A mesoscale investigation of the coalescence phenomena for wet agglomeration

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ABSTRACT

Granular material is one of the most common products in industry. In many cases, industrial practice requires an enlargement of the particle sizes, in this way particles are more easily handled and they acquire different mechanical properties. This operation can be achieved by wet agglomeration.

Although it is used in food, pharmaceutical, detergent and chemical industries, wet agglomeration processes are often operated inefficiently, with high wasting ratios in resources and energy.

As first step in a multiscale approach, we want to focus on the formation and breakage of clusters of particles in a granular system under shear in a simple element test. So we perform three-dimensional DEM simulation of granular packing sheared under volume conserving conditions. We start from a dry case using a viscoelastic contact interaction and subsequently we include interstitial liquid using a model for capillary [1] and additional viscous force for higher strain rates.

These simulations are carried out for studying the clustering kinetics of the granular material according to the process and shearing conditions. The volume of liquid inside the system is modified to cover different situations: from the dry case to increasing liquid content, up to the pendular state limit [2]. The response of the material is analysed, as a parametric study in shear intensity, local solid fraction, liquid content and binder properties.

From these simulations final granule size, shape and information on the force distribution inside granules are obtained. The clusters are identified using time-persistent long-lasting contact and force network criteria. This will allow us to identify different regimes of agglomeration and compare our results with experimental data in Iveson et al. [3].

The present study can help bring forward industrial process design and optimization, and solve scientific challenges in fundamental research. The developed method may be applied in future work for simulations of industrial equipment involving the agglomeration process.

REFERENCES