Numerical Simulation and Experimental Validation of Yielding For Cohesive Dry Powder

H. Shi *, A. Singh †, V. Magnanimo † and S. Luding †

* † Multi Scale Mechanics, CTW, MESA+,

University of Twente,
P.O. Box 217, 7500 AE Enschede, The Netherlands
Email: h.shi-1@utwente.nl, a.singh-1@utwente.nl,
v.magnanimo@utwente.nl, s.luding@utwente.nl.

ABSTRACT

Granular materials are omnipresent in our daily life. Important granular phenomena such as yield of powder under shearing have attracted significant scientific interest in the past decades. With development of computer technology, numerical modeling is getting more significant with solving problems in particle-based engineering. A topic of particular relevance from the application point of view is to understand when different powders yield, i.e. when they start flowing under shear or what is the shear stress necessary to keep them flowing. This issue has been studied numerically by using Discrete Element Simulations (DEM) in the so-called "split bottom ring shear cell" where a slow, quasi-static deformation leads to wide shear bands [1,3]. From a single simulation, along with density, velocity and deformation gradients, the whole stress tensor can be computed by applying time- and (local) space averaging [2]. When it is plotted from the stress output, the steady state shear (termination loci) is found to become nonlinear by increasing cohesion [2].

Physical experiments are carried out on fine limestone powder in direct shear box and Schulze ring shear tester to validate the interesting non-linearity in the material behavior, as predicted by DEM simulations with a non-linear elasto-plastic history dependent adhesive contact model [2,3]. The influence of two shear testers and particle sizes as well as the difference between the yield (transition from static to flow) and the steady state shear stress (required to maintain shear motion) will be addressed.

REFERENCES

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