Computational modeling of flow and size segregation in a stockpile with multiple outlets

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ABSTRACT

Gravity reclaim stockpiles are widely used for storing large amounts of granular materials. Material is added to the surface via conveyors and is drawn from one or multiple outlets at the base of the pile, at a speed controlled with belt or apron feeders. In silos, the discharge typically occur as *mass flow*, which means that all the material move downwards at approximately the same speed and with little size segregation. The flow pattern in stockpiles, on the other hand, is that of *funnel flow*, where the material flow through vertical channels formed over each outlet [1]. These channels of active flow are surrounded by material that is stagnant, except near the surface where material flowing when the angle of repose is exceeded. Stockpiles are subject to significant size segregation due to several mechanisms [1,2]. The material is normally segregated already on the incoming conveyor and this is enhanced by trajectory segregation. Rolling and sifting segregation occur when the material spread on the pile surface. Segregation by percolation takes place in the shear zones between the funnel flow and stagnant zones.

We estimate the flow pattern and size segregation transport coefficients in a stockpile model with multiple outlet using the nonsmooth discrete element method [3,4]. Based on the analysis, similar to [5], a kinematic hybrid particle-cellular automata stockpile model is developed. Finally, we examine the possibility of realtime monitoring of the transport and the size segregation in a stockpile and feasibility of maintaining an net outflow with stable size distribution by controlling flow rate of the individual outlets.

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