tank reactors are emphasized. Segregation can have an influence not only on conversion but on selectivity when competing reactions are involved. Also considered were a number of interesting models of drop formation and circulation and the effect of dead spaces. Some experimental measurements involving segregation and interaction have been attempted in both physical and chemical systems, but confirmation of the theory in reacting systems is missing so far. In spite of the lack of much present practical applicability of the theories discussed in this article, it does seem that the phenomena discussed are important and will receive more study in the future.

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Distillation, E. S. Perry and A. Weissberger, Editors, Wiley, New York (1965). 2 ed., 838 pages, $24.00.

This book on "Distillation" is Volume 4 of an eleven-volume general treatise termed "Technique of Organic Chemistry" concerned with the tools and techniques used in the laboratory