Triboelectric Charging of Polyethylene Powders – Experimental and Modeling study

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***Abstract* — Triboelectrification, as a surface-related phenomenon, is most significant in systems with relatively high surface-to-volume ratios like powders. Excess electrostatic charge poses a significant problem for industry, where products often consist of dielectric powder particles (e.g., polymers, flour, drugs, pigments). Specifically in polymerization fluidized-bed reactors and in post-processing units, powder polymer particles undergo various particle-particle and particle-wall friction contacts, thereby generating the excess charge on their surfaces. Oppositely-charged particles tend to form particle agglomerates and charged particles in general are attracted to metal walls of devices. Such behavior contributes to the unwanted agglomeration and fouling, which can impair manufacturing and storage of polymers. In order to better understand the charging processes, we performed a systematic series of experiments accompanied by mathematical modeling in the exemplary system of polyethylene (PE) powder particles and a metal wall. We combine cascade method apparatus (a slide followed by the Faraday's pail) with the Discrete Element Method (DEM) model of sliding polyethylene particles describing thus the charging of PE particles caused by particle-wall collisions. Using this apparatus, we measure not only the saturation charge of PE particles, but also the charging dynamics as a function of industrially relevant parameters: temperature, sorption equilibria, PE density and molecular weight. Our DEM model is complemented by the capacitor model of particle-wall charging and validated by the measured data. Assuming that electron transfer dominates in triboelectrification, we also address the general question of whether the charging depends only on the contact area of colliding objects (which correlates with the spontaneous release of electrons) or also on the amount of dissipated mechanical energy during the contact (which correlates with the excitation energy necessary for the electron transfer). Our study thus contributes to a better understanding of triboelectric charging fundaments while providing valuable information for polyolefin industry.**