of an Eastech 2350 vortex shedding flowmeter. This unit is valved into a separate, clear plastic, pipe loop as shown in Fig. 1. Internal diameter of the pipe is 25.4 mm, this loop's control valve being also of stainless steel. With the ancillary signal processor, digital display of the flow rate (in gpm) is obtained. Since the fluid flowing past this device is fed to the rotameter (Fig. 1), this meter's readings can be compared with those obtained by weighing. Also, the straight entrance length required before the meter and the fact that the minimum measurable flow rate is much higher with a 50.8 mm than with a 25.4 mm diameter pipe, necessitated inclusion of a separate pipe loop.

The choice of a vortex shedding flowmeter over other sophisticated and nearly fool-proof systems, was made because of its educational value. In the first place, its principle of operation (that of vortex shedding when real fluids flow past submerged bluff objects) is a natural phenomenon and is usually covered in undergraduate fluid mechanics course. Also, with clear plastic pipe, the vortex shedding frequency can be observed using a strobe-light assembly.

Another feature that has been incorporated involves installation of a series of 1.6 mm diameter flush-mounted pressure taps upstream and downstream of the orifice. This is intended to highlight the dependence of orifice discharge coefficient on pressure tap locations, as well as the trends in pressure distribution in the vicinity of surface mounted protrusions.

CONCLUDING REMARKS

The design of a versatile fluid flow experiment for undergraduate instruction has been presented. The flexibility in design and construction facilitates addition of some of the latest technology in flow measurement. The equipment is inexpensive when compared to the cost of commercial units with limited features. In addition to the supplies, about a week of a technician's time is required for construction of the unit.

As to the laboratory teaching procedure, it may be noted that each group of three is required to carry out this experiment, and drag measurement or mixing, during a two-week period. Even with the additional features noted above, seven hours of laboratory time are allowed for this experiment, as is the case for the other fluid mechanics experiment. Groups that do not complete an experiment during the scheduled period are required to do so on their own time. In general, each group is required to give an oral progress report after completion of the first of two laboratory periods. Plots of all data obtained during the first laboratory period, along with typical calculations, must be presented to the instructor just before the oral presentation.

REFERENCE

1. *Chemical Engineers' Handbook*, R. H. Perry, et al. (eds.), 5th ed., McGraw-Hill, N.Y. 1973. □

ChE book reviews

THE CHEMISTRY TUTOR: BALANCING EQUATIONS AND STOICHIOMETRY

By Frank P. Rinehart
Wiley Educational Software, Wiley & Sons, Inc., $25.00 (1984)

Reviewed by
Pradeep B. Deshpande and Walden L. S. Laukhuf
University of Louisville

The Chemistry Tutor consists of programs designed for use with the APPLE II+ or IIe computer with a disc drive and DOS 3.3. The programs deal with balancing equations, stoichiometry, and limiting reagents.

The first set of programs is designed to teach the user how to balance chemical equations. The exercises ask the user to select the coefficients in the equation, and the program checks whether the equation is balanced. If the equation is balanced the user moves on to the next exercise. If not, another set of coefficients may be entered and checked for correctness. The user has the option to ask for help through a tutorial. The tutorial asks how many atoms of each element are present on each side of the equation. Sooner or later the reader discovers what element is not in balance.

The second segment deals with stoichiometry. The exercises enable the user to decide how much of a reactant or product is consumed or formed given the mass of any other reactant and product. The final set of programs is concerned with limiting reagents. The objective, in this instance, is to decide how much of any product could form given the specified amounts of two reactants, when one of them is a limiting reagent.

The programs are well written and are user friendly. Unfortunately, the exercises are too elementary for college level students. The usefulness of the programs would be enhanced if the author could be persuaded to include the analysis of redox reactions by change in oxidation state or ion-electron technique.

The reviewer was assisted by Prof. Emeritus P. M. Christopher in the review. His assistance and comments are gratefully acknowledged. □