

# Unit Operations of Chemical Engineering

SEVENTH EDITION

Warren L. McCabe  
Julian C. Smith  
Peter Harriott

# UNIT OPERATIONS OF CHEMICAL ENGINEERING

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**Warren L. McCabe**

*Late R. J. Reynolds Professor of Chemical Engineering  
North Carolina State University*

**Julian C. Smith**

*Professor Emeritus of Chemical Engineering  
Cornell University*

**Peter Harriott**

*Fred H. Rhodes Professor Emeritus of Chemical Engineering  
Cornell University*



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## ABOUT THE AUTHORS

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**WARREN L. McCABE** (1899–1982) received his Ph.D. from the University of Michigan. He was successively Vice President and Director of Research of the Flintkote Company, Dean of Engineering at the Polytechnic Institute of Brooklyn, and the R. J. Reynolds Professor in Chemical Engineering at North Carolina State University. He served one term as President of the American Institute of Chemical Engineers.

**JULIAN C. SMITH** (B.Chem., Chem.E., Cornell University) is Professor Emeritus of Chemical Engineering at Cornell University, where he joined the faculty in 1946. He was Director of Continuing Engineering Education at Cornell from 1965 to 1971, and Director of the School of Chemical Engineering from 1975 to 1983. He retired from active teaching in 1986. Before joining the faculty at Cornell, he was employed as a chemical engineer by E.I. duPont de Nemours and Co. He has served as a consultant on process development to Du Pont, American Cyanamid, and many other companies, as well as government agencies. He is a member of the American Chemical Society and a Fellow of the American Institute of Chemical Engineers.

**PETER HARRIOTT** (B. Chem.E., Cornell University, ScD., Massachusetts Institute of Technology) is the Fred H. Rhodes Professor Emeritus of Chemical Engineering at Cornell University. Before joining the Cornell faculty in 1953, he worked as a chemical engineer for E.I. duPont de Nemours and Co. and the General Electric Co. In 1966 he was awarded an NSF Senior Postdoctoral Fellowship for study at the Institute for Catalysis in Lyon, France, and in 1988 he received a DOE fellowship for work at the Pittsburgh Energy Technology Center. Professor Harriott is the author of *Process Control* and *Chemical Reactor Design*. He is a member of the American Chemical Society and the American Institute of Chemical Engineers. He has been a consultant to the U.S. Department of Energy and several industrial firms on problems of mass transfer, reactor design, and air pollution control.

## PREFACE

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The seventh edition of this text on the unit operations of chemical engineering contains much new material and many additional problems, but the basic structure, general level of treatment, and overall length are largely unchanged. This is an introductory text, written for undergraduates in their junior or senior year who have completed the usual courses in mathematics, chemistry, physics, and an introduction to chemical engineering. An elementary knowledge of material and energy balances is assumed. Because it contains up-to-date correlations for heat transfer, mass transfer, and equipment design, this text should also be useful to chemists and engineers in industry.

Separate chapters are devoted to each of the principal unit operations, grouped into four sections: fluid mechanics, heat transfer, mass transfer and related separations, and operations involving particulate solids. One-semester courses may be based on any of these sections or combinations of them. Bioengineering is not treated as a separate topic, but examples of food processing, bioseparations, and diffusion in biological systems are included in various chapters.

Nearly all equations are written for SI units, but the older cgs and fps systems have not been completely eliminated. Chemical engineers must be familiar with all three systems of units. Most of the equations are dimensionless and may be used with any set of consistent units.

## NEW TO THIS EDITION

- Thirty percent of the end-of-chapter problems are new or revised for this edition. Nearly all the problems can be solved with the aid of a pocket calculator, but for a few, a computer solution is preferable.
- The section on fluid viscosity in Chap. 3 is expanded to include simple theories for gases and liquids. In later chapters, similar theories for thermal conductivity and diffusivity are discussed and comparisons made.
- The analogies among momentum transfer, diffusion, and heat conduction are given more emphasis, and the section on transient diffusion is expanded to include an example of controlled-release drug delivery.
- New material in Chap. 25 deals with the use of powdered carbon to treat aqueous waste in tanks, and expanded-bed adsorption that can be used for purification of fermentation broths.
- Chapter 29 has a new section on diafiltration, a process often used in protein purification. There is also an expanded treatment of ultrafiltration and microfiltration of protein and polymer solutions.
- The discussion of filter cake washing is completely revised and a plot of some data is included.



- Heat pipes and plate-type exchangers are included in the chapter on heat-exchange equipment
- The distillation chapters contain revised sections on flash distillation, flooding limits, and plate efficiency
- Correlations for drying rates and a treatment of dryer thermal efficiency have been added

## WEB RESOURCES

An Instructor and Student Resource Web site is available at <http://www.mhhe.com/mccabe7e>. Users will find the password-protected solutions to the end-of-chapter problems, PowerPoint Slides of text figures, and general textbook information.

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