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# Bi-Component Particle Segregation Studies in a Spiral Concentrator Using Experimental and CFD Techniques

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**Abstract :** Spiral concentrators are commonly used in various industries, including mineral and coal processing, to efficiently separate materials based on their density and size. In these concentrators, a mixture of solid particles and fluid (usually water) is introduced as feed at the top of a spiral channel. As the mixture flows down the spiral, centrifugal and gravitational forces act on the particles, causing them to stratify based on their density and size. Spiral flows exhibit complex fluid dynamics, and interactions involve multiple phases and components in the process. Understanding the behavior of these phases within the spiral concentrator is crucial for achieving efficient separation. An experimental bi-component particle interaction study is conducted in this work utilizing magnetite (heavier density) and silica (lighter density) with different proportions processed in the spiral concentrator. The observation separation reveals that denser particles accumulate towards the inner region of the spiral trough, while a significant concentration of lighter particles are found close to the outer edge. The 5th turn of the spiral trough is partitioned into five zones to achieve a comprehensive distribution analysis of bicomponent particle segregation. Samples are then gathered from these individual streams using an in-house sample collector, and subsequent analysis is conducted to assess component segregation. Along the trough, there was a decline in the concentration of coarser particles, accompanied by an increase in the concentration of lighter particles. The segregation pattern indicates that the heavier coarse component accumulates in the inner zone, whereas the lighter fine component collects in the outer zone. The middle zone primarily consists of heavier fine particles and lighter coarse particles. The zone-wise results reveal that there is a significant fraction of segregation occurs in inner and middle zones. Finer magnetite and silica particles predominantly accumulate in outer zones with the smallest fraction of segregation. Additionally, numerical simulations are also carried out using the computational fluid dynamics (CFD) model based on the volume of fluid (VOF) approach incorporating the RSM turbulence model. The discrete phase model (DPM) is employed for particle tracking, thereby understanding the particle segregation of magnetite and silica along the spiral trough.

**Keywords :** spiral concentrator, bi-component particle segregation, computational fluid dynamics, discrete phase model
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