A Particle Collision Apparatus to Study the Magnitude and Direction of Charge Transfer between Two Colliding Particles

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***Abstract*—An operational challenge faced in gas-solid fluidized beds is the generation of electrostatic charge, which can lead to significant wall fouling. Triboelectric charging in gas-solid fluidized beds occur due to the continuous particle-wall and particle-particle contacts during the fluidization process. A good understanding of triboelectric charging and its effects in gas-solid fluidized beds allows the development of techniques to reduce or control the charging in the bed. It also gives rise to the development of electrostatic charging models for use in computer simulations, which are a cost-effective alternative to running experiments, especially for industrial-scale test runs.**

Since triboelectric charging in gas-solid fluidized beds occurs due to both particle-wall and particle-particle charging, a charging model must carefully consider the mechanisms for both types of charging within the bed. One important charging phenomenon observed in gas-solid fluidized beds, specific to particle-particle interactions, is bipolar charging. Bipolar charging occurs when particles of the same material, but different sizes, become oppositely charged during fluidization. It has been observed that the wall fouling thickness in a fluidized bed depends on both the magnitude of charge in the bed and the presence of both positively and negatively charged particles [1]. The mechanism to describe how bipolar charging occurs is still unclear, since the studies on poly-sized particle systems have shown conflicting results; some noted that the smaller particles charged negatively and the larger particles charged positively [2], while others have reported the opposite [3]. The objective of this work was to construct a novel particle collision apparatus that provides the magnitude and direction of charge transfer between two colliding particles. The apparatus has three sections: the initial charge measurement each particle, collision and separation of the particles, and final charge measurement of each particle. The design focus for this apparatus was to minimize any external influence on the system; the charge transferred must solely be due to the collision between the two particles. Computer-

aided design was utilized to determine the desired dimensions and operating conditions to improve the success rate of particle collisions. The collisions were observed using a video recording device linked to a particle-tracking program.

REFERENCES

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