

CHEMICAL PROCESS EQUIPMENT DESIGN

RICHARD TURTON • JOSEPH A. SHAEIWITZ



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AND CHEMICAL ENGINEERING SCIENCES

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Chemical Process Equipment Design

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Richard Turton
Joseph A. Shaeiwitz

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*We would like to dedicate this book to our long-suffering wives, Becky and Terry,
without whose love and support this work would never have been completed.*

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Preface

Why write a book entitled *Chemical Process Equipment Design* when there are many good books on the market that cover this topic, often in much greater detail than in this text? The purpose of this book is not to repeat what others have written but rather to present material to undergraduate students in such a way that they can easily use this information to make preliminary designs of important equipment found in the chemical process industry. Rather than give a compendium of design equations for a vast array of process equipment, this text aims to provide a set of algorithms and methods that the undergraduate chemical engineer can use to design the majority of process equipment found in a typical chemical plant that processes gases and/or liquids. Little time is devoted to deriving formulae or detailing the theoretical background for the equations, which can be found in other textbooks. The approach used here is to state what equation applies to a given situation and then to show how to use the equations to design and evaluate the performance of equipment.

To this end, approximately 80 worked examples are provided in this text covering most of the fundamental concepts found in the undergraduate curriculum for fluid mechanics, heat transfer, separation processes, heterogeneous reactions/reactors, and basic vapor-liquid separators. The text is meant as a supplemental resource for these courses and provides information often omitted in the standard undergraduate texts in the area of equipment design. Moreover, the authors have paid particular attention to addressing how the performance of existing equipment can be estimated when operating conditions differ from the design case, which is how most equipment operates throughout its lifetime. Coverage of the performance or rating problem is often omitted in the chemical engineering curriculum, but its understanding is essential for both the neophyte and experienced engineer. For example, how is the change in exit temperature from a heat exchanger estimated when the process flowrate is increased by 20%, or what is the maximum liquid flow possible through a pumped circulation loop, or by how much can the flowrate to an exothermic reactor be changed without having a temperature runaway occur in the reactor? These are important practical questions that are often not addressed in standard chemical engineering courses.

The book is organized into five chapters—fluid mechanics, heat transfer, separations, reactors, and phase separators and steam ejector systems. Chapter 1, “Process Fluid Mechanics,” could be the basis of a practical undergraduate fluid mechanics class, and Chapter 2, “Process Heat Transfer,” could be the basis of a practical undergraduate class in heat transfer. Chapter 3, “Separation Equipment,” and Chapter 4, “Reactors,” are meant to be supplements to the popular textbooks used for these classes. Finally, Chapter 5, “Other Equipment,” provides information pertinent to the senior design course. Alternatively, this text could be used as a recommended book in curricula that have a separate course for the design of equipment. It could also be used as a supplement to the

senior design course, especially when that course is where the majority of process equipment design is covered. If the design of process equipment is distributed throughout the curriculum, then this text would be a good resource for several courses typically taught in the junior year (fluids, heat transfer, reactors, and separations).

Register your copy of *Chemical Process Equipment Design* at informit.com for convenient access to downloads, updates, and corrections as they become available. To start the registration process, go to informit.com/register and log in or create an account. Enter the product ISBN (9780133804478) and click Submit. Once the process is complete, you will find any available bonus content under “Registered Products.”

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