Investigation of the Contact Behaviour of Cylindrical Composite Particles For DEM-CFD Simulation of Fluidized Bed.

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**Highlights**

* Compression tests of cylindrical particles
* Measurement of particle-wall sliding friction
* Magnetic Particle Tracking (MPT)
* For the used particles the stiffness is independent of the number of impact

**1. Introduction**

In many processes of particle technology, cylindrical particles produced by extrusion or press agglomeration are used and further processed in various production steps e.g. spheronization, fluidization, drying and coating. In order to control and optimize these processes the particle dynamics can be predicted with numerical simulation. The frequently used methods are computational fluid dynamics (CFD), the discrete element method (DEM) or the coupling of both methods (CFD-DEM). There are numerous CFD-DEM studies reported in the literature predicting spherical particles in complex processes, however, only few studies of fluidization processes with cylindrical particles can be found [1–3]. For cylindrical particles, there is a lack of understanding of how particle shape influences the particle contact behaviour during different loading scenarios. Especially for the exact calculation of the particle interactions in DEM, it is essential to describe the particle contact behaviour with a compatible contact model. The modelling of contact behaviour with DEM poses a number of challenges: the shape construction, the contact detection and the contact force calculation for different deformation behaviours [4,5].

**2. Methods**

In this work, the influence of loading direction (contact geometry) and deformation behaviour (from elastic to plastic) on force-displacement behaviour during compression and shearing of cylindrical particles is investigated. The compression tests are performed with a Texture Analyser®. For the measurement of particle-wall sliding friction, a self-developed setup at the TU Kaiserslautern is used. During the measurement of tangential force, the particles are fixed to a flat holder and moved over a defined wall surface at a constant normal load. In addition, experiments in a fluid bed rotor processor equipped with a Magnetic Particle Tracking (MPT) system are conducted in order to visualize and quantify the real particle behaviour [6–9]. In Figure 1, the function of the MPT system is shown. The anisotropic magnetoresistive (AMR) sensors detect the magnetic field lines of the magnetic marker particles and allows the analysis of the movement and rotation behaviour of the marker particles.



**Figure 1.** Functioning of the Magnetic Particle Tracking (MPT) system

**3. Results and discussion**

The intention of these investigations is the experimental calibration of contact models, which can be applied for numerical DEM studies of fluidization processes with cylindrical particles. Cyclic loading tests for different loading positions of the particles show that the stiffness is independent of the number of impacts. For the used particles sizes, different loading positions do not lead to significant differences in stiffness. The behaviour of different particle shape models with the multi-sphere approach is also performed and compared with experimental results.

**4. Conclusions**

With the conducted compression tests and measurement of particle-wall sliding friction it is now possible to calibrate a contact model, which can be used for DEM studies, in particular for a CFD-DEM simulation of a fluid bed rotor processor.

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