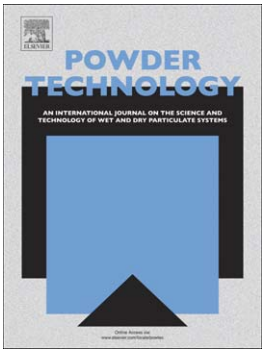

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Coarse-grained discrete particle simulations of particle segregation in rotating fluidized beds in vortex chambers

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Abstract

Vortex chambers allow the generation of rotating fluidized beds, offering high-G intensified gas-solid contact, gas-solids separation and solids-solids segregation. Focusing on binary particle mixtures and fixing the density and diameter of the heavy/large particles, transient batch CFD-coarse-grained DPM simulations were carried out with varying densities or sizes of the light/small particles to evaluate to what extent combining these three functionalities is possible within a vortex chamber of given design. Both the rate and quality of segregation were analyzed. Within a relatively wide density and size range, fast and efficient segregation takes place, with an inner and slower rotating bed of the lighter/small particles forming within the outer and faster rotating bed of the heavier/large particles. Simulations show that the contamination of the outer bed with lighter particles occurs more easily than contamination of the inner bed with heavier particles and increases with decreasing difference in size or density of the particles. Bubbling in the inner bed is observed with an inner bed of very low density or small particles. Porosity plots show that vortex chambers with a sufficient number of gas inlet slots have to be used to guarantee a uniform gas distribution and particle bed. Finally, the flexibility of particle segregation in vortex chambers with respect to the gas flow rate is demonstrated.