PAPER ID:5

Performance Evaluation of Spiral Separator for Coal Cleaning using Mixture Model

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ABSTRACT

Spiral separator is considered to be the most effective gravity separator, capable of processing a wide range of minerals such as coal, iron, chromite, gold, zircon and other heavy minerals ores (Figure 1).1,2 Combined action of gravity, hydrodynamic forces and the centrifugal forces that act on the solid particles, causes the stratification of gangue and pure mineral particles.3 With the increase in the demands of coal fines recovery, spiral separators are widely deployed in the concentration process of 0.1 mm to 3 mm coal. In this study, coal slurry is simulated with a two- phase mixture model in which the flow-particle interaction is considered using a standard k-ε turbulence model. The dynamics of slurry can be modeled by the equation of continuity, transport of momentum equation, and transport equation for the volume fraction of solid phase for the mixture. The characteristics of the two-phase flow field and the influence of different process and design parameters on the distribution of the coal slurry is analyzed based on the computational results, which influence the separation of coal. Performance study of spiral separator is carried out by varying process parameters such as feed pulp density (weight % of solids) and feed rate (m3/hr). Analysis of spiral separator for different combination of process parameters is also analysed. To improve performance, numerical studies are validated against experimental studies have been performed. The main focus of this paper is to examine computationally the potential of using mixture model for coal processing and evaluate the separation efficiency, in order to optimize the operating range of mass flow rates.4-6 Relating the flow characteristics to separation is a subject of major interest that can immensely help in the design optimization of spiral separator.

Keywords: Spiral separator, coal slurry, mixture model, flow-particle interaction, separation efficiency.

 ISBN: 978-81-947843-2-6; DOI: 10.21467/abstracts.108