A student gets the maximum out of a problem if he has to work on its solution before the subject is discussed.

A pipe was lowered into the sea with a semipermeable membrane at the bottom. Fresh water would rise in the pipe. The density of the salt water is greater than that of pure water. If the unit were lowered deep enough into the sea, the pressure difference would exceed the osmotic pressure, and water would flow out of the pipe. What is wrong with this conclusion? The answer is that ΔG is zero over the sea water, and zero over the pure water. Also ΔG across the membrane is independent of the depth and never would be zero.

This problem is the same problem as the beaker problem, only more verbose. An article on desalination where the sea water on the bottom is less salty than at the surface was proposed to produce fresh water. This idea led to a method of using the pipe to desalinate water due to a concentration gradient. What started as a single short quiz ended with a real process and helped educate a great many people in the process.

SOME HOME EXAMINATIONS

HOMEWORK PROBLEMS are quite vital in any course. These problems should be thought-provoking and not merely require substitution into equations that are derived in books.

The osmotic head of a 0.35% NaCl solution is about 95 ft. When desalinating water, the head needed (410 ft.) is much greater as illustrated by the following problem:

A perfect membrane is to be used to produce water from a NaCl solution.

$P = \pi + 1$ $P = 1$ Atm

——→ Pump ——→ Membrane ——→ Turbine ——→

70°F
0.35% NaCl

↓ (from Membrane)

H_2O
$P = 1$ Atm

Calculate the minimum energy required to produce a pound of water if the compressor and expander have an efficiency of 70% each.

Two interesting homework problems would be as follows:

1. Given dry air at 90°F. It is desired to keep a room at 70°F with a Freon 12 air conditioner. 400 BTU/minute is the desired heat load.

(a) Draw a flow diagram for a satisfactory unit assuming reasonable operating conditions.

(b) Account for all the extra horse power required over the needed reversible work. Give the HP loss for each unit in your flow diagram.

2. Estimate how fast a penny will sink through a field of ice which is at 32°F.

CONCLUSIONS

A STUDENT GETS the maximum out of a problem if he has to work on its solution before the subject is discussed. The best course that I took in thermodynamics was one where we had to solve all the problems without class discussion. I feel that the above approach is especially productive for graduate courses, but I have used the above method on juniors in college with excellent results.

The quiz method of teaching is productive from elementary school through high school, undergraduate and graduate-college courses. In place of cramming for one or two large examinations, students are kept aware of their progress in the subjects from day to day.

When the learning process is distributed over a long period, the retention of the principles is much better than if that same material were crammed into a couple of weeks before a big exam. □

ChE book reviews

INTRODUCTION TO WASTE-WATER TREATMENT PROCESSES

By R. S. Ramalho,
Academic Press, Inc., 1977 ($22.50).
Reviewed by Robert C. Ahlert,
Rutgers State University

My initial, superficial reaction to Professor Ramalho's book was quite positive. His plan was well conceived. The subject matter is of great professional interest to several disciplines, especially at an elementary level. The sequential development of topics in the text is very appropriate, while the tutorial technique employing illustrative examples is effective as a teaching tool and as a model for independent design.

A second reading, in depth, dampened my enthusiasm. What is the audience for this text? It is clearly prepared for use as an undergraduate engineering text or as the basis for a nonprofes-

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BOOK REVIEW: Waste-Water

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sional, graduate level, survey course. There are few undergraduate curricula or options in Sanitary and/or Environmental Engineering in the United States. However, for these it is relatively well suited. Teachers and students alike will recognize that this text is indeed an introduction and must be followed by further study or an apprenticeship in design before actual professional plant design can be contemplated. As a supplementary text for Chemical Engineering process or plant design courses the book is admirable.

The larger audiences may be in undergraduate Environmental Science and graduate Planning, Management Science, Urban Policy, etc. For these user groups, the text is too quantitative, lacking the descriptive material to place unit processes and overall treatment in proper overall community or industrial context. It may even create a false sense of intellectual security leading to attempts at independent design or design critiques that are controversial and counterproductive. In short, it lacks the clarity and comprehensive coverage that survey material aimed at managers and decision makers requires. If the author's goal is to "train the reader to evaluate any wastewater treatment problem so that he may properly select the processes and the design of the required equipment," he falls far short with the first audience and has an inappropriate goal with the second.

As an undergraduate engineering text, Professor Ramalho's book has some defects in detail. His references are outdated; the latest reference, that of Metcalf and Eddy (1972), should be one of the earliest. The last 5-10 years have been a period of great reorganization and reinterpretation of wastewater treatment technology. As a glaring example, there are no citations of USEPA manuals, yet many are good compendiums of design data and procedures. In addition, any design of consequence must meet the USEPA review criteria from which these manuals evolved. The AWWA, APWA, AWRA, AIChE, ASCE and other agencies concerned with "water" have excellent material available, also.

The use of a mixture of metric and English units is disconcerting. In most instances, there is unnecessary reliance on pounds for total loads and milligrams for concentration units. The letter M is used ubiquitously for million, as MGD, yet current metric usage of M for "kilo" and MM as the 10^6 multiplier notation is recognized widely. Rate constants on a per hour basis are not useful.

A discomfort and tentativeness with desirable depth of design detail is apparent in several chapters. I will use Chapters 3 and 5 as examples. Chapter 3 begins with a good elementary theory section, lacking only a clear distinction between settling and thickening. The real process design actually commences with the section on Flocculent Settling. This section, i.e. 3.5, devotes many pages to "cook book" procedure that is not direct or unambiguous, lacks adequate theory and uses language that places more emphasis on jargon than on clarity. Section 3.6 fails to draw distinctions between clarification and thickening and, similarly has little substance in an important design case study. Section 3.7 is of practical concern and is much too brief.

Chapter 5 requires rework for a second edition. It is a mixture of modeling, design and microbial ecology. It attempts too much and achieves too little. Why? Figure 5.1 and Table 5.1 are one reason. The number of variables stated is very large and of interest only to advanced modelers. This is an awesome introduction to activated sludge. The use of THOD as a design basis is questionable. The description of laboratory rate measurement experiments is best left to a graduate laboratory manual or kinetics text. There is too much jargon; is MLNVSS really necessary? An overconcern for detail in this chapter leads to cluttered displays, e.g. Figures 5.16 and 5.17, that serve to distract rather than to inform.

All-in-all, I am in sympathy with Professor Ramalho's effort and interests. However, the result has a narrow audience and does not compete with the Metcalf and Eddy text in conjunction with a set of USEPA manuals.

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plastics and rubber particularly well is that they spend too much space on synthetic chemistry. It would be better spent discussing solid state structure, crystalline morphology, mechanical properties and performance. If one can accept copper and steel without saying much of how they are made, can't we do the same for polyethylene?

In summary, this volume is a reasonably well done intermediate level undergraduate text in materials science. □