Modeling Seed Flow in Planter Tanks Using the Discrete-Element Method

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ABSTRACT A discrete element model was developed to simulate the behavior of seeds and fertilizer inside the tanks of planters. The main objective is to design the geometry of the tanks (wall angles, planes, curvatures, cavities) in order to optimize the flow of particles at various product levels inside the tank and for different loading/unloading scenarios as functions of the agricultural product (with various rheological properties) and the properties of the tank wall material. Specific simulations are developed to equalize the quantity of particles remaining in the tank across the various metering segments when it is nearly empty. This is completed to ensure product does not run out for one segment while a different segment has an ample product supply. It also ensures minimizes the amount of particles remaining in the tank for clean-out when the operator wants to switch product. Some simulations are also developed to determine the maximum static load on the tank and the effect on the wall deformation for structural analysis purposes. Finally, other simulations are developed to study the behavior of bulk material during loading (especially at high-speed) and unloading (for clean out).

Keywords: tank, seed flow, planter, discrete element method