BOOKS

One-Dimensional Two-Phase Flow, Graham B. Wallis, McGraw-Hill, New York (1969).

A truly outstanding book with an incisive treatment of difficult and often bewildering subjects!

Although Wallis' book rests heavily upon the contributions made by Wallis himself, his colleagues, and his students, the supporting literature that is used is so extensive that one can adopt this book as a definitive and starting point for future contributions. The author is to be commended for his breadth of vision, the imaginative applications, and the logic of the treatments. The style and crispness of the language add immeasurably to the reader's interest.

The author has stated that "The purpose of this book is to make a thorough presentation of the basic techniques for analyzing one-dimensional two phase flows and to show how they can be applied to a wide variety of practical problems." Whereas heat and mass transfer phenomena have of necessity been excluded in order to keep this book of manageable proportions, Wallis should be encouraged to bring forth the appropriate sequel. Wallis has noted a refreshing list of two-phase flow cases, such as "fog, smoke, rain, clouds, snow, icebergs, quicksands, dust storms, and mud" as those occurring in nature; " . . . boiling water, tea making, egg scrambling, salad tossing, jam spreading, cream whipping, sugar stirring, and spaghetti twirling . . . " as kitchen and dining room exercises; blood, semen, and milk as examples in biological systems; and paints, inks, plastics, and nuclear slurries as examples in industrial processes.

The book has been arranged with Part 1 devoted to analytical techniques, covering an introduction, homogeneous flow, separated flow, the drift-flux model, velocity and concentration profiles, one-dimensional waves, and interfacial phenomena. Part 2 treats practical applications involving suspensions of particles in fluids, bubbly flow, slug

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INFORMATION RETRIEVAL*

Optimal feedforward control of concurrent tubular reactors, Bertran, David R., and Kun S. Chang, **AIChE Journal, 16,** No. 6, p. 897 (November, 1970).

Key Words: A. Control-7, 8, Feedforward-0, Optimization-8, Reactor-9, Tubular-0, Concurrent-0, Jacketed-0, Denbigh Reactions-4, Algorithms-10, Heat-6, Feed-6, Yields-7.

Abstract: Optimal control of concurrent nonlinear tubular reactors for complex reaction systems is studied. The jacket side temperature is allowed to vary along the reactor length and with time. The optimal control possesses feedforward component only, and the nonlinear gain may be precomputed. For Denbigh type of reaction system, if the heat generation is negligible, the control temperature is insensitive to feed concentration variations. With heat generation effect present, the optimal control is time dependent, and the nonlinear feedforward gain is obtained. The gain may be approximated by a linear function to construct a simple linear feedforward control loop which contains a synchronized time delay.

Mixing in viscous liquids, Coyle, C. K., H. E. Hirschland, B. J. Michel, and J. Y. Oldshue, **AIChE Journal, 16,** No. 6, p. 903 (November, 1970).

Key Words: A. Mixing-7, 8, 9, Liquids-9, Pseudoplastic-0, Newtonian-0, Viscous-0, Speed-6, Impeller-9, Helical-0, Blending-7, 8, 9, Time-7, Viscosity-6, Geometry-6.

Abstract: Detailed data are reported for blend time and turnover time with a 17-in. impeller operating in an 18-in.-diam. tank. Above 1,500 centipoises, viscosity had no effect on blend time at constant speed. Blend time was inversely proportional to speed. The inner flight of a helical impeller is of value when blending pseudoplastic fluids but has no effect on blend time with Newtonian fluids. The ratio of blend time to turnover time is given, as well as the effect of several different helical impeller geometry variables.

Recoverable shear measurements in a parallel plate rheometer, Fruh, S. M., and F. Rodriguez, **AIChE Journal, 16,** No. 6, p. 907 (November, 1970).

Key Words: A. Measurement-8, Shear Stress-8, 9, Rheometer-10, Parallel Plate-0, Polyisobutylene-9, Poly(dimethyl siloxane)-9, Hooke's Law-8.

Abstract: A parallel plate rheometer has been devised which permits measurements of shear stresses of 10^2 to 10^5 dynes/cm^2., and shear rates of 10^{-5} to 1 sec.$^{-1}$. With a sample of polyisobutylene and with several samples of poly(dimethyl siloxane), it has been established that a Hookean range exists for each sample at low stresses.

Predictive feedback control of a continuous flow stirred tank reactor, Huber, C. I., and R. I. Kermode, **AIChE Journal, 16,** No. 6, p. 911 (November, 1970).

Key Words: A. Control-8, Feedback-0, Predictive-0, Continuous Flow-10, Stirred Tank Reactor-9, Reactor-9, Concentration-10, Effluent-9; B. Comparison-8, Control-9, Direct-0, Feedback-0, Predictive-0.

Abstract: A novel feedback control system called a predictive feedback control system is developed for the regulation of the exit composition of a continuous flow stirred tank reactor. The control system utilized two basic feedback signals. One is the effluent concentration of the composition to be controlled. This is measured by a batch-type composition analyzer such as a chromatograph. The other is a predictive-feedback signal which continuously predicts the difference between the actual value of the controlled variable and the measurement supplied by the analyzer. The predictive signal is generated from a plant model which approximately relates the controlled variable and the continuously measured reactor temperature.

Free tear sheets of the information retrieval entries in this issue may be obtained by writing to the New York Office.

* For details on the use of these Key Words and the AIChE Information Retrieval Program, see **Chem. Eng. Progr.,** Vol. 60, No. 8, p. 88 (August, 1964). A free copy of this article may be obtained by sending a post card, with the words "Key Word Article" and your name and address (please print) to Publications Department, AIChE, 345 East 47 St., N. Y., N. Y., 10017. Price quotations for volume quantities on request.

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flow, annular flow, and drop flow. Empirical correlations and practical applications are interspersed in Part 1 for comparisons, and Part 2 includes additional analytical treatments. Thus the division of the parts is not absolute, nor should it be.

The great strength of Wallis' developments is the applicability of the relations presented to a variety of problems in relatively easy to follow logical steps. Numerous, well-chosen illustrations are given which enhance the interpretations, including appraisals of limitations when desirable. The problems which accompany the chapters add to the subtleties of the work, but may prove to be overwhelming.

With the subject material so vast, Wallis has had to choose carefully the areas to be developed and the extent of the sophistication warranted. Thus, treatments dear to others might be only obliquely presented here, such as the choking steam-water flow given in Example 3.1. In considering momentum balances for each phase and combinations, one might ask what are the limitations, if any, in the case of weighting factors for the combinations, and not be content with what is convenient. Wallis is careful in remarking that in his notation (which is excellent and ought to be used by all) the f's introduced to care of what is left over in the momentum balances " . . . contain components due to hydrodynamic drag, apparent mass effects during relative acceleration, particle-particle forces, forces due to momentum changes during evaporation or condensation and so on." Components are treated in various portions of the book, but are not given a unified exposition.

The chapters are done well and with considerable finesse. For example, Professor Wallis remarked in conjunction with continuity and dynamic waves, that "Only very simple ideas of continuity are needed in order to understand what is going on and it is high time that the subject was given a place in elementary fluid mechanics texts." Chapter 6 on One-Dimensional Waves demonstrates that Wallis has indeed successfully accomplished this goal.

It may come as an exciting revelation to most engineers and scientists that two-phase flow is really of direct interest and benefit to their studies and work, too. Thus, Wallis' book, "One-dimensional Two-Phase Flows," should make a strong impact in teaching, research, and practice.

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