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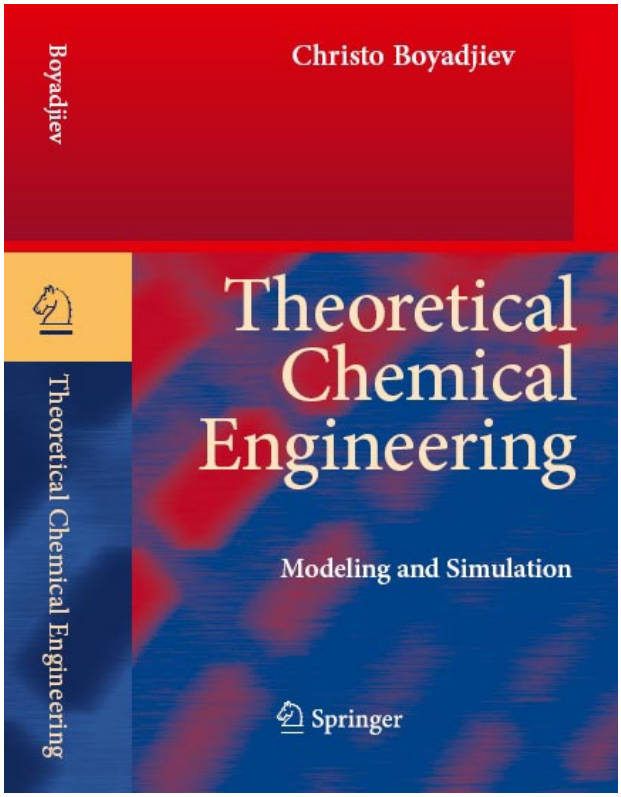
BOOK REVIEW



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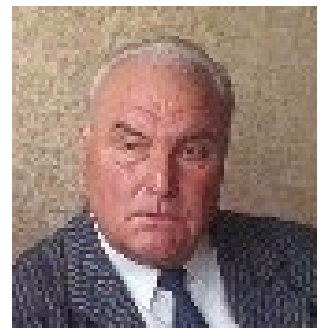

THEORETICAL CHEMICAL ENGINEERING (MODELING & SIMULATION),

Springer-Verlag, Berlin Heidelberg, 2010, 594 pp.

The theoretical methods of chemical engineering for modeling and simulation of industrial processes are surveyed in the book of Prof. Christo Boyadjiev from Institute of Chemical Engineering, Bulgarian Academy of Sciences. Modeling and simulation are principle approaches employed for quantitative description of processes for solution of scientific and engineering problems. The basis of the book (as a motto) is the brilliant formulation of Max Plank about the role of *theory* in the science:

"Experimenters are the striking force of science. The experiment is a question which science puts to nature. The experiment is the registration of nature's answer. But before the question is put to nature, it must be formulated. Before the measurement result is used, it must be explained, i.e., the answer must be understood correctly. These two problems are obligations of the theoreticians."

Part 1 concerns model construction problems. The simple processes in the chemical engineering concern hydrodynamic, diffusive, heat conduction, adsorption and chemical ones. The mechanics of the continious approach is used for modeling these elementary processes. Modeling of complex processes in chemical engineering is presented on the basis of the relation between the process mechanism and the mathematical description. The mathematical description of all this process contains many parameters, but their number can be reduced if dimensionless parameters are used. On this base the relations between dimensionless parameters and process mechanism boundary conditions, chemical kinetics and this mechanism are analyzed. The models are classified in accordance with the knowledge available concerning the process mechanisms. In the book the diffusion type, similarity (absorption in packed bed column) and regression type models (in the case of absence of information of the process) are presented. The linear, nonlinear, and pattern mass transfer theories are considered too.

Part 2 focuses on theoretical analysis of chemical engineering process models. The qualitative analysis uses generalized (dimensionless) variables and shows the degree to which the different physical effects participate in a complex process. On this basis, similarity

criteria and physical modeling conditions are shown. The quantitative analysis concerns the scale-up problems and statistical analysis of the models. The stability analysis of the models permits the nonlinear mass transfer effects to be obtained and the creation of the self-organizing dissipative structures with very intensive mass transfer.

Part 3 addresses the calculation problems in modeling and simulation. Different analytical and numerical methods for the solution of differential equations are considered. The estimation of the model parameters is related to the solutions of the ill-posed inverse problems. An iterative method for incorrect problem solutions is presented. Different methods for function minimization are shown for the purposes of process optimization and model parameter identification.

Part 4 examines modeling and simulation of the chemical plant systems. The simulation of the systems on the basis of structure system analysis is presented. The optimal synthesis of chemical plants is considered in the case of the optimal synthesis of heat recuperation systems.

This book can be used as a basis for theoretical and experimental investigations in the field of the chemical engineering. The methods and analyses presented permit theoretical problems to be solved, the experimental conditions to be correctly formulated, and the experimental results to be interpreted correctly.

The fundamental suggestion in this book is the necessity for full correspondence (direct and inverse) between the separated physical effect in the process and the mathematical (differential) operator in the model equation.

Examples from the author's investigations are presented at the end of all chapters.

The problems covered in the book will provide the readers (Ph.D. students, researchers, and teachers) the tools to permit the solution of various problems in modern chemical engineering, applied science, and other fields through modeling and simulations.

Professor D.Sc. Stoyan Stoyanov