

## Chapter 2

### Short Answer Problems

- The LMTD factor is required for heat exchangers when the two streams do not exhibit pure counter-current flow. Most exchangers such as S&T and other arrangements fall into this category.
- This statement is not generally true. In fact, condensers often have high heat transfer coefficients on the condensing side. One exception is for partial condensers where the majority of the condenser-side of the exchanger comprises of non-condensing gas – in this case the heat transfer coefficient on the condensing side may be limiting.
- Turbulent flow on both sides of the heat exchanger – see Table 2.9
 

|    |            |                      |                                                        |                                |
|----|------------|----------------------|--------------------------------------------------------|--------------------------------|
| a. | Shell-side | $h \propto Re_{0.6}$ | $\frac{h}{h_{\text{base case}}} = \frac{1.5^{0.6}}{1}$ | 1.275 or and increase of 27.5% |
| b. | Tube-side  | $h \propto Re_{0.8}$ | $\frac{h}{h_{\text{base case}}} = \frac{1.5^{0.8}}{1}$ | 1.383 or and increase of 38.3% |
- Laminar flow on both sides of the heat exchanger – see Table 2.9
 

|    |            |                       |                                                         |                                |
|----|------------|-----------------------|---------------------------------------------------------|--------------------------------|
| a. | Shell-side | $h \propto Re_{0.45}$ | $\frac{h}{h_{\text{base case}}} = \frac{1.5^{0.45}}{1}$ | 1.20 or and increase of 20%    |
| b. | Tube-side  | $h \propto Re_{0.3}$  | $\frac{h}{h_{\text{base case}}} = \frac{1.5^{0.3}}{1}$  | 1.145 or and increase of 14.5% |
- All else considered, the heat transfer coefficient for turbulent flow will be (much) higher than for laminar flow. For this reason when possible flow should be in the turbulent regime.
- Refer to Section 2.2.1.7 – three reasons for placing a fluid on the tube side of a S&T exchanger
  - 2-If the fluid is corrosive
  - 2-If the fluid causes severe fouling or scaling
  - 2-If the fluid is at a much higher pressure than the other fluid
  - 2-If the fluid has a much higher film coefficient
  - 2-If the material in contact with the fluid must be an expensive alloy

# Solution Manual Chemical Process Design And Integration

**Robin Smith**



## **Solution Manual Chemical Process Design And Integration:**

**Integration of Process Design and Control** E. Zafiriou, 2014-05-23 The existence of interactions between the design of a process and that of its control system have been known to industrial practitioners for a long time In the past decade academic research has produced methodologies and tools that begin to address the issue of designing processes that are flexible can be controlled reliably and are inherently safe This publication unites the work of academics and practitioners with interests in the integration of process design and control in order to examine the state of the art in methodologies and applications The scope covers the design of chemical plants at different stages of detail It also examines control issues from the plantwide level where for example recycles between units can be important to the specific unit level where the availability or selection of measurements might be the most important factor

**Integrated Design and Simulation of Chemical Processes** Alexandre C. Dimian, Costin Sorin Bildea, Anton A. Kiss, 2014-09-18 This comprehensive work shows how to design and develop innovative optimal and sustainable chemical processes by applying the principles of process systems engineering leading to integrated sustainable processes with green attributes Generic systematic methods are employed supported by intensive use of computer simulation as a powerful tool for mastering the complexity of physical models New to the second edition are chapters on product design and batch processes with applications in specialty chemicals process intensification methods for designing compact equipment with high energetic efficiency plantwide control for managing the key factors affecting the plant dynamics and operation health safety and environment issues as well as sustainability analysis for achieving high environmental performance All chapters are completely rewritten or have been revised This new edition is suitable as teaching material for Chemical Process and Product Design courses for graduate MSc students being compatible with academic requirements world wide The inclusion of the newest design methods will be of great value to professional chemical engineers Systematic approach to developing innovative and sustainable chemical processes Presents generic principles of process simulation for analysis creation and assessment Emphasis on sustainable development for the future of process industries

**Chemical Process Design and Integration** Robin Smith, 2016-09-26 Written by a highly regarded author with industrial and academic experience this new edition of an established bestselling book provides practical guidance for students researchers and those in chemical engineering The book includes a new section on sustainable energy with sections on carbon capture and sequestration as a result of increasing environmental awareness and a companion website that includes problems worked solutions and Excel spreadsheets to enable students to carry out complex calculations

*Chemical Process Engineering, Volume 2* A. Kayode Coker, Rahmat

Sotudeh-Gharebagh, 2022-06-20 **CHEMICAL PROCESS ENGINEERING** Written by one of the most prolific and respected chemical engineers in the world and his co author also a well known and respected engineer this two volume set is the new standard in the industry offering engineers and students alike the most up to date comprehensive and state of the art

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*Collaborative and Distributed Chemical Engineering. From Understanding to Substantial Design Process Support* Manfred Nagl,Wolfgang Marquardt,2008-07-23 IMPROVE stands for Information Technology Support for Collaborative and Distributed Design Processes in Chemical Engineering and is a large joint project of research institutions at RWTH Aachen University This volume summarizes the results after 9 years of cooperative research work The focus of IMPROVE is on understanding formalizing evaluating and consequently improving design processes in chemical engineering In particular IMPROVE focuses on conceptual design and basic engineering where the fundamental decisions concerning the design or redesign of a chemical plant are undertaken Design processes are analyzed and evaluated in collaboration with industrial partners

*Product and Process Design Principles* Warren D. Seider,Daniel R. Lewin,J. D. Seader,Soemantri Widagdo,Rafiqul Gani,Ka Ming Ng,2016-05-17 The new 4th edition of Seider s Product and Process Design Principles Synthesis Analysis and Design covers content for process design courses in the chemical engineering curriculum showing how process design and product design are inter linked and why studying the two is important for modern applications A principal objective of this new edition is to describe modern strategies for the design of chemical products and processes with an emphasis on a systematic approach This fourth edition presents two parallel tracks 1 product design and 2 process design with an emphasis on process design Process design instructors can show easily how product designs lead to new chemical processes Alternatively product design can be taught in a separate course subsequent to the process design course

**Analysis, Synthesis and Design of Chemical Processes** Richard Turton,Richard C. Bailie,Wallace B. Whiting,Joseph A. Shaeiwitz,2008-12-24 The Leading Integrated Chemical Process Design Guide Now with New Problems New Projects and

More More than ever effective design is the focal point of sound chemical engineering Analysis Synthesis and Design of Chemical Processes Third Edition presents design as a creative process that integrates both the big picture and the small details and knows which to stress when and why Realistic from start to finish this book moves readers beyond classroom exercises into open ended real world process problem solving The authors introduce integrated techniques for every facet of the discipline from finance to operations new plant design to existing process optimization This fully updated Third Edition presents entirely new problems at the end of every chapter It also adds extensive coverage of batch process design including realistic examples of equipment sizing for batch sequencing batch scheduling for multi product plants improving production via intermediate storage and parallel equipment and new optimization techniques specifically for batch processes Coverage includes Conceptualizing and analyzing chemical processes flow diagrams tracing process conditions and more Chemical process economics analyzing capital and manufacturing costs and predicting or assessing profitability Synthesizing and optimizing chemical processing experience based principles BFD PFD simulations and more Analyzing process performance via I O models performance curves and other tools Process troubleshooting and debottlenecking Chemical engineering design and society ethics professionalism health safety and new green engineering techniques Participating successfully in chemical engineering design teams Analysis Synthesis and Design of Chemical Processes Third Edition draws on nearly 35 years of innovative chemical engineering instruction at West Virginia University It includes suggested curricula for both single semester and year long design courses case studies and design projects with practical applications and appendixes with current equipment cost data and preliminary design information for eleven chemical processes including seven brand new to this edition

Sugarcane Alexandre De Oliveira, 2018-05-16 Sugarcane *Saccharum officinarum* L is considered one of the major bioenergy crops grown globally Thus sugarcane research to improve sustainable production worldwide is a vital task of the scientific community to address the increasing demands and needs for their products especially biofuels In this context this book covers the most recent research areas related to sugarcane production and its applications It is composed of 14 chapters divided into 5 sections that highlight fundamental insights into the current research and technology on this crop Sugarcane Technology and Research intends to provide the reader with a comprehensive overview in technology production and applied and basic research of this bioenergy species approaching the latest developments on varied topics related to this crop

*The Art of Chemical Process Design* G. L. Wells, L. M. Rose, 1986 Illustrating all aspects of chemical process design this book demonstrates process synthesis material and heat balancing by manual and computerised methods the use of flowsheeting programs and their construction flowsheet development plant safety process economics and project engineering The reader is introduced to each of the key areas and is given further information to follow these up The process is developed as a whole entity with appropriate partitioning of certain tasks In recent years there has been increased activity in process synthesis particularly in the development of heat exchanger networks and distillation trains Various chapters

describe and develop these and other areas of interest In particular note is made of the need to select appropriate unit operations for given process tasks Traditional manual methods of material and heat balancing introduce the computerised methods used in flowsheeting programs Plant safety continues to generate professional and public interest as catastrophes continue to occur The recent developments in this area are described Advanced Control of Chemical Processes 1994 D. Bonvin, 2014-05-23 This publication brings together the latest research findings in the key area of chemical process control including dynamic modelling and simulation modelling and model validation for application in linear and nonlinear model based control nonlinear model based predictive control and optimization to facilitate constrained real time optimization of chemical processes statistical control techniques major developments in the statistical interpretation of measured data to guide future research knowledge based v model based control the integration of theoretical aspects of control and optimization theory with more recent developments in artificial intelligence and computer science Chemical Process Analysis and Design Using Computers Working Party on the Use of Computers in Chemical Engineering. Symposium, 1982 , *Ludwig's Applied Process Design for Chemical and Petrochemical Plants Incorporating Process Safety Incidents* A. Kayode Coker, 2024-07-10 Ludwig's Applied Process Design for Chemical and Petrochemical Plants Incorporating Process Safety Incidents is ever evolving starting with the first edition some 60 years ago The volumes in this fifth edition provide improved techniques and fundamental design methodologies to guide the practicing engineer in designing process equipment and applying chemical processes to the properly detailed hardware As indicative of the new title process safety incidents are incorporated in many of the chapters reviewing the root causes and how these could be mitigated in future Like its predecessor this new edition continues to present updated information for achieving optimum operational and process conditions and to avoid problems caused by inadequate sizing and lack of internally detailed hardware The volumes provide both fundamental theories where applicable and direct application of these theories to applied equations essential in the design effort This approach in presenting design information is essential for troubleshooting process equipment and in executing system performance analysis Volume 1B continues to cover mixing of liquids process safety and pressure 1 relieving devices metallurgy and corrosion and process optimization It builds upon Ernest E Ludwig's classic text to further enhance its use as a chemical engineering process design manual of methods and proven fundamentals This new edition includes new content on three phase separation mixing of liquids ejectors and mechanical vacuum systems process safety and pressure relieving devices metallurgy and corrosion and optimization of chemical process blending Some chapters review pressure relieving devices and provide case studies for process safety incidents which are well illustrated from US Chemical Safety Hazard Investigation Board [www.csb.gov](http://www.csb.gov) Finally this book contains a glossary of Petroleum and Petrochemical Terminologies and Physical and Chemical Characteristics of Major Hydrocarbons Provides improved design manual for methods and proven fundamentals of process design with related data and charts Covers complete range of basic

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**Principles and Applications of Mass Transfer** Jaime Benitez, 2022-10-19 Principles and Applications of Mass Transfer Core textbook teaching mass transfer fundamentals and applications for the design of separation processes in chemical biochemical and environmental engineering Principles and Applications of Mass Transfer teaches the subject of mass transfer fundamentals and their applications to the design of separation processes with enough depth of coverage to guarantee that students using the book will at the end of the course be able to specify preliminary designs of the most common separation process equipment Reflecting the growth of biochemical applications in the field of chemical engineering the fourth edition expands biochemical coverage including transient diffusion environmental applications electrophoresis and bioseparations Also new to the fourth edition is the integration of Python programs which complement the Mathcad programs of the previous edition On the accompanying instructor's website the online appendices contain a downloadable library of Python and Mathcad programs for the example problems in each chapter A complete solution manual for all end of chapter problems both in Mathcad and Python is also provided Some of the topics covered in Principles and Applications of Mass Transfer include Molecular mass transfer covering concentrations velocities and fluxes the Maxwell Stefan relations and Fick's first law for binary mixtures The diffusion coefficient covering diffusion coefficients for binary ideal gas systems dilute liquids and concentrated liquids Convective mass transfer covering mass transfer coefficients dimensional analysis boundary layer theory and mass and heat transfer analogies Interphase mass transfer covering diffusion between phases material balances and equilibrium stage operations Gas dispersed gas liquid operations covering sparged vessels tray towers diameter and gas pressure drop and weeping and entrainment Principles and Applications of Mass Transfer is an essential textbook for undergraduate chemical biochemical mechanical and environmental engineering students taking a core course on Separation Processes or Mass Transfer Operations along with mechanical engineers and mechanical engineering students starting to get involved in combined heat and mass transfer applications

**Process Control Engineering** A. Ramachandro. Rao, 2022-01-26 Process Control Engineering is a textbook for chemical mechanical and electrical engineering students providing the theoretic fundamentals of control systems and highlighting modern control theory and practical aspects of industrial processes The introductory nature of the text should appeal to undergraduate students while later chapters on linear systems optimal control adaptive control and intelligent control are directed toward advanced students and practising engineers The textbook has been extensively tested in both undergraduate and graduate courses at the University of Alberta

*26th European*

*Symposium on Computer Aided Process Engineering*, 2016-06-17 26th European Symposium on Computer Aided Process Engineering contains the papers presented at the 26th European Society of Computer Aided Process Engineering ESCAPE Event held at Portoro Slovenia from June 12th to June 15th 2016 Themes discussed at the conference include Process product Synthesis Design and Integration Modelling Numerical analysis Simulation and Optimization Process Operations and Control and Education in CAPE PSE Presents findings and discussions from the 26th European Society of Computer Aided Process Engineering ESCAPE Event

**Chemical Engineering Design** Ray Sinnott, 2014-06-28 This 2nd Edition of Coulson agitated vessels are now covered and the discussion of fired heaters and plate heat exchangers extended The appendices have been extended to include a computer program for energy balances illustrations of equipment specification sheets and heat exchanger tube layout diagrams This 2nd Edition will continue to provide undergraduate students of chemical engineering chemical engineers in industry and chemists and mechanical engineers who have to tackle problems arising in the process industries with a valuable text on how a complete process is designed and how it must be fitted into the environment

Scaleup of Chemical Processes Attilio Bisio, Robert L. Kabel, 1985-07-25 The focus of this book is on the technical factors that are critical to the design and startup of a commercial manufacturing facility

*Second International Conference on Chemical Engineering Education* D.C. Freshwater, R.M. Blunden, J.R. Flower, 2013-09-11 Second International Conference on Chemical Engineering Education presents the situation in chemical engineering education in Germany Hungary Spain Japan and in the United States This book depicts an awareness of the problems of professional education together with a wide spectrum of opinions on their solution Organized into 39 chapters this book begins with an overview of the actual situation of chemical engineering education program in Spain This text then examines the detailed formalities of chemical engineering in secondary schools Other chapters consider the change in chemical engineering education in Japan due to the change of chemical industries as well as by a great change of students attitude This book discusses as well the curriculum proposal for the education of undergraduate and graduate levels as well as foreign students education The final chapter reviews the European situation of chemical engineering education system This book is a valuable resource for teachers and students of chemical engineering

AI and Robotic Technology in Materials and Chemistry Research Xi Zhu, 2024-11-06 A singular resource for researchers seeking to apply artificial intelligence and robotics to materials science In AI and Robotic Technology in Materials and Chemistry Research distinguished researcher Dr Xi Zhu delivers an incisive and practical guide to the use of artificial intelligence and robotics in materials science and chemistry Dr Zhu explains the principles of AI from the perspective of a scientific researcher including the challenges of applying the technology to chemical and biomaterials design He offers concise interviews and surveys of highly regarded industry professionals and highlights the interdisciplinary and broad applicability of widely available AI tools like ChatGPT The book covers computational methods and approaches from algorithms models and experimental data systems and includes case studies

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