Radiation and Combined Heat Transfer in Channels

By M. Tamonis and edited by A. Zukauskas

New York: Hemisphere Publishing Corp., 1987. Pp. 239. $69.95

This book is one of a series produced by the Institute of Physical and Technical Problems of Energetics at Kaunas, Lithuania. The books describe, in great detail, the research carried out at the Institute related to thermodynamics and fluid mechanics.

Although the title appears to have general appeal to those working in the broad area of heat transfer, it is a book that is more suited to the specialist. This is not a criticism: it is simply a warning to those who might purchase the book thinking that it would provide a general reference. The subject matter is dedicated to the study of heat transfer from high-temperature gases, taking account of radiation as well as convection and conduction.

Chapter 1 is concerned with the optical properties of gases at high temperatures, such as those found in furnaces, internal combustion engines, rockets, and in nuclear reactions. Due to the complexity of the physical processes in the radiation by molecular gases, this is an area that the author feels that, until now, has received insufficient attention. The text moves on to develop the governing equations for combined heat transfer and discusses their transformation and solution. The experimental equipment and techniques that have been employed in the studies are described. Temperature-related changes in gas transport and chemical properties and their effects on convective heat transfer are investigated before moving on to include their interrelation. Specific problems are addressed, including radiation in spectral line bands, radiation heat flux sensors, laminar and turbulent gas flows, conductive and radiative heat transfer in a plasma layer, and heat transfer in MHD generator channels.

The book provides a comprehensive source of data, results, and correlation from one of the major research centres of the USSR that will not be found in any other single publication. Useful nomograms and tables are included in the appendix together with a list of references from which the book was compiled. The coverage of the book is very thorough and reflects the authority with which it was written. It will be a useful addition to the library of those involved in the study of heat transfer from high temperature gases.

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Turbulence Measurements and Flow Modeling

Edited by C. J. Chen, L.-D. Chen, and F. M. Holly, Jr.

New York: Hemisphere Publishing Co., 1986. Pp. 818. $125.00

This large and expensive volume is not a textbook, as it might at first appear, but a collection of the lectures and papers presented at the International Symposium on Refined Flow Modeling and Turbulence Measurements held at the University of Iowa in September 1985. The Symposium actually incorporated two meetings, on modeling and measurement, so the scope of the book is wide. It contains nearly 80 contributions arranged under the headings of experimental fluid mechanics, computational fluids mechanics, and (at over 40 percent of the total) applications. Four keynote lectures were delivered by Professors Lumley, Goldstein, Haugel and Macagno, the last on the methodology of Leonardo da Vinci. That this collection of contributed material represents a balanced treatment, as the editors claim, is debatable. To this reviewer, it more accurately reflects the unevenness of the work presented at this and most other research conferences. Here, as is usual in the proceedings of these events, are a few excellent papers, a few barely worthy of publication, and the majority between these extremes. It would be invidious to particularize. Many turbulence workers will have seen at least some of these papers already. Now all are made available, although it is not altogether clear to this reviewer at whom the book is aimed. Within the three main sections are papers describing a variety of measurement techniques; subsections on finite-element, finite-difference and finite-analytic methods; and experimental and computational applications to jets, boundary layers, cavity and duct flows, separation, stratified flow, and alluvial hydraulics.

The main weakness of the book is in this broad catch-all approach in which there are too many topics and too many papers. At 878 pages the book is too big for comfortable reading. Except in individual papers there has been no attempt to relate the two main topics of computational and experimental fluid dynamics, and specialists might wish that the papers in these areas had been published in separate volumes. It is, moreover, difficult to believe that all or even most of the papers here deserve this expensive treatment. Some are clearly interim reports on work in progress, valuable and interesting at a conference, but too ephemeral to be worth recording permanently. Their authors will no doubt wish in due course to publish the definitive account of their work in established and more accessible journals. But there are good things here to be read with pleasure and profit. One wishes that the editors had identified and published them in less cumbersome form.

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Vaporizers, Selection Design and Operation

By R. A. Smith

Harlow: Longman Group Ltd., 1987. Pp. 341. £45.00

For a long period of time engineers concerned with the performance of heat exchangers in process chemical plant used Kern's *Process Heat Transfer* as their bible. Over the last ten years a spate of handbooks have appeared, which present a more rational and complete basis for rating heat exchangers, particularly those involving vaporization. This book by Smith is, as far as I am aware, the first specifically and comprehensively devoted to the design and operation of waste heat boilers, vaporizers, and evaporators for the process industries. It is one of a series on "Designing for Heat Transfer," the other two titles promised are *Heat Exchangers—Construction and Thermal Design* (Single Phase) and *Condensation and Condenser Design*.

The author R. (Bob) A. Smith is particularly well qualified to write this book, as he has many years worked for ICI advising on the design and operational aspects of all types of heat exchangers. He is currently an independent consultant working for ICI, the Heat Transfer and Fluid Flow Service (HTFS), and ESDU. Additional specialist chapters, which enhance and complete the book, have been contributed by other colleagues from ICI: O.J. Dunmore advises on the materials of construction of vaporizers whilst P. J. Nicholson covers the operation, maintenance, and commissioning of vaporizers and the initially important topic of water treatment of steam-generating plants.

A short introduction outlining the contents of the book and an initial chapter that qualitatively describes the various modes of boiling and evaporation are followed by two chapters describing the various types of waste heat boilers and evaporators together with the ancillary equipment needed (separators, condensers etc.). Often inadequate performance from a vaporizer stems from an inappropriate initial choice of the type of unit. Guidance on the selection of the most appropriate equipment is given in Chapter 5, together with many tips on good operating practice based on experience so obviously learned the hard way!

The later chapters are devoted to rating calculations for vaporizers, starting with the single precepts of heat exchanger thermal design. A sound set of recommendations is provided for the estimation of heat transfer coefficients on the heating side of the vaporizer, be it the tube side or shell side of the heat exchanger. These recommendations include single-phase flow, condensation of single- or multi-component fluids, fouling, and methods of enhancing heat transfer. Three chapters (7, 8, and 9) are devoted to the details of calculating the heat transfer and the pressure drop (and therefore the circulation rate) for boiling systems. These chapters include a considerable number of worked examples to show exactly how the recommended correlations should be applied. Having established the details of the heating and vaporizing heat transfer coefficients, the remaining chapters show how the overall surface area of the vaporizer should be established and describe the mechanical design of the vaporizer, including the all-important check for flow-induced vibration of the tubes.

I have no doubt that this book should be on the shelf of every rating engineer for heat exchangers in the process industries. Waste heat boilers, vaporizers, and evaporators are notoriously difficult to get right. If the advice in the book is followed, then at least the designer has maximized his chances of providing a satisfactory and reliable unit.

The book is well presented and clearly written with a good index and reference list. The units employed are SI. It would be a pity if this limited the appeal of the book in the United States.

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