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Chemical Engineering Journal 81 (2001) 337–341

Chemical Engineering Journal

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Book reviews

Transport phenomena

W.J. Beek, K.M.K. Muttzall, J.W. van Heuven; John Wiley and Sons Ltd., 1999, 2nd edition, 342 pp, £34.95 (paperback), £100.00 (hardback), ISBN: 0-471-99990-3 (paperback), 0-471-99977-6 (hardback)

This is a textbook covering the classical topics within transport phenomena, which includes the transport of momentum (fluid dynamics), heat and mass. It is intended to serve as a basis for a course within the curricula of, for instance, chemical or mechanical engineering. In the preface to this second edition the authors emphasize its suitability for 'vocational studies'.

The book is part of a tradition in transport phenomena here in The Netherlands, which has its origins in a series of lecture notes written in the 1950s by Prof. H. Kramers, who taught the subject at Delft Technical University. Also the well-known book 'Transport Phenomena' by Bird, Stewart and Lightfoot has benefited from this tradition.

In the preface to this second edition, the authors defend the existence of their book, next to the one by Bird et al., with the argument that this book mainly serves vocational studies and students 'not opting for an academic career' (p. xi). This argument is, in my opinion, not necessary: this book is sufficiently fundamental in its treatment, and one wonders if students in the more vocational studies would wish to wrestle with transport phenomena at this level. Nevertheless, the book has right of existence: experience teaches us that a subject can only be fully appreciated if it has been studied in at least two texts; not until then is it possible to distil out the essentials. The trend towards one worldwide standard textbook in each subject is therefore not a good one. Having more points of view enriches our understanding.

The organization of the book is in four chapters, Chapter 1 is an introduction to the basic concepts, and Chapters 2, 3 and 4 are devoted to momentum, heat and mass transfer, respectively. Each chapter is then subdivided into sections. All the classical topics are covered. One new topic, which is not included, is that of computational fluid dynamics. Rightly or wrongly, computational fluid dynamics now plays such a central role as a tool in transport phenomena that an introduction to the method and some of its possibilities and limitations might well be included in a textbook such as this.

The book is pleasing to read: the typeface used and the general layout make it very readable. Diagrams help to visualize the material. As the authors state, estimating orders of magnitude is an important aspect of the study and application of transport phenomena. A feature of the book are the many pieces of information helpful for doing that, for instance the list of drag coefficients in Table II.4 and the list of heat transfer coefficients in Table III.6. The authors have struck a good balance between giving detail of derivations and clarity of the exposition. Another prominent feature of the book is the problems included after each subsection, some of which are also discussed.

As mentioned above, diversity surely enhances our understanding, but it also leads to more glitches. This book is not without blemishes either. One aspect, which is essential for understanding flow phenomena, is the *sign of shear stresses*. The convention in this book (as in Bird et al.) is to consider shear stresses as momentum fluxes. This means that the shear stress τ acts on the fluid at *greater* coordinate, one consequence of which is that it appears with a minus sign in the famous force balance on a central plug of fluid leading to the laminar velocity profile in a pipe. The *direction* in which τ acts is then expressed in its numerical value. If the student does not appreciate this, he or she will wade through the entire subject in constant confusion about signs. This book does not make this clear. In fact, we are even told on page 44 that the sign with which τ appears in the force balance is a consequence of the direction in which it acts.

Overall, I can recommend the book to the student or lecturer of transport phenomena as an enrichment. It is also suitable as the main textbook for a university course, making a somewhat less daunting impression than some of the other books on the subject.

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PII: S1385-8947(00)00180-7

Chemical engineer's condensed encyclopedia of process equipment

Nicholas P. Cheremisinoff; Gulf Publishing Company, 2000, 387 pp, $125.00 (hardback), ISBN: 0-88415-144-1

After receiving this book for review I started browsing through it and that gave me an as yet unidentified bad feeling.

Then I started reading some entries on equipment I had been working with during the last few years. I read the entries on cooling towers, on pumps, on extruders, on distillation, on compressors, just to mention a few and the bad feeling did not disappear, although it remained difficult to pinpoint what the real problem was I had with the book. I gave the book to my son, who is a technician, specialised in reading comics, and he helped me to find what is wrong.

This book certainly presents a rather complete listing of process equipment as used by chemical engineers in all their diverse fields of activity. The equipment is listed alphabetically, which could make it easy to find, if only the listing had been on the main equipment name. Unfortunately, this book does it on the adjective! For example, Twin Screw Extruders are found under T, while under the heading Extruders (under E) there is no reference to the existence of Twin Screw Extruders. In general, cross-references between entries are lacking and, even worse, analogies between processes are not mentioned (Is an absorption column really completely different from a distillation column?). Furthermore, the entries are rather incomplete about types of equipment within a category. For example, structured packings are not mentioned at all, neither under distillation nor under absorption.

Most of the text is used to explain how a piece of equipment works in such a general way, without dealing with the principles that govern its performance, that the value of the book for an engineer in actual practice is very questionable. References are generally lacking and most of the referenced literature is rather old.

The book contains a lot of illustrations to elucidate the text, but most of them are of very bad quality. This is where my son helped me out: a lot of illustrations have apparently been picked from other publications and have been adapted in size and/or form to fit the space. This has led to distorted equipment (ellipses instead of circles) and gives the impression that process equipment is full of ellipsoidal rotors, pulleys, vessels etc. Some figures contain so much detailed information in a small picture that they are unreadable and some illustrations are really misleading. The typical operating scheme of a centrifugal pump, showing a pump with a suction line extending into a pit below the pump is an example of this (It suggests that centrifugal pumps would be selfpriming; the text explains that that is not the case.). The editing of the figures is of such an unbelievably low quality that I do not understand the gratitude the author expresses to the publisher in the preface 'for their fine production of this work.'

It is the combination of the above features that explains in hindsight my bad feelings during my first browsing through the book. This book does not even deserve browsing.

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PII: S1385-8947(00)00181-9

The Chemistry and Technology of Furfural and its Many By-products

Karl J. Zeitsch; Elsevier, 2000, 358 pp, US$ 235.00 (hardback), ISBN: 0-444-50351-X

There has been increasing interest in producing chemicals and fuels from renewable resources or biomass, especially with today's environmental concerns. Among the several bio-chemicals manufactured commercially, furfural is important for its wide applications with over 200,000 t annual production in the world and for its unique availability from agricultural wastes and forest residues. Karl J. Zeitsch's book may help promote new technology and applications of furfural.

This comprehensive book precisely describes the chemical mechanism and technology of furfural production, its by-products, and its many derivatives. The first eight chapters concentrate on the mechanism and kinetics of furfural generation from pentosan and its loss by resinification and condensation. Chapters 9 through 13 review various developed and potential furfural processes by hydrolysis, distillation and wastewater treatment. The remaining, Chapters 14 through 32, cover by-products of acetic acid and diacetyl and many furfural derivatives. Appendices list properties of covered chemicals, some details of analysis, operation conditions, and furfural applications.

Based on a clear picture of the kinetics of furfural formation and loss, Zeitsch addresses the low yield of furfural in commercial processes, which can only reach 50–60% of the laboratory value. In the temperature range 140–180°C used in the industry, the furfural yield is limited by the loss reactions of resinification and condensation with intermediates during the hydrolysis. He also attributes the low yield to the furfural being in a liquid phase at these low temperatures. In the elucidation of furfural existence in liquid phase, however, mass transfer and complete phase equilibrium principles are not employed. Many furfural processes are reviewed with emphasis on Quaker Oats and Rosenlew. However, several processes used in China, Italy and Russia are lacking. Zeitsch strongly suggests higher temperature hydrolysis because the furfural loss reactions can then be subdued. Consequently, three potential processes carried out at 200–240°C: Supertherm, Stake, and Suprayield, are discussed. Besides production from biomass directly, the production of furfural from sulfite liquor, a waste in a paper mill, is described. This adds value to the book since these special processes are rarely published in books on furfural.

In the section on by-products, Zeitsch presents acetic acid first, then moves to diacetyl and its derivative, acetoin. The recovery of by-product acetic acid includes various processes: extraction, freezing, azeotropic distillation, extractive distillation and re-circulation. One of Zeitsch' major contributions covers the recovery of diacetyl and 2,3-pentanedione. Followed by the explanation of formation mechanisms and processes of the by-products in furfural reactors, Zeitsch details the recovery techniques by extractive