Int. J. Heat Mass Transfer. Vol. 16, pp. 1062–1064. Pergamon Press 1973. Printed in Great Britain

BOOK REVIEWS

H. BRAUER, **Stoffaustausch einschliesslich chemischer Reaktionen.** Verlag Saurlander Aaran. 696 pp. 95 DM.

DIE BEKANNTE Buchreihe "Grundlagen der chemischen Technik" ist durch einen Band "Stoffaustausch" bereichert worden. Das Buch ist in sechs Teile gegliedert, in denen die allgemeinen Grundlagen des Impuls-, Energie- und Stofftransportes, die Diffusion im ruhenden Medium, der Stofftransport an den Oberflächen umströmter und durchströmter Körper, der Stofftransport durch die Grenzflächen einfacher zweiphasiger Systeme und in zweiphasig durchströmten technischen Apparaten behandelt werden.

Im ersten Teil werden für den molekularen Transport die wichtigsten Ergebnisse der kinetischen Gastheorie angeführt und erläutert. Dabei hat der Verfasser auf die Darstellung der theoretischen Zusammenhänge bewusst verzichtet zugunsten einer zusammenfassenden und übersichtlichen Wiedergabe von Berechnungsformeln und Zahlenwerten, die in dieser Ausführlichkeit erstmalig im deutschen Schrifttum erscheinen. Ebenfalls im ersten Teil finden sich einige Abschnitte über turbulente Transportkoeffizienten—basierend auf der Prandtl'schen Mischungsweghypothese und deren Modifikation durch die van-Driest'sche Dämpfungsfunktion—sowie ein sehr ausführlicher Abschnitt über die Bilanzgleichungen (u.a. auch eine übersichtliche Zusammenstellung der Stoff-, Impuls- und Energiegleichung in zylindrischen und sphärischen Koordinatensystemen—leider nicht in der dem Titel des Buches angemessenen Allgemeinheit) und die Grenzschichtvereinfachungen. Den Abschluss des ersten Teiles bildet ein Kapitel über die Analogie von Impuls-, Energie- und Stofftransport.

Bei den in den folgenden Abschnitten behandelten speziellen Problemen werden eine Fülle von Berechnungsergebnissen und Messungen aus der in- und ausländischen Literatur zusammengefasst. Der Verfasser konnte dabei besonders auch auf numerische Ergebnisse aus Dissertationen und Studienarbeiten seiner Mitarbeiter zurückgreifen. Die Ergebnisse werden in der Regel in dimensionsloser Form dargestellt und dürften für den Ingenieur in der Praxis ausserordentlich wertvoll sein. Allerdings beschränken sich die Beispiele mit chemischen Reaktionen auf einfache Modellvorstellungen katalytischer Wandreaktionen. Bei der starken Betonung der Ergebnisse numerischer Verfahren würde man sich auch etwas mehr Information über die eingeschlagenen Lösungsverfahren und kritische Vergleiche verschiedener Verfahren hinsichtlich Rechenzeit und Speicherplatzbedarf wünschen.

Dass dieses Werk nicht so sehr als Einführung in die Probleme des Stoffaustausches verstanden sein will, sondern sich in erster Linie an den Fachmann wenden möchte, zeigen die Auswahl und vor allem die Darbietung des Stoffes, bei der die Einzelmessung sich in Kennzahlabhängigkeiten verbirgt. Kennzeichnend für diese Art der Betrachtung ist, dass im Sachverzeichnis Stichworte wie z.B. Verdunstung, Kühlturm, Extraktion, Rektifikation, Ablation, Katalyse, Kondensation, Trocknung, Transpirationskühlung überhaupt nicht erscheinen.

K. F. KNOCHE

A. V. LUIKOV, **Heat and Mass Transfer (Handbook).** Energiya, Moscow (1972).

THE THEORY of heat and mass transfer is one of the newest fields of knowledge. It is of great practical importance for calculation of thermal processes in different branches of industry and agriculture. This theory embraces a number of physical sciences such as thermodynamics, mathematical physics, etc.

As far as computing engineering progresses, the above sciences have considerably advanced. This advance may primarily be attributed to new mathematical solutions of old physical problems. The result of it was publication of a great number of monographs wherein numerical calculations and mathematical manipulations shaded the physical essence of constitutive sciences of the heat transfer theory such as hydrodynamics, thermodynamics, etc.

It is quite clear that in this situation a researcher concerned with heat and mass transfer problems is faced with tremendous difficulties in revealing the physical essence of a problem among innumerable mathematical formulas and operations.

Evidently, the necessity is quite urgent for a monograph to be published which would show in a concise and clear form the physical essence of constitutive sciences of the heat and mass transfer theory and mathematical methods and operations used.

The handbook *Heat and Mass Transfer* by A. V. Luikov may probably be regarded as such a monograph.

In the first chapter of the book the author presents a general theory of transfer equations. First, concept of visible and invisible motions involved in transfer of any physical substance is explained and the Umov general transfer equation is derived. Then the differential equations of mass, momentum and energy transfer are derived from the Umov equation. Further, to obtain the equations in a closed form, the Fick laws of mass diffusion, the Newton law of internal friction and the Fourier heat-conduction laws are discussed.

The author considers in detail the problems which arise in derivation of equations of motion of perfect and viscous liquid and gives a brief but comprehensive review of semi-empirical and statistical phenomenological theories of turbulence.

It should be noted that the book under review is the first wherein the contribution of Moscow school of physicists to hydrodynamics is appreciated. This contribution is

extension of the Euler and Navier–Stokes equations to vortex and turbulent flows.

In conclusion of this chapter the hyperbolic heat conduction equation is derived and used for solution of the Stefan problem.

The second chapter of the monograph entitled "Heat Conduction" is devoted to the solution of practical problems concerned with propagation of heat in a solid. The author considers in detail the statement of problems, initial and boundary conditions and all existing methods of integration of parabolic partial differential equations.

All mathematical procedures are given in a simple easily understood form and particular applications to engineering problems are given.

In the next chapter some aspects of heat and mass transfer in flows under forced and free-convection are

One of the main problems of the viscous flow theory is that of a flow over a plate, solved by Blasius in 1908. The fluid flow theory was further developed by refinements of the problem. Unfortunately, these refinements are not important for engineering practice and are of minor mathematical interest.

This is probably the reason why in this chapter the author has presented various heat and mass transfer problems arising in turbulent and laminar flows over a plate. Great attention is paid here to free convective flows in finite and infinite ranges. These passages are based on theoretical and experimental results obtained at the Heat and Mass Transfer Institute, B.S.S.R. Academy of Sciences.

Chapter 4 deals with the conjugate heat transfer probblems. The author gives a detailed presentation of the physical basis which allows simultaneous consideration of heat transfer process in a solid and in the main gaseous flow.

The mathematical methods are illustrated by particular engineering calculations.

The next chapter is devoted to transfer processes in capillary-porous bodies and essentially based on the results by the author and his numerous pupils, which are widely used in practice in this country and abroad.

The author was the first to introduce the term "a capillary-porous body", which implies that properties of porous bodies are considered simultaneously with capillary properties of saturating liquids and gases.

In the book an extensive description is given of application of capillary porous bodies to space engineering. Capillary-porous bodies are primarily used to provide normal vital functions of astronauts under no gravity; they are also important for release of heat accumulated inside the space vehicle.

In the final part of this chapter some problems of hydrodynamics and heat transfer under zero gravity are given.

Chapter 6 is devoted to the same subject as the previous one. The recent mathematical results on unsteady-state heat and mass transfer in capillary-porous bodies and porous materials are mainly discussed.

Unfortunately, the book under review does not include the works on filtration by N. E. Zhukovsky, a well-known Russian scientist in mechanics. Zhukovsky's ideas were further developed by L. S. Leibenzon whose works constitute a scientific basis for the Soviet petroleum engineering.

The book by A. V. Luikov is a new type of a handbook which may be very useful for engineers, research students and research workers concerned with heat physics.

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Professor M. A. GLINKOV, **Fondements de la Théorie Générale de Fonctionnement des Fours** (Foundations for a General Theory of Furnace Operation).
Maison et Cie, Paris, 1971. French translation by Professor R. VICHNIEVSKY and J. JULLIEN, Faculté des Sciences de Paris. 170F, 446 pp.

THE PUBLISHERS do not disclose the date of publication of the original Russian edition. Private and unconfirmed researches on the part of the reviewer suggest that their French translation is of the second and last Russian edition which appeared in 1962.

Professor Glinkov has recognized the need to unite the several specialized sciences: fluid mechanics, convective heat and mass transfer, combustion and thermal radiation in order to provide a theoretical base for the establishment of mathematical procedures for furnace design; his book is devoted to this cause.

A general discussion of heat equipment is presented in the first chapter according to four principal subdivisions: thermal machines; heat exchangers; thermal generators (taken to include equipment such as convertors and resistance and induction furnaces where the emphasis is on the production of heat rather than on the transfer of heat); and an equipment group, having no apparent English name equivalent, which comprises: boilers, evaporators, dryers, open-hearth and billet-reheating furnaces, and all other furnaces characterized by both the production of heat and its transfer to a receiver substance. It is this latter group which serves to bond the material of the subsequent chapters. The principal subject headings include: general furnace operational characteristics, aerodynamics of non-reacting jets, the reacting jet or flame, thermal radiation, convection, and particle beds. The subjects: heat production by electricity, automatic control of furnaces, and the thermal behaviour of refactory are also treated, but at a lesser depth. The book is well documented by 363 references, the great majority of which are Russian.

A book on furnace theory cannot be assessed without first deciding to which of two kinds of reader it is most likely to appeal: the practising engineer who wishes to design furnaces; or the research scientist engaged on the development of design procedures who requires a comprehensive reference treatment of his field. Professor Glinkov neglects to name his intended audience, but a present-day one must be primarily composed of readers of the former kind. This is because the modern theorist is concerned with the development of computer-based numerical methods, for these are the only ones which will ultimately permit the complex reacting, absorbing, three-dimensional turbulent flows, which most often occur in furnaces, to be predicted with adequate accuracy and generality. The author deals