# Size Segregation of Particles during a Pumping Process: A DEM Study

**Martin A. Haustein*** **and Rüdiger Schwarze†**

*,† TU Bergakademie Freiberg
Institute of Mechanics and Fluid Dynamics
Lampadiusstrasse 4, 09599 Freiberg, Germany
e-mail: martin.haustein@imfd.tu-freiberg.de, web page: http://www.tu-freiberg.de/

## ABSTRACT

The segregation of granular materials is a well known process with a large influence on a variety of applications in science and industry. Especially highly polydisperse materials consisting of large amounts of coarse particles like concrete tend to segregate[1]. In case of concrete, this process is of major importance for the formation of the so called lubrication layer. This layer is nearly completely depleted of coarse material like gravel and consists of fine sand, cement and water. Due to this layer, the pumping of the material over large distances becomes possible, since the pressure loss during the process is reduced[2]. Furthermore, the rheological behavior plays a significant role for the applicability of the material for modern 3D-printing technologies.

The understanding of the process leading to the formation of the lubrication layer is a topical question not only for concrete industry. Especially the influence of pumping on the segregation is not well understood yet. For this purpose, we use the Discrete Element Method (DEM) to investigate the behavior of polydisperse, dry granular materials during the pumping process. The pumping will be modelled to be a pulsating flow regime as it is expected for double piston pumpes typically used at the construction site. Thus the material will be compressed and relaxed during the pumping cycle.

The investigation of the material in the near-wall layer and in the bulk is done by using micro-macro transition [3, 4] in every pumping state. This will reveal the shear rate and shear stresses in the material, that can be used to determine the rheology of the granular material during the transport through pipes. The demixing of the material near the wall will be investigated in detail. The results of the pulsating pumping process will be compared with the case of linear pumping of polydisperse granular media through a tube.

It is shown that the processes leading to segregation of the material takes place in dry granular systems, which should be also considered in highly concentrated suspensions like concrete. The understanding of the mechanism without the influence of hydrodynamic forces is of high importance for the optimization of material properties.

## REFERENCES

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