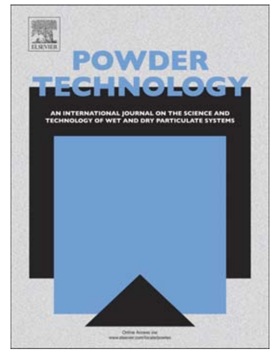

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Experiments and CFD-based erosion modeling for gas-solids flow in cyclones

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Abstract

In this study, CFD-based erosion modeling combined with experimental work was applied to a cyclone operating with Fluid Catalytic Cracking (FCC) particles as solid phase with 64 μm of diameter, and air at room temperature as gas phase. The inlet velocities ranged from 25 to 35 m/s and the solids loading ratios from 105 to 254 grams of solid per cubic meter of gas (g/m³), which are typical values for a regime transition between dilute and dense phases. Experimental data for the erosion rate were obtained in a test facility using a cyclone comprised of gypsum to accelerate the erosion phenomenon and make it more prominent. Numerical simulation was performed using the Euler-Lagrange approach with the Reynolds stress model (RSM) for turbulence in the gas phase, with two-way coupling to take into account the gas-solid interaction, and two erosion models (DNV and Oka models). The experiments showed an increase in the erosion with the gas inlet velocity in the cyclone, notably at velocities of 30 and 35 m/s, and a decrease with the solids loading rate for the same velocities (approx. 20 and 40%, respectively). This decrease in the erosion rate is attributed to the cushioning effect promoted by inter-particle collisions. On the other hand, a comparison between the experimental data and numerical calculations conducted using the two erosion models was carried out and the results show satisfactory agreement for both models.

Keywords: Cyclones; Computational fluid dynamics (CFD); Erosion modeling; Euler-Lagrange model.

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