GAS-SOLID TWO-PHASE FLOW IN SUDDEN EXPANSION PIPES, DIFFUSERS AND ORIFICES- A COMPUTATIONAL STUDY

Abstract

The present dissertation deals with the computational study of the turbulent gas-solid two-phase flow in three types of pipe fittings, namely, (a) a sudden expansion, (b) a diffuser, and (c) a square orifice (both the thin and the thick orifices) using the Eulerian-Eulerian approach (two-fluid modelling approach). The study involves the computations of the gas-solid two-phase flow pressure recovery or the pressure drop for the flow through these pipe fittings under various operating conditions. The computations have been carried out under the moderate to higher limits $(0.005 \le \alpha_s \le 0.10)$ of the dilute phase flow, considering both the fine and the coarse particles $(1\mu m \le d_p \le 2\,mm)$. Under this range of the solid volume fraction, the inter-particle and the particle-wall collisions affect the system performance. Thus the present study explores the collisions' role in conjunction with the pertinent parameters on the gas-solid flow behavior through these pipe fittings, which has rarely been reported in the literature. The pertinent parameters include the solid-phase volume fraction (the solid loading ratio), the particle size, the solid-phase density, the inlet velocity of the gas-phase, the inlet slip ratio, and the geometrical parameters such as the area ratio, the diffuser angle, and the thickness of the orifices. The numerical procedure incorporates the four-way coupling approach to account for the role of collisions. It uses the Kinetic theory of Granular flow (KTGF) to compute the solid-phase stresses arising out of these collisions. Based on the simulation results the present study also proposes suitable correlations for the pertinent parameters of interest. The findings of the present dissertation will be useful to the practicing engineers at the industries and the academicians.