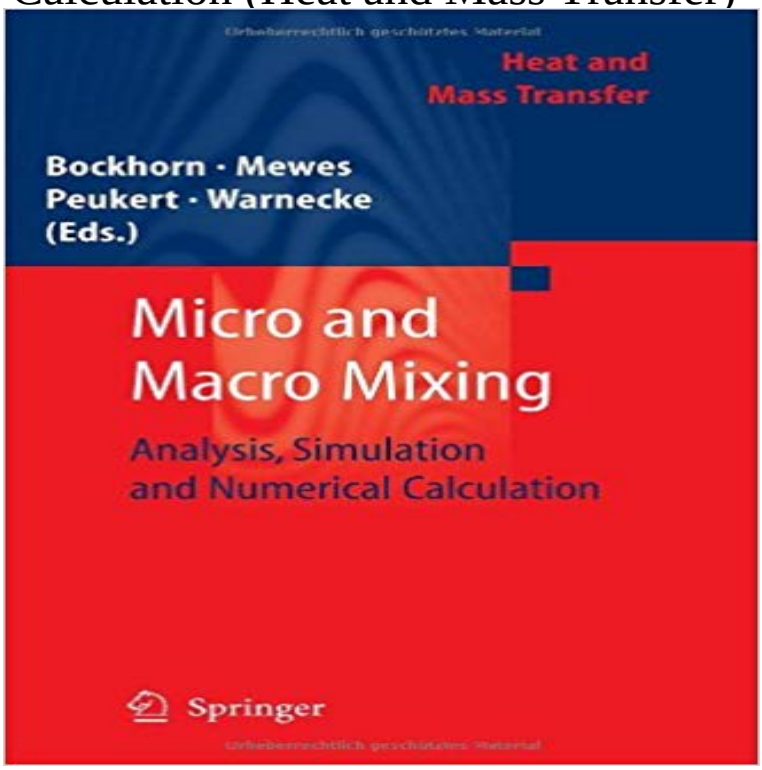
Micro and Macro Mixing: Analysis, Simulation and Numerical Calculation (Heat and Mass Transfer)



The homogenization of single phase gases or liquids with chemical reactive components by mixing belongs to one of the oldest basic operations applied in chemical engineering. The design of equipment for mixing processes is still derived from measurements of the mixing time which is related to the applied methods of measurement and the special design of the test equipment itself. This book was stimulated by improved modern methods for experimental research and visualization, for simulations and numerical calculations of mixing and chemical reactions in micro and macro scale of time and local coordinates. It is aimed to improve the prediction of efficiencies and selectivities of chemical reactions in macroscopic scale. The results should give an understanding of the influence of the construction of different mixing equipment on to the momentum, heat and mass transfer as well as reaction processes running on microscopic scales of time and local coordinates. Newly developed methods of measurement are adjusted to the scales of the selected special transport and conversion processes. They allow a more detailed modeling of the mixing processes by the formulation of an appropriate set of momentum-, heat- and mass balance equations as well as boundary conditions in time and local coordinates together with constitutive equations and reaction kinetics equations as closure laws for numerical and analytical calculations. The latter were empirically derived in the past and therefore of limited reliability only. The improved and more detailed modeling leads to a major progress in predicting mixing processes on the different scales adjusted to transport and reaction processes in molecular, micro- and macro dimensions. As a consequence improved numerical calculations are performed on the basis of newly derived experimental,

measurement and modeling methods which are the basis for the prediction of mixing time as well as conversion rates and selectivities of chemical reactions during the mixing process. The research efforts are focused onto the design of the technical equipment for flow mixing processes. Mixing is performed inside velocity fields leading to deformation gradients from free or wall induced boundary layers. The different kinds of process equipment are jet mixer, static mixer and mixing vessels equipped with rotating stirrers. Especially in micro mixing newly developed constructions are investigated permitting the scale up from laboratory to technical dimensions.

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