MR1905401 (2003d:80003) 80A20

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Mathematical model for heat transfer mechanism for particulate system. (English summary)

Appl. Math. Comput. **129** (2002), *no. 2-3,* 295–316.

The role of various parameters and the mechanism of heat transfer from a hot surface to a fluidized bed have been the subject of extensive investigations during the last three decades. Many empirical correlation relating bed to surface heat transfer coefficients for a range of operating variables have been proposed. They are of limited validity because they cannot make adequate allowance for different geometies of the equipment used and varying degrees of accuracy of the experimental techniques used. Furthermore, it is difficult to extrapolate outside the experimental range of variables studied. Different models have been proposed to explain the different aspects of this complex problem. Particularly diverse concepts have been suggested by different workers regarding the mechanism of heat transfer between a fluidized bed and a heat transfer surface. In this paper an attempt is made to explain the mechanism of heat transfer from bed to surface in liquid fluidized systems. The heat transfer coefficient increases to a maximum and then steadily decreases as the bed void fraction increases from that of a packed bed to unity. The void fraction $\varepsilon_{\max}$ at which the maximum value of the heat transfer coefficient occurs is a function of the properties of the solid-liquid system. An unsteady state thermal conduction model is suggested to describe the heat transfer process. The model consists of strings of particles with entrained liquid moving parallel to the surface, during the time in which interval heat conduction takes place. These strings are separated by liquid into which the principal mode of transfer is by convection. The model shows a dependence of the heat transfer coefficient on the void fraction and on physical properties. The model results are compared with experimental data and with the computed values of existing models.

Reviewed by *P. Rochus* (Liège)