

1. Record Nr.	UNINA9910566698503321
Titolo	Multiphase flows for process industries : fundamentals and applications // edited by Vivek V. Ranade, Ranjeet P. Utikar
Pubbl/distr/stampa	Weinheim, Germany : , : Wiley-VCH GmbH, , [2022] ©2022
ISBN	3-527-81206-7 3-527-81204-0
Descrizione fisica	1 online resource (695 pages)
Disciplina	620.1064
Soggetti	Manufacturing processes Electronic books.
Lingua di pubblicazione	Inglese
Formato	Materiale a stampa
Livello bibliografico	Monografia
Nota di bibliografia	Includes bibliographical references and index.
Nota di contenuto	Cover -- Title Page -- Copyright -- Contents -- Preface -- Part I Introduction -- Chapter 1 Multiphase Flows and Process Industries -- 1.1 The Process Industry -- 1.2 Multiphase Flows -- 1.3 Organization of This Book -- References -- Part II Fundamentals of Multiphase Flows -- Chapter 2 Multiphase Flows: Flow Regimes, Lower Order Models, and Correlations -- 2.1 Introduction -- 2.2 Modeling of Multiphase Flows -- 2.3 Chronological Development of Mathematical Models -- 2.4 ZeroDimensional TwoEquation Model -- 2.5 Homogeneous Equilibrium Model -- 2.6 Drift Flux Model -- 2.7 OneDimensional Five Equation Models -- 2.8 OneDimensional SixEquation TwoPhase Flow Models: Axial Variation of Field Variables -- 2.8.1 Mathematical Formulations -- 2.8.2 Closure -- 2.8.2.1 Regime Maps and Criteria for Transition -- 2.8.2.2 Momentum Closure -- 2.8.2.3 Energy Closure -- 2.8.3 Software (RELAP5) -- 2.8.4 Application and Validation of Various OneD Models and CFD -- 2.8.4.1 Nodalization for the One Dimensional Models -- 2.8.4.2 Model Details -- 2.8.4.3 Comparison Between Three, Five, and SixEquation Model with Experimental Data -- 2.9 OneDimensional SixEquation TwoPhase Flow Models: Radial Variation of Field Variables -- 2.9.1 Hydrodynamic Regimes and Criteria for Transition -- 2.9.2 Mathematical Model -- 2.9.3 Stepwise Solution Procedure -- 2.9.3.1 Model Equation -- 2.9.3.2 Model for

Eddy Diffusivity -- 2.9.3.3 Solution Procedure -- 2.10 Prediction of Design Parameters Using OneDimensional Models -- 2.10.1 Pressure Drop -- 2.10.2 Prediction of Heat Transfer Coefficient -- 2.10.3 Mixing Time and Liquid Phase Dispersion Coefficient -- 2.11 Process Design Using OneDimensional Models -- 2.12 The ThreeDimensional CFD Simulations to Overcome the Limitations of OneDimensional Models: The Current Status -- Nomenclature -- Greek Letters -- References.

Chapter 3 Multiscale Modeling of Multiphase Flows -- 3.1 General Introduction to Multiphase Flows -- 3.2 Multiscale Modeling of Multiphase Flows -- 3.3 Euler-Euler Modeling -- 3.3.1 Introduction -- 3.3.2 Governing Equations -- 3.3.3 Numerical Solution Method -- 3.3.4 Results -- 3.3.4.1 Hydrodynamics of a Pseudo TwoDimensional Gas Fluidized Bed -- 3.3.4.2 Hydrodynamics of a 3D Cylindrical Bed -- 3.3.4.3 GasFluidized Bed with Heat Production -- 3.3.5 Conclusions and Outlook -- 3.4 Euler-Lagrange Modeling -- 3.4.1 Introduction -- 3.4.2 Discrete Particle Modeling -- 3.4.2.1 Soft Sphere -- 3.4.2.2 Hard Sphere -- 3.4.2.3 Fluid-Particle Coupling -- 3.4.3 Discrete Bubble Model -- 3.4.3.1 Collision, Coalescence, and Breakup -- 3.4.4 Direct Simulation Monte Carlo -- 3.4.5 Conclusions and Outlook -- 3.5 Immersed Boundary Methods -- 3.5.1 Introduction -- 3.5.2 Methods -- 3.5.2.1 Governing Equations -- 3.5.2.2 Continuous Forcing or Diffuse IBM -- 3.5.2.3 Discrete Forcing or Sharp IBM -- 3.5.2.4 Mass and Heat Transport -- 3.5.3 Recent Results -- 3.5.3.1 Hydrodynamics Using Diffuse IBM -- 3.5.3.2 Hydrodynamics Using Sharp IBM -- 3.5.3.3 Heat and Mass Transport Using Diffuse IBM -- 3.5.3.4 Heat and Mass Transport Using Sharp IBM -- 3.5.4 Discussion and Outlook -- 3.6 Direct Numerical Simulations of Gas-Liquid and Gas-Liquid-Solid Flows -- 3.6.1 Introduction -- 3.6.2 Governing Equations -- 3.6.3 Moving Grid Methods -- 3.6.4 Fixed Grid Methods -- 3.6.4.1 Volume of Fluid Method -- 3.6.4.2 LevelSet Method -- 3.6.4.3 Front Tracking -- 3.6.5 Results -- 3.6.5.1 Verification -- 3.6.5.2 Validation -- 3.6.5.3 Drag Coefficient of Bubble Swarms -- 3.6.5.4 Droplet-Droplet Interactions -- 3.6.6 Gas-Liquid-Solid Three Phase Flows -- 3.6.7 Discussion and Outlook -- 3.7 Verification, Experimental Validation, and Uncertainty Quantification -- Acknowledgments -- References.

Chapter 4 Enabling Process Innovations via Mastering Multiphase Flows: Gas-Liquid and Gas-Liquid-Solid Processes -- 4.1 Introduction -- 4.2 "Tools" for Process Innovation of Gas-Liquid and Gas-Liquid-Solid Processes -- 4.3 Process Innovations in Multiphase Reactors -- 4.3.1 Stirred Tank Reactors -- 4.3.2 Bubble Column and Slurry Bubble Column Reactors -- 4.3.3 Spinning Disc Reactors -- 4.3.4 Oscillatory Baffled Reactors -- 4.3.5 Cavitation Reactors -- 4.3.5.1 Ultrasound Cavitation Reactors -- 4.3.5.2 Hydrodynamic Cavitation Reactor -- 4.3.6 Monolith Reactors -- 4.3.7 Microreactors -- 4.4 Process Innovations in Multiphase Unit Operations -- 4.4.1 Mixing in Multiphase Systems -- 4.4.2 Multiphase Separation -- 4.4.2.1 HiGee Distillation -- 4.4.2.2 Cyclic Distillation -- 4.5 Summary -- Acknowledgments -- List of Abbreviations -- References -- Part III

Enabling Process Innovations via Mastering Multiphase Flows -- Chapter 5 Liquid-Liquid Processes: Mass Transfer Processes and Chemical Reactions -- 5.1 Overview -- 5.2 Liquid-Liquid Thermodynamics and Processes -- 5.2.1 Ternary Systems and Triangle Diagrams -- 5.2.2 SingleStep Extraction -- 5.2.3 CrossFlow Extraction -- 5.2.4 Countercurrent Extraction -- 5.2.5 Solvent Selection Criteria -- 5.3 Mass Transfer in Liquid-Liquid Systems -- 5.3.1 Interface of Droplets -- 5.3.2 Numerical Simulation of Droplet Flow -- 5.3.3 Modeling of Mass Transfer -- 5.3.4 Extraction Processes -- 5.4 Liquid-Liquid Reactions and Applications -- 5.4.1 Mass Transfer and Chemical

Reaction at the Liquid-Liquid Interface -- 5.4.2 Interfacial Area and Specific Surface -- 5.4.3 Turbulent Mixing and Dispersion -- 5.4.4 ScaleUp Considerations -- 5.5 Liquid-Liquid Process Equipment and Typical Applications -- 5.5.1 Overview of Liquid-Liquid Extraction Equipment -- 5.5.2 Liquid-Liquid Extraction Columns -- 5.5.3 Centrifugal Extractors. 5.5.4 Applications of Reactive Extraction -- 5.5.5 Chemical Reactors for Liquid-Liquid Processes -- 5.5.6 Future Development in Liquid-Liquid Process Equipment and Applications -- 5.6 Conclusion -- References -- Chapter 6 Enabling Process Innovations via Mastering Multiphase Flows: Gas-Solid Processes -- 6.1 Introduction -- 6.2 Process Equipment -- 6.3 Gas-Solid Flow Investigation Methods -- 6.4 Case Study 1: FCC Riser -- 6.4.1 Introduction -- 6.4.2 Challenge in CFD Modeling of Gas-Solid Flow in Riser -- 6.4.3 EMMS Approach -- 6.4.4 Verification of EMMS Drag Model -- 6.4.5 Calculation of EMMS Drag -- 6.4.6 CFD of ColdFlow FCC Riser -- 6.4.7 CFD of Reactive Flow in FCC Riser -- 6.4.7.1 Effect of Baffles -- 6.4.7.2 Effect of Pulsating Flow -- 6.4.8 Conclusion -- 6.5 Case Study 2: FCC Stripper -- 6.5.1 Introduction -- 6.5.2 Experiments -- 6.5.3 CFD Modeling -- 6.5.4 Results and Discussion -- 6.5.4.1 Experimental Data and Model Validation -- 6.5.4.2 Effect of Packing -- 6.5.5 Conclusion -- 6.6 Case Study 3: Rotary Cement Kiln -- 6.6.1 Introduction -- 6.6.2 Gas-Solid Flow in a Cement Kiln -- 6.6.3 CFD Modeling -- 6.6.3.1 Model for Bed Region -- 6.6.3.2 Model for Freeboard Region -- 6.6.3.3 Radiation Modeling -- 6.6.3.4 Mass Transfer From Bed to Freeboard -- 6.6.4 Coupling Between Two Models -- 6.6.5 Simulations of Rotary Cement Kilns -- 6.6.6 Effect of Burner Operational Parameters -- 6.6.7 Conclusions -- 6.7 Case Study 4: Bubbling Fluidized Bed -- 6.7.1 Introduction -- 6.7.2 CFDDEM Model -- 6.7.2.1 Governing Equation of Gas Phase -- 6.7.2.2 Governing Equation of Solid Phase -- 6.7.2.3 Closure Models -- 6.7.3 Gas-Solid Drag Models -- 6.7.4 Simulation Setup -- 6.7.5 Simulation Results for Goldschmidt et al. -- 6.7.6 Simulation Results for NETL Challenge Problem -- 6.7.7 Discussion -- 6.7.8 Conclusion -- 6.8 Summary and Outlook -- References. Chapter 7 Liquid-Solid Processes -- 7.1 Introduction -- 7.2 Slurry Transportation -- 7.2.1 Hydrodynamics and Flow Regimes -- 7.2.2 Modeling of Slurry Transport System -- 7.2.2.1 NonSettling Slurries -- 7.2.2.2 Settling Slurries -- 7.2.3 Applications -- 7.3 Agitation and Mixing in Stirred Vessel -- 7.3.1 Hydrodynamics of Nonsettling Slurries -- 7.3.1.1 Kneading and Muller Mixer -- 7.3.1.2 Vertical/Horizontal Screw Mixer -- 7.3.1.3 HighShear and UltraHigh Shear Mixer -- 7.3.1.4 Planetary Mixer -- 7.3.1.5 Triple Shaft Anchor/Helical Mixer -- 7.3.2 Modeling of Nonsettling Slurries -- 7.3.3 Applications -- 7.3.4 Hydrodynamics of Settling Slurries -- 7.3.4.1 Minimum Impeller Speed for Solid Suspension -- 7.3.4.2 Solid Suspension Characterization Using Cloud Height -- 7.3.4.3 Solid Concentration or Homogeneity -- 7.3.5 Modeling of Settling Slurries -- 7.3.6 Applications -- 7.4 Fluidized Bed Reactor -- 7.4.1 Hydrodynamics and Flow Regimes -- 7.4.1.1 Minimum Fluidization Velocity -- 7.4.1.2 Flow Instability in Conventional Fluidization Regime -- 7.4.1.3 Average Solids Holdup -- 7.4.1.4 Radial Solids Holdup and Liquids Velocity -- 7.4.2 Models for Liquid-Solid Fluidized Bed -- 7.4.2.1 Drift Flux Model -- 7.4.2.2 CoreAnnulus Model -- 7.4.2.3 Computational Modeling of Liquid-Solid Fluidized Bed Reactors -- 7.4.3 Applications -- 7.4.3.1 Bioreactor and Bioprocesses -- 7.4.3.2 Reflux Classifier -- 7.4.3.3 Fluidized Bed Crystallizers (FBCs) -- 7.5 Hydrocyclones -- 7.5.1 Flow Fields in Hydrocyclones -- 7.5.1.1 Velocity Components -- 7.5.1.2 Particle Separation -- 7.5.2 Modeling

of Hydrocyclones -- 7.5.2.1 Empirical Correlations -- 7.5.3
Applications -- 7.6 Summary and Path Forward -- References --
Chapter 8 Three or More Phase Reactors -- 8.1 Introduction -- 8.2
Selection of Multiphase Reactor -- 8.2.1 Transport Effects on ScaleUp
Relative to Kinetics.
8.2.2 Ease of Operation and Safety at Scale.
