Title Particle velocity profiles and residence time distribution in mixed-flow grain dryers

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Abstract

Non-uniform moisture content distribution of grains at the discharge of Mixed-Flow Grain Dryers is one of the sources of product quality loss during subsequent storage. Unfavorable design of this kind of dryers may cause uneven residence times of single grain portions resulting in non-uniform drying. It is then of paramount importance to understand the physical phenomena that control the flow of grains in a mixed-flow dryer to guarantee their quality and minimize the risk of quality loss and waste of energy, thereby optimizing the process drying condition. With this objective, a two dimensional simulation model for the grain mass flow in a mixed-flow dryer based on Discrete Element Method (DEM) has been developed. The influences of the side walls and air ducts on solids mass flow were studied by evaluating the residence time distribution (RTD), particle velocity profiles and particle trajectories. The simulation results were validated with experiments using a semi-technical dryer test station with transparent Plexiglas front wall. The obtained results revealed the complexity of the drying process, the influences of the wall friction and half air ducts positioned directly on the wall on the bulk particle movement. Grains in mixed-flow dryers have different vertical velocities resulting in different residence times of every single portion of grains. The experimental validation confirms and verifies the DEM calculation ability for predicting particle flow.