

Preface

Mass transfer from the gas phase to the solid phase is of interest in a broad range of applications. In order to accurately describe gas-to-particle mass transfer, a number of things must be known. These include the particle structure, thermal, fluid, and chemical conditions near the particle surface, and the flow condition—laminar, turbulent, etc. This introduces the importance of gas-to-particle mass transfer and the challenges posed in modeling the fluid-particle interactions, with an emphasis placed on the surface conditions and modeling the dynamics via direct numerical simulations (DNS) and large eddy simulations (LES). Subsequent chapters cover surface conditions and transport within the particle, model sorption kinetics and enhanced mass transfer, direct numerical simulation of mass transfer at different Stokes numbers, and the differences between DNS and LES in predicting gas-to-particle mass transfer. Additionally, the application of mercury adsorption on activated carbon is studied. Porous particles are modeled as a homogeneous assembly of sorbent material, forming a spherical, macroporous structure. The “Langmuir” theory is used to model sorption kinetics, and the effects of enhanced mass transfer due to convection at the gas/particle interface are captured.

This brief presents an integrated approach that includes the fluid-particle interactions in a manner that captures the underlying physicochemical interactions as a function of space and time. It incorporates recent developments in physical and mathematical modeling and numerical algorithms in one monograph and is divided into three chapters. Chapter 1 focuses on the fundamentals of gas-to-particle mass transfer (condensation and uptake), relevant parameters, and flow regimes. Chapter 2 introduces unsteady fluid motion and considers how those dynamics affect mass transfer. Finally, Chap. 3 discusses the application to turbulent flows (in the context of LES). We describe how such modeling is performed and the effects on the unresolved interactions on accuracy of the predictions.

This book introduces the latest information in the field; a conscious effort has been made to minimize coverage of related information that otherwise can be found in standard texts or technical references available in the open literature.

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