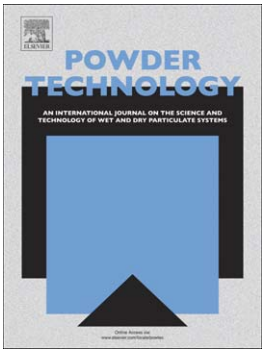

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CFD-DEM investigation of particle elutriation with electrostatic effects in gas-solid fluidized beds

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Abstract: Unsuccessful prediction of particle elutriation in fluidized beds is in part due to the negligence of electrostatic effects. In addition, lack of properly designed experiments makes it difficult to quantify the effects of electrostatics on particle elutriation. In this work, the CFD-DEM modeling approach has been used for the first time to investigate particle elutriation in a 2D fluidized bed taking into account electrostatic effects. Model predictions show that electrostatic charges on particles suppress particle elutriation and even eliminate elutriation completely at relatively higher charge levels. The study further shows that electrostatic effects result in the increase of the fluidized bed height and axial velocity of small particles in free board which ultimately promotes particle elutriation. However, the presence of agglomerates caused by electrostatic attractions is dominant, thus the decrease in the concentration of small particles in the free board suppresses particle elutriation.

Key words: fluidized bed; electrostatic effects; particle elutriation; CFD-DEM modeling

1. Introduction

In gas-solid fluidized beds, fine particles whose terminal velocities are smaller than the superficial gas velocity, are splashed into the free board at the bed surface and eventually transported out of the fluidized bed, this is known as particle elutriation [1]. Particle elutriation is common and a major disadvantage of gas-solid fluidized bed reactors [2]. An in-depth understanding of this phenomenon is one of the preconditions for successful design of particles separators and recovery equipment, and is also the key to successful and economic applications of gas-solid fluidized bed reactors [2-4]. Several correlations [5-11] exist from the open literature for predicting elutriation rates of fine particles based on experimental results or hydrodynamic principles, however predicted elutriation rates using these