TRIBOELECTRIC STUDY OF POLYETHYLENE POWDER: CHARGING DURING POWDER MANUFACTURING AND CONVEYING

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Contact (triboelectric) charging of powders is a severe industrial problem. During powder handling, the particles undergo collisions with other particles or a device wall. When a particle collides with another object a charge is generated. For example, in the manufacturing process of polyethylene (PE), if the charge of particle reaches a critical value then two phenomena occur: a) particles with opposite polarities can create the undesired agglomeration center, and b) particles will adhere to a reactor wall, thus forming particle sheets on the wall. The sheet formation (fouling) alters the hydrodynamic properties of the reactor and sometimes even plugs the reactor. The formation of agglomerates or sheets is driven by the charge difference and kinetic energy dissipation during collisions. Although the control of electrostatic charge would be beneficial for industries that produce dielectric powders in general (polymers, drugs, pigments); the mechanisms of triboelectric charging are still poorly understood; especially in the field of polyolefin charging. The same applies to the quantitative contact mechanics of PE particulate systems.

We constructed two apparatuses, in each of these either particle-particle or particle-wall mode of contact is pronounced. To investigate collision behavior, we utilize a high-speed camera. The results indicate that the saturation charge (maximum charge at given conditions) is proportional to the energy of collisions. This dependence can be explained by the differences in the accessible contact area. The results of charging at various humidities show that in the case of nonpolar polymers like PE the concentration of water molecules in the boundary layer has a significant effect on the charging, unlike in the case of polar polymers, where adsorbed water on the surface of polymer reduces the charging. The results of collision behavior investigation suggest that the irregularly shaped particles dissipate more kinetic energy during collisions, and the dependence of the energy dissipation on the impact velocity has been observed. Our work contributes to a better understanding of triboelectric charging and collision mechanics in general and provides a valuable information for polyolefin industry.