# DISCRETE ELEMENT METHOD MODELING STUDY OF POLYETHYLENE PARTICLE CHARGING

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Charging caused by the friction of objects, i.e., electrostatic charging is a common phenomenon, whose mechanism still lacks detailed understanding. This limits our predictions of what parameters can affect the charging and how. Significant accumulation of the charge is typical for dielectric powders that are of industrial importance (polymers, pigments, flour, medicaments). Such powder particles frequently collide with themselves or with a device wall during their production and transportation and thereby they generate electrostatic charge on the surfaces. The excess electrostatic charge can result in particle aggregation or fouling of a device walls by particles.

We focus on the electrostatic charging of polyethylene (PE) powders manufactured in fluidized-bed polymerization reactors that can encounter problems with aggregation or fouling. Specifically, we developed the Discrete Element Method (DEM) model incorporating a charging mechanism [1]. The model includes the balance of transferrable charged species as a charging mechanism and predicts the charging of PE particles due to particle-particle collisions as a function of particle size distribution (PSD), particle segregation and the magnitude of electrostatic forces. The results suggest that systems of well-mixed particles of a broad PSD exhibit fastest charge accumulation, which is in agreement with experimental evidence. The presence of electrostatic attraction among oppositely charged particles affects particles trajectories and results in the formation of particle aggregates, which has been observed experimentally. Our detailed model of particle charging also predicts the variation of charge at different spots on particle surfaces in dependence on particle shape, which can't be reliably measured by today's charge/voltage measurement devices.

The combination of another model with our measurements utilizing sliding apparatus and the Faraday's pail enabled us to investigate in detail the charging of PE particles caused by particle-wall collisions. Our experimental results suggest that PE particles charge faster at elevated temperatures and our model simulations show that such behavior can be explained by the softening of PE particles at elevated temperatures.

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[1] Konopka L., Kosek J.: *Discrete Element Modeling of Electrostatic Charging of Polyethylene Powder Particles,* Journal of Electrostatics (2017), accepted.