COAL PROCESSING

Continued from page 186.

The lectures or chapters cover a wide range of topics starting with the origin and formation of coal and continuing through the physical and chemical structure and properties of coal, and methods for processing and utilizing various kinds of coal. Although established technology is reviewed, there is an important emphasis on newer techniques such as fluidized bed combustion, supercritical gas extraction, and the production of carbon fibers. New processes under development for manufacturing gaseous and liquid fuels from coal are also discussed. There is an additional chapter not covered by the original lectures which deals with the application of high resolution electron microscopy to study the microstructure of graphitized and partially graphitized carbons derived from coal.

The volume is highly readable and provides a basic but rather brief (210 pages) introduction to the science and technology of coal utilization. It does not probe any topic in great depth nor provide many details and the list of references at the end of each chapter is short. On the other hand, it does provide a good overview of a number of topical areas and should appeal to a great many readers who desire a brief introduction to the subject. Furthermore, even though the book tends to emphasize technology which is of particular interest to the British, it includes enough material about new developments in the United States and other countries to insure world-wide interest. The volume could well serve as a text for an introductory course on coal science and technology for college students with some background in chemistry and chemical engineering. □

THE CHEMICAL REACTOR OMNIBOOK

By Octave Levenspiel; published by the author and distributed by Oregon State University Book Stores, Corvallis, OR 97330

Reviewed by Rutherford Aris
University of Minnesota

As one who has often been puzzled by the ways of publishers it is refreshing to find them at once so right and so wrong. So wrong those conventional publishers who declined a book of Octave Levenspiel's; so right, the author and the Oregon State University Book Stores who published the book in the form which it takes. In it the problems are beautifully typed and are linked by chapters in Levenspiel's own hand. This is a round cursive of admirable clarity and consistency and in itself conveys the vitality and interest of the spoken word. When linked with his figures and sketches in the organic way which he achieves, we have the effect of being in the classroom with a teacher of known and valued vitality and his pages have all the immediacy and effectiveness of the author's presence.

One of the first things the teacher of chemical engineering will spot is that here is a positive gold mine of problems. There are no less than 1394, though it must be admitted that many are one-line modifications of their neighbors. The book is divided into seven main divisions (numbered to leave a small remainder when 10 n is subtracted, n = 0, 2, 3, 4, 5, 6, 8) with an interlude between the first two and a coda on "Dimensions units, conversions and the orders of magnitude of this and that." Single phase reactors are the burden of the first division which is divided into seven sections and has more than a third of the problems. The interlude (sec. 11) is on the background of multiphase reactors and leads to a division on (secs. 21-25) reactors with solid catalysts that ranges from the particle to the fluidized bed. Then there is a discussion (secs. 31-34) of catalytic reactors with changing phases, of gas/liquid and liquid/liquid reactions (secs. 41, 42) and the reactions of solids (secs. 51-55). Levenspiel next groups together some discussions of the flow of materials through reactors (secs. 61-64, 66, 68) and concludes with a section on biochemical reactors using enzymes and microbes (secs. 81-85). It is interesting to speculate whether a future doctorate (a D.Ed. perhaps) will be awarded for discussion of what forms of life might once have played in these "Lacunae of Levenspiel" (secs. 65, 67, and the 70's).

The style of the text sections is, by design, sketchy. More often than not, it jumps from the statement of a problem and its background to a conclusion and adds certain comments afterwards. This makes it an interesting book to think of using in a course since, although one would be to some extent committed to its notation (and who among us is not fiercely jealous of their own) it would provide a most useful framework with the least restriction. Indeed Levenspiel suggests that its use might be as a supplementary text in a course and very helpfully explains how he himself has used it. It can also be used for a self-paced/self-study course on the subject and is certainly a useful book to have for reference. The reader using the Omnibook for self-study would no doubt wish for more references, for these are not given in any complete and systematic way. I would have liked to have seen Levenspiel's presentation of the dynamics of reactors, for his virtuosity in the integration of text and figure would have been extended by a description of the recent work on possible behaviors of the stirred tank. But I must not get carried away on my hobby horses.

The last chapter (sec. 100) is an admirable collection of units and conversions between them. I trust I shall never need to use a number with a dimension, but if such disaster should come upon me, I shall flee for refuge to this "Miscellany". As in so many places throughout the book, Levenspiel has here an original touch; he gives "spectra" of the orders of magnitude of various diffusivities, conductivities and rates of reaction. □

ChE class and home problems

The object of this column is to enhance our readers' collection of interesting and novel problems in Chemical Engineering. Problems of the type that can be used to motivate the student by presenting a particular principle in class or in a new light or that can be assigned as a novel home problem are requested as well as those that are more traditional in nature that elucidate difficult concepts. Please submit them to Professor H. Scott Fogler, ChE Department, University of Michigan, Ann Arbor, MI 48109.

Our undergraduate student readers are encouraged to submit their solution to the following problem to Prof. Ray Fahien, Editor, CEE, ChE Department, University of Florida, Gainesville, FL 32611, before January 1, 1982. A complimentary subscription to CEE will be awarded, to begin immediately or, if preferred, after graduation, for the best solution submitted (Oregon State students are not eligible). We will publish Prof. Levenspiel's solution in a subsequent issue.

DOLPHIN PROBLEM

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Whales, dolphins and porpoises are able to maintain surprisingly high body temperatures even though they are immersed continuously in cold, cold water. Since the extremities of these animals (tails, fins, flukes) have a large surface to volume ratio, a large portion of the heat loss occurs there.

a) Now an ordinary engineering junior designing a dolphin from first principles might view the flipper as a flat single pass heat exchanger with heat transfer occuring between a blood vessel passing through the flipper and the flipper itself which is assumed to be at the water ambient temperature.

Let us suppose that blood at 40°C enters the flipper at 0.3 kg/s, feeds the flipper, is cooled somewhat, and then returns to the main part of the body. The dolphin swims in 4°C water, the overall heat transfer coefficient is 100 cal/s·m²·K and the heat transfer area is 3 m². At what temperature does the blood reenter the main part of the body of the dolphin?

b) Frankly, the ordinary engineer above (which you obviously are not) would design a lousy dolphin. Let's try to do better; in fact let us try to learn from nature. Let us see if we can reduce some of the undesirable heat loss by inserting an internal heat exchanger B ahead of the flipper exchanger A above. This internal exchanger is a countercurrent one which transfers heat from the outgoing warm arterial blood to the cooled venous blood returning from the flipper. Heat conservation of this sort, by having arteries and veins closely paralleling each other, in counterflow, is one of nature's clever tricks.

Assume for this internal exchanger B that

$$A_B = 2\ \text{m}^2$$

and

$$U_B = 150\ \text{cal/s}\cdot\text{m}^2\cdot\text{K}$$

With this extra exchanger find T_3, the temperature of blood returning to the main part of the body; and, in addition, the fraction of original heat loss which is saved. Approximate the properties of blood by water. □