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Book review

MODELING OF PROCESS INTENSIFICATION

Frerich J. Keil (Ed.)

WILEY-VCH Verlag GmbH & Co. KGaA, Weinheim, Germany
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The integration of several unit operations into one single unit is of a major importance in chemical process engineering, since it leads to a significant reduction of both investment and operational costs. Besides, the application of new modelling approaches can significantly enhance the efficiency of such integration processes. So, combining the knowledge involved in process engineering and process modelling, this is the first book reviewing recent developments in modelling methods applicable to process intensification.

Experts in various areas of process intensification, from both industry and academia, have contributed to this book that does not cover all the developments in this field, but it demonstrates the activities in modelling for some representative problems. *Modeling of Process Intensification* edited by F.J. Keil However emphasizes the necessity for new modelling approaches of new microreactors, membrane reactors, ultrasound reactors, and those in simulated moving-bed chromatography, magnetic fields in multiphase processes or reactive distillation, non-stationary processes, and the use of supercritical media.

Frerich J. Keil is a Professor of Chemical Reaction Engineering at the Hamburg University of Technology. For twenty-two years he has been employed at UHDE GmbH in Dortmund working on process development of coal gasification, heavy water, methanol synthesis, and ammonia synthesis. He gained his PhD at the Karlsuhe University of Technology in 1976, and is the holder of an honorary doctorate from the University of Chemical Technology and Metallurgy in Sofia. His research interests are diffusion/reaction phenomena in catalysis, process modeling, and molecular modeling. Professor Keil is the co-editor of several international journals and some books, and has published around 150 research articles.

The book is structured in eleven chapters. After an introduction and overview, in Chapter 2 the efforts on process intensification are described from an industrial point of view. A special feature is the use of molecular simulations on various levels, like quantum chemistry, and classical molecular dynamics or Monte Carlo simulations. Cash flow analysis and project valuation under risk are investigated by Monte Carlo approaches.

Chapter 3 describes flow distributions and heat transfer in various microchannels. Fast mass transfer and mixing are key aspects of microreactors. Modeling of micromixers is discussed in detail.

Chapter 4 is on modeling and simulation of unsteady-state operated trickle-flow reactors. A review of unsteady-state operated trickle-flow reactors is presented and a dynamic reactor model based on an extended axial dispersion model is described in detail.

Chapter 5 consists in an extensive review of packed-bed membrane reactors. Computational results based on realistic data originating from the important class of partial oxidation reactions are presented. Results of a three-dimensional model using the lattice Boltzmann method are also presented.

In Chapter 6 are discussed the advantages and disadvantages of using segmented flow in micro-channels to intensify catalytic processes.

Chapter 7 focuses on chemical-reaction modeling in supercritical fluids, in particular in supercritical water. This chapter gives detailed presentations of modeling of systems by elementary reactions and their reaction engineering.

Chapter 8 consists of two parts: the first one explains some fundamentals of cavitation and its modeling applied to a so-called "High Energy Density Crevice Reactor", while the second one stresses important factors for efficient scale-up of cavitational reactors and subsequent industrial

applications based on the theoretical and experimental analysis of the net cavitational effects.

Chapter 9 reviews the applications and modeling of simulated moving-bed chromatography that represents a powerful purification process allowing the continuous separation of a feed mixture into two product streams.

Chapter 10 reviews modeling of reactive distillation. The theoretical description is illustrated by several case studies and supported by the results of laboratory, pilot and industrial scale experimental investigations. An outlook on future research requirements is given.

In Chapter 11 are presented experimental and theoretical investigations on artificial gravity generated by strong gradient magnetic fields that could potentially open up attractive applications, especially in multiphase catalytic systems where a number of factors can be optimized in an original manner for improving process efficiency.

In its treatment of hot topics of multidisciplinary interest, this book is of great value to researchers and engineers alike.

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