Chemical Engineering: An Introduction

By M. M. Denn, Cambridge University Press, New York, NY. 2012, 265pp., Hardbound $125.00; Paper $48.00

A staple of the undergraduate chemical engineering curriculum is the introductory course, usually taught in the first term of the sophomore year, and often referred to as "mass and energy balances", "chemical process principles", or just "introduction to chemical engineering." Over the years, a number of textbooks have been available for this course; at present, the most widely used text is Felder and Rousseau, *Elementary Principles of Chemical Processes*. Another noteworthy text is Murphy, *Introduction to Chemical Processes*. The basic elements of most courses include fundamentals of material balances, including process flow sheets, single and multiphase systems, energy balances on closed and open systems, and balances on nonreactive and reactive processes. Details of the chemical reactor and of particular separation processes await the traditional subsequent courses. The nature of the introductory course depends in many respects on the extent to which it bears a portion of the thermodynamics instruction. Felder and Rousseau covers a good deal of thermodynamics, and, therefore, fits well with a subsequent one-term thermodynamics course.

Chemical Engineering: An Introduction by Morton Denn, offers a different approach than current textbooks. The overall goal of the book is to give the student a sense of what chemical engineering is all about, using material and energy balances on real, albeit simplified, problems in process design. After an introductory chapter on the scope of modern chemical engineering, the next three chapters introduce elements of balance equations, including financial balances and the concept of net present value. Chapter 5 uses membrane separation, as exemplified by hemodialysis, as a vehicle for introducing the idea of a separation, with an introduction to the concept of countercurrent processing, one of the great paradigms of chemical engineering. The CSTR is introduced in Chapters 6 and 7, along with elements of chemical kinetics and optimal reactor design. A brief chapter on bioreactors introduces nonlinear reactor behavior. The concept of overcoming equilibrium in a chemical reactor by removal of the product is illustrated with the membrane reactor in Chapter 9. Chapters 10 and 11, favorites of mine, use two-phase systems and interfacial mass transfer to introduce the equilibrium stage, another of the paradigms of chemical engineering, as the limiting case when mass transfer between two phases is effectively infinitely rapid. Chapter 11 is a nice introduction to equilibrium-staged separations. Chapters 12–15 are devoted to energy balances, for which a prior course in thermodynamics is not required. Chapter 15 is focused on energy balances on chemically reacting systems and the special role played by the heat of reaction. The (relatively few) end-of-chapter problems throughout the book allow the students to solve straightforward problems as well as test their understanding on those that explore the material in more depth.

The book lays a foundation for what will follow in the courses on thermodynamics, chemical reaction engineering, and separation processes. The focus is on concepts rather than detailed problem solving, and Denn develops the concepts with care and precision. The book introduces ideas of time scales and limiting behavior, concepts that will pervade transport phenomena and reaction engineering. Synthesis and analysis of process flow sheets, traditional topics in the introductory course, which are covered in detail in Felder and Rousseau and Murphy, are not treated. Comparing Denn to Felder and Rousseau (or Murphy) is truly apples and oranges. Denn's book is a compact introduction to material and energy balances that gives a flavor for the kinds of problems with which chemical engineers grapple.

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