AN ABSTRACT OF THE THESIS OF

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Title: Hydrodynamic Effects of Particle Chaining in Liquid-Solid Magnetofluidized Beds: Theory, Experiment, and Simulation.

Abstract approved: _____
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In a fluidized bed of magnetically susceptible particles, the presence of a magnetic field induce the formation of particle chains due to interparticle magnetic forces. The resulting effect is a change in the overall spatial distribution of the particles, transitioning from a random, isotropic distribution to an ordered, anisotropic distribution. For a magnetic field with the same direction as the superficial fluid velocity, the resulting structures offer less resistance to flow, resulting in a decrease of the effective drag coefficient. Thus the bed is less expanded and have lower voidage in the presence of the magnetic field, at a given fluid superficial velocity.

The effect of particle chaining in the particle drag in a liquid-solid fluidized bed is studied. Experimental data is collected on voidage and pressure drop for particle Reynolds number between 75 and 190, and for particle chain separation force to buoyant weight ratio between 0 and 0.58.

A two-parameter equation for the change in drag coefficient with respect to the hydrodynamic and magnetic operating conditions in the bed is obtained. It provides very good agreement with the experimental data.

A proprietary 3-D simulation code implementing a Computational Fluid Dynamics-Discrete Particle Method is developed and tested under the same conditions as the experiments performed. Without the use of any correction in the drag coefficient, the simulation code overestimates the bed expansion by as much as 70%. This error is reduced to or below 10% when the drag coefficient is corrected using the equation here obtained.