2013

Effects of Particle Properties, Temperature and Relative Humidity on Electrostatics in Gas-Solid Fluidized Beds

Wajeeh O. Moughrabiah
University of British Columbia, Canada

John R. Grace
University of British Columbia, Canada

Xiaotao T. Bi
University of British Columbia, Canada

Effects of Particle Properties, Temperature and Relative Humidity on Electrostatics in Gas-Solid Fluidized Beds

Wajeeh O. Moughrabiah*, John R. Grace, Xiaotao T. Bi

Fluidization Research Center
Department of Chemical and Biological Engineering, University of British Columbia
2360 East Mall, Vancouver, Canada, V6T 1Z3

Abstract

Electrostatic charges in polyolefin fluidized bed reactors are unavoidable. Minor reduction in electrostatics could substantially improve operation and reduce downtime. In this study the influences of particle size, density, shape, temperature and relative humidity were investigated. Eight collision probes at different levels in the bed measured electrostatics. Charges were higher in beds of 45 μm glass bead particles than 250-850 μm beads, probably due to an increase in bubble splitting, complexity of emulsion flow patterns, increased particle-particle and particle-wall contact surface areas and domination of other interparticle forces such as van der Waals forces. Addition of fine glass beads (up to 5 wt%) to a bed containing 650 μm particles decreased electrostatics. As the amount of fine glass beads increased beyond 10 wt%, electrical charges increased. When the density of polyethylene particles increased, electrostatics increased. Particle shape played a significant role in determining particle charging mechanisms and consistency of the degree of electrification in the bed. Non-spherical particles with uneven surfaces produced inconsistent electrostatics compared to beds of closely spherical particles, probably due to different charging mechanisms. Temperature played a significant role in determining the charge polarity. At higher temperatures (up to 90°C) the polarity in the bed was opposite to that at low temperatures (<50°C). The bed exhibited smoother fluidization at higher temperatures (up to 90°C). Increasing the relative humidity of the fluidizing air to 30% reduced electrostatic charging in the bed, probably due to increasing surface conductivity, thereby enhancing charge dissipation.