# Introduction

A vast number of specialized investigations concerned with different aspects of transport processes in heterogeneous and, in particular, granular media has been published. This stems from the exceptionally great variety of such media and processes and also from their extremely extensive prevalence in the most varied fields of energy generation, metallurgy, chemical technology, mining thermophysics and other practical activities. A large number of monographs and other surveys were also published for the purpose of systematizing in a relatively complete form the most important advances and results attained during the past decades in disciplines of quite portentous import

For this reason the first question that arises immediately, upon an even casual perusal of the boundless ocean of journal articles and the numerous monographs on the subject, is that of the need of still another such monograph. It is our opinion that the motivation for this will become evident upon recognizing the wide methodological chasm between the many engineering-type studies and attempts of general-physical analysis of transport processes on the basis of rigorous methods of theoretical physics and applied mathematics. Studies of the first type contain an enormously large body of empirical material, pertaining to different aspects of heat and mass transfer in engineering practice; these are absolutely necessary for efficient design and optimization of most of industrial devices and equipment. However, they do not always or insufficiently explain the underlying physical factors and mechanism of transport and the very abundance of these studies and their excessive detailing frequently only complicate analytic correlation. On the other hand, the second type of studies suffers from excessive

model simplifications, which usually are very far from the actual situation. As a result they are too complicated both for direct use and even for gaining insight into the processes, which makes them poorly accessible and not too interesting to the practicing engineer.

The existence of this chasm reduces to a large extent the value both of applied and theoretical studies and overcoming it requires, first of all, developing a consistent system of physical concepts on the principal features of transfer of heat, mass and electrical discharge in heterogeneous and multiphase media of different structure and under different conditions. This applies, in the first place, to gaining insight and incorporation of only principal factors that affect these processes, while neglecting secondary and unimportant details and, on the other hand, developing sufficiently simple and understandable general principles of modeling them, which would have a sufficiently wide applicability and would not involve excessively refined analytical methods.

The attempt to formulate certain unified approaches to describing different aspects of the different transport processes in dispersed media is, in fact, the main purpose of this book. This goal did not consist so much in providing a general description of these approaches, based on the technique of averaging over an ensemble and illustrating their workability with respect to elementary applied problems, but in broadening the range of methodologies which could then be used in analyzing more complex and constantly arising problems.

This goal left its imprint on the level and style of presentation. Firstly, given the extensive bibliography and surveys of empirical correlations on heat and mass transfer in various specific media, the authors have completely forgone systematizing these data in a more or less complete form. Publications were used primarily only to the extent to which they appeared to be useful for better mastering the idea and methods of their implementation and for this reason reference to these are somewhat arbitrary or random. Secondly, since our objective consisted in presenting these ideas and methods in a sufficiently simple form, which could be actually used by engineering personnel in solving the problems that they face, ensuring better understanding required at times sacrificing elements of rigor and preexistent validity of the assumed representations and approaches, leaving the matter to the intuition of the reader. This feature of individual chapters of the book may apparently cause some lack of internal satisfaction not only to the adherents of rigor, but also to fully sensible theoreticians. However, in our opinion, this is compensated for by the obvious practical applicability of the methods developed here for practical solution of new problems of the theory of heat and mass transfer, including those coupled with phase and chemical transitions.

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