The Summer Undergraduate Research Fellowship (SURF) Symposium
2 August 2018
Purdue University, West Lafayette, Indiana, USA

Bringing Particle Scale Properties into Descriptions of Powder Behavior through the Enhanced Centrifuge Method

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ABSTRACT

Inconsistent powder behavior introduces problems such as agglomeration, poor flowability, dust hazards, and segregation that decrease efficiency in powder processing environments. Understanding how a powder interacts with a surface at the particle scale provides insight into how to accommodate individual particle properties and avoid process deficiencies. This project uses an enhanced centrifuge technique to evaluate the adhesion between a stainless-steel surface and a powder comprised of fluorescent particles. Particles are deposited onto stainless steel plates which are rotated in a centrifuge. The adhesion properties are monitored by tracking the rotational speed at which particles of a known size are removed from the steel. To model the adhesion, a simulator was produced in MATLAB to map an ideal model to the experimental observations. In reality, the particles and steel are rough, and the particles are nonuniform in shape. The ideal case assumes the particles are smooth spheres and the steel is smooth. A modified van der Waals force model describes the observed forces. Within this model, a Hamaker constant, which usually describes only the effect of composition on the van der Waals force, is tuned to also describe the effects of the non-uniformity of the particles. This creates a distribution of 'effective Hamaker constants' that describes particle scale effects on the adhesion between the bulk powder and the stainless steel. This approach will allow industry to account for the effects of surface roughness, particle shape, and particle size when designing powder processing operations.

KEYWORDS

Hamaker constant, Enhanced centrifuge technique, Particle adhesion, Powder characterization