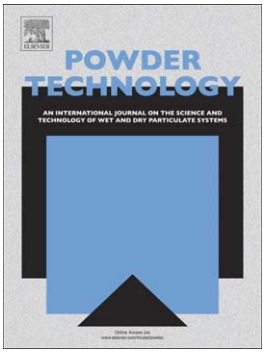

Stress profile in bulk of seeds in a shallow model silo as influenced by mobilisation of particle-particle and particle-wall friction: Experiments and DEM simulations

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Stress profile in bulk of seeds in a shallow model silo as influenced by mobilization of particle-particle and particle-wall friction: Experiments and DEM simulations

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ABSTRACT

We present an experiment and the results of DEM simulations of the stress profile within a bulk of seeds in a shallow cylindrical model silo. The goal of our study is to understand the microscopic origins of the impact of friction mobilisation during particle-particle and particle-wall contacts on the distribution of stress in bulk of seeds. Experiments were performed with horse beans and field pea seeds. Mobilisation of friction was increased a) experimentally, by hanging a dead load on the wall of the cylindrical container holding seeds, and b) in DEM simulations, through small vertical movements of the silo wall. DEM simulations were performed with spherical particles and axially symmetric clusters of spheres containing rolling friction. It was found that the radial profile of the normal pressure $\sigma_z(r)$ on the bottom of a shallow silo may be constant, increasing, or decreasing depending on the particle shape and filling method. Consequently, the radial profile of the shear stress $\tau(r)$ in the bulk of particles follows linear, convex, or concave relationships, respectively. Different trends of change of the radial profile of shear stress during down- and upward movement of the wall were observed. During downward movement of the wall the shear stress increased nearly uniformly along the radial position. During the upward movement a zone of change of shear stress was distinctly reduced. This effect may be a result of the participation of compressive and lack of tensional interactions in building of shear resistance.

Keywords: bulk of seed, silo loads, stress distribution, friction mobilisation

1. Introduction

Granular solids exhibit complex nonlinear behaviour resulting from elastic and frictional interactions between particles. As the frictional force from particle contact is defined by an inequality, the mobilisation of friction is undefined under static conditions, and