BOOKS

Convective Mass Transfer—An Introduction, D. B. Spalding, McGraw-Hill, New York (1963). 448 pages. $12.50.

This book is fairly unusual among introductory books on mass transfer, in content and philosophy and in form and organization. It is neither an elementary treatise on the equations of conservation and transport nor another compilation of accepted design techniques of perhaps limited applicability. Rather the book develops, in simplified fashion, generalized methods intended to permit prediction of mass transfer rates in a wide variety of fields and situations, with accuracy sufficient for engineering purposes. As the author emphasizes in his preface, the book is primarily for the engineer who must deal with mass transfer in a number of areas rather than for the specialist in a particular field.

Basis for the methods presented is the Reynolds flow concept, a model which describes the actual transport processes between the bulk of a fluid and an interface in terms of hypothetical counterfluxes of bulk and near-interface fluids. This model permits the mass transfer rate to be expressed by the product of a conductance (obtainable frequently from convective heat transfer relationships) with a "driving force" found by a steady state balance on any convenient conserved property of the system. As with other mass transfer models, corrections must often be made for deviations from the simple model. With the methods proposed, mass transfer problems involving heat transfer and chemical reaction are handled in much the same fashion as more ordinary mass transfer problems.

The book is divided into two chapters, the first being a short, descriptive introduction. Roughly a third of the second chapter is the detailed development of the Reynolds flow model applied to a single phase. Considerable attention is given to basic definitions and concepts, calculation of the driving force, comparison of the model with other approaches and with experimental results, and to the establishment of recommended calculational procedures. The next fourth of the chapter applies the procedures to diverse problems including absorption with and without chemical reaction, transpiration cooling, missile stagnation temperatures, heterogeneous catalysis, and combustion. The remainder of the chapter is divided between simultaneous heat and mass transfer and the introduction and use of the transfer-unit concept for the

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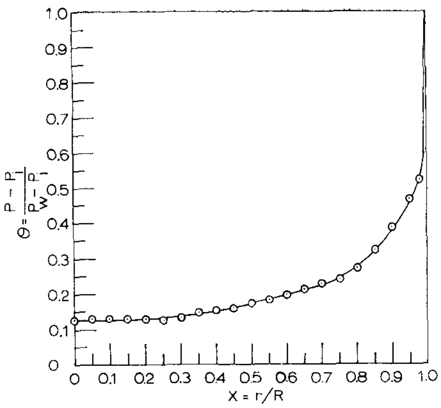

Fig. 2. Typical illustration of a concentration profile obtained in a wetted-wall column under isothermal and given turbulent flow conditions.

obtained in a 2¾ in. I.D. wetted-wall column. In this figure a dimensionless partial pressure term defined as

$$\theta = \frac{P - P_i}{P_w - P_i}$$

is plotted against a dimensionless radial position term defined as $X = r/R$. The probe might be constructed much smaller in size, but is is doubtful if the response time could be reduced to much less than 1 min. Although the probe is capable of sensing a small change in water vapor concentration,

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sizing of overall equipment, with emphasis on the air-water system in both portions. Numerical illustrations are liberally provided. The mathematical level of presentation has been kept elementary, with much of the theoretical background developed in intuitive or empirical fashion. However, it is intended that subsequent volumes will present a more solid theoretical foundation and extend the methods. Mass units are used for concentrations and rates; the notation employed differs frequently from that found in the chemical engineering literature, but is consistent and readily understood. The author writes with a personalized, effective style not often found in a technical presentation.

The nature of "Convective Mass Transfer" makes it difficult to specify precisely the place of this book from a chemical engineering viewpoint. Many of the common mass transfer problems in chemical engineering may be handled as or more readily by other approaches or treated more exactly by recent theoretical developments; and the extremely detailed presentation and general organization may well discourage a person already familiar with other techniques from perusing the book. These characteristics also limit its attractiveness as an introductory textbook, quite aside from the question almost certain to arise as to whether the model proposed is the most satisfactory way to introduce mass transfer concepts. This book, however, has many features to recommend it for consideration. Professor Spalding has brought an extensive and impressive knowledge of transport processes to the development of his methods, and examination of his concepts is a stimulating experience that may be very helpful in clarifying and extending the reader's basic ideas on mass transfer. The unified approach to mass transfer calculations which permits treating, in a relatively simple fashion, the complicated problems arising when high heat transfer and chemical reactions are coupled with mass transfer is of considerable interest because of the increasingly frequent occurrence of these types of problems in today's technology. Some very effective comparisons with experimental results have been provided for these more complex cases; however, more experimental substantiation of the general validity of the proposed methods for such complex situations appears desirable. Perhaps this will be included in the subsequent volumes.

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