ABSTRACT

The shallow crossflow fluidised bed is a standard piece of equipment for heating or cooling particulate materials. In spite of its wide use, only a limited amount of work has been published on this type of system. In this dissertation a generalized analysis in terms of a gas-particle heat transfer coefficient has been developed to describe heat transfer in this type of system. The analysis includes the possibility of both particle internal resistance to heat transfer and a residence time distribution of particles in the bed. The experimental results from a small scale unit operating with relatively large particles were used in conjunction with the analysis to obtain the following relationship between the gas-particle heat transfer coefficient and the system variables :

$$\frac{hd}{k} = 0.353 \left(\frac{\rho u d}{\mu}\right)^{0.9} \left(\frac{d}{Z_T}\right)^{0.47} \left(\frac{d}{P}\right)^{0.19} \left(\frac{d}{D}\right)^{-0.19}$$

An extension of the analysis to include a particle size distribution was shown to be valid experimentally.

An investigation was also carried out to determine the basic gas-particle contacting characteristics in fluidised beds of large particles. The results of this investigation were used to develop a simplified mechanism to explain the process of heat transfer in such a system. The validity of this analysis was examined by using it in conjunction with appropriate experimental results to predict an outlet

air temperature fluctuation, this being compared to an experimentally measured fluctuation. The predicted and measured fluctuations showed similar trends but some differences in the ranges were noted and possible reasons for these differences are presented.