Numerical modeling of triboelectric separation: application to vegetal powders

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Abstract

Electrostatic separation processes rely on the triboelectric properties of particles to sort them in an electrical field. One major benefit of these processes is that they produce no effluent and allow separation for various materials as for example separation of plastic grains from waste or for the removal of unburned carbon from fly ash. More recently the triboelectric separation was used for vegetal powders using and has proved to be well adapted for the purification of targeted compounds as Peeling and Gluten [1] or lignin in wheat straw [2].To better understand the triboelectric separation, we developed a numerical model based on the Discrete Element Method (DEM). This model takes into account 1) the triboelectric charging during particles contacts and collisions, 2) the exchange of electric charges and 3) the collective effect of the electric fields generated by all particles and by electrodes. In this study, we first investigate the dynamics of charging of a vibrated packing of particles. The simulated evolution compares well with experimental data from the literature. This evolution allows to determine the so-called work function which is an intrinsic physical property characterizing charge transmission during collisions. Assuming that the effect of the air results only in a drag force applied to the center of mass of the grains, we were able to take into account the aerodynamic transport of particles. Finally, the real geometry of the experimental setup is considered and we highlight the capabilities of the model to simulate complex features as electrodes clogging, flow eddies resulting in dead zones or particles agglomeration.

References

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