

Abstract

In this study, a model for the prediction of coal particle gradation in horizontal fluid pipeline was developed. The intent of this study is to develop a model that can predict the coal particle gradations in horizontal coal-liquid slurry pipelines. A semi empirical model originally developed by Karabelas has been modified by applying the $k-\epsilon$ approach to model a dimensionless diffusivity, originally assumed to be constant. The mechanistic model developed shows that dimensionless diffusivity is a

function of root mean square turbulent velocity fluctuations and many other parameters which include fluid velocity, pipe diameter, carrier fluid and suspended particles densities, particle size, and the efflux concentration. The modified model was compared with four different sets of experimental data and a CFD model, and was found to have overall good agreement. It was employed to analyze particle gradations and the results show that larger coal particles tend to drift to the pipe bed,

leaving the upper section of the pipes for smaller particles. The results show that concentration profile of coal particles in single-sized homogenous slurry is different from that of the same particle concentration in multi-sized slurry flow for each particle size and the same efflux concentration. The modified model was applied to analyze the d_{50} concentration profile and the result shows that d_{50} concentration profile represents the actual profile accurately within low and moderate range of particle sizes in the slurry. The mechanistic model presented in this study will be useful for coal and other mining industries worldwide, for accurate prediction of concentration profiles and choice of particle sizes as well as flow velocity of slurry in horizontal pipelines to avoid deposition and clogging of particles along the pipeline, thereby reducing associated danger in the pipelines.