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BOOK REVIEW

Review of: Transport Phenomena with Drops and Bubbles, by **S. S. Sadhal, P. S. Ayyaswamy and J. N. Chung** (Springer Verlag, 1997, 520 p. DM 128).

Readers of this Journal will probably be familiar with the book "Bubbles, drops and Particles" (1978) by Grace, Clift and Weber. In that book the emphasis was mainly on fluid mechanics. The book under review, while giving attention to fluid mechanics, emphasizes the transport of heat and mass. It is divided in nine Chapters: 1. Fundamental principles and definitions. 2. Shape and size of Fluid Particles. 3. Transport at low Reynolds numbers. 4. Transport at intermediate and high Reynolds numbers. 5. Wall interactions. 6. Transport with a spectrum of Fluid Particles. 7. Formation and Break up of Bubbles and Drops. 8. Compound Drops and Bubbles. 9. Special topics. In undertaking such a huge project one should have a clear idea for whom one writes. According to the preface "This book is intended to be a reference volume for engineers, educators and graduate students concerned with transport phenomena in relation to mechanical and chemical engineering". Now, engineers and researchers will need expressions for heat and mass transfer in terms of dimensionless numbers, applicable in circumstances of their interest. Educators and graduate students will look for enlightment and insight to understand the processes and mechanisms which lead to the desired relations. The authors have not always succeeded in providing a good balance between the two. Students will be confused repeatedly and be misinformed on occasions. Some examples:

– After the introduction on page 4 of the continuity equation $\nabla \cdot \mathbf{u} = 0\,(1.3)$ and the definition of the vorticity, as $\zeta = \nabla \times \mathbf{u}$, we read: "The continuity equation (1.3) still holds and leads to the following relationship for the vorticity $\nabla \cdot \zeta = o$".

This is misleading since ζ is a solenoidal vector merely by its definition.

– On p. 43 the subject of surface viscosity is mentioned. The authors write "The velocity gradients within an interface require generally a surface in order to sustain them. This is due to the existence of a surface viscosity. Boussinesq ..... "As readers, we are curious what the opinion of the authors is about these surface viscosity's. However there is no further mention in the book. And to complete the confusion we read on p. 7 "For most cases, an interface can be considered to be of infinitesimal thickness".

– Whereas extensive use is made of the unit normal $\mathbf{n}$, the surface curvature is always expressed as $(1/R_1 + 1/R_2)$, without mentioning that this quantity equals $\nabla \cdot \mathbf{n}$.

– Even for an experienced researcher or educator, let alone for a student, the following sentence willl be incomprehensible "the main criterion is that the Henry's law constant be at least 100 atm. This is the proportionality constant that relates the partial pressure of the gas at the interface to the surface molar concentration c of the dissolved gas." Here it would have been appropriate to derive Henry's law from thermodynamic principles (Gibbs-Duhem) and to discuss the dimensions and units of the various quantities.

While the above remarks more or less concern the tutorial quality of the book under review, here follow some comments on the scientific content.

In general the list of references at the end of each chapter is extensive and as complete as possible. However the weight that is attached in the text does not always correspond with the significance of papers. For example,

in Chapter 7, "Formation of Bubbles and Drops" much space is devoted to a dubious calculation of added mass, whereas an important paper by Óguz and Prosperetti [121] is given a few lines.

Another criticism is that some important fields of recent research get little attention. For example, more should have been said about nonspherical bubbles. Not mentioned at all are the results on suspensions obtained by Batchelor, Hinch, Jeffrey and others with help of statistical methods. It is true that these developments are mentioned in passing on p. 30 where we are promised that "we have dealt exclusively with this topic in Chapter 6. Almost nothing of the kind is found however in Chapter 6".

The authors are at their best when dealing with their own work or with work with which they are closely associated; thermocapillary effects, Marangoni effects, compound bubbles and similar phenomena. There is a lot of that in the book so that there is much to enjoy.

In summary; Useful as a reference book if you are in search for a specific result but this reviewer hesitates to recommend it as a textbook for students.

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