Subject:

Microstructure simulation as a tool to investigate the inhomogeneous filter cake formation process

Type: Master thesis (theoretical, 6 months)

Start: by agreement (February 2025 at the earliest)

Location: University of California, Davis (UCDavis)

Supervisor: Dr.-Ing. Marco Gleiß (KIT); Prof. Dr. Jennifer Sinclair Curtis (UCDavis)

Examiner: Prof. Dr.-Ing. habil. Hermann Nirschl (KIT)

Motivation and objective

For the design of cake filtration on an industrial scale, laboratory experiments on pressure nutsches are still used today to determine the necessary properties of the filter cake which are permeability, porosity and capillary pressure. The lack of knowledge of particle properties means that changes in the industrial process require re-characterization of the filter cake properties and only a narrow range is represented by the investigated material properties.

UCDavis and KIT developed a framework to simulate the flow resistance on a microscale. Based on this framework both groups investigated the influence of particle size distribution, particle flow and particle roughness for homogeneous packings. In reality, however, incompressible filter cakes are often formed. As a result, the assumption of a homogeneous filter cake structure is not valid and the common Darcy, Ergun and Carman-Kozeny models reach their limits.

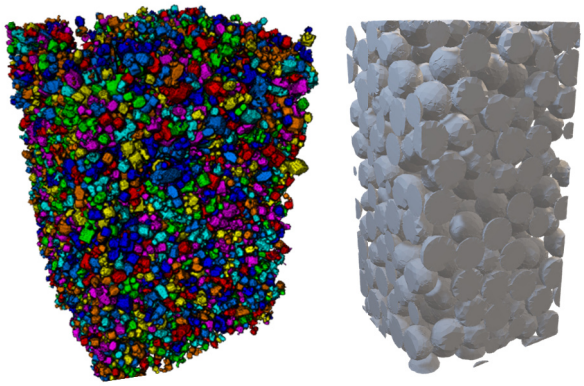

Figure 1: Reconstruction of a filter cake after measurement in the µCT and its negative for the microstructure simulation.

This master project deals with the formation of inhomogeneous filter cakes and their influence on the flow resistance. For this purpose, the existing framework for the simulation of cake resistance of homogeneous filter cakes will be adapted to allow the investigation of the flow in inhomogeneous filter cakes. The master thesis will be carried out at the University of California, Davis, USA, in the group of Prof. Dr. Jennifer Sinclair Curtis. Using a DEM code from UCDavis, particle packings are formed as a function of particle properties. Microstructure simulations using the OpenFOAM software tool are then used to perform simulations to predict the necessary filter cake properties dependent on particle properties and packing structure. The simulation results will be validated by the Process Machines Working Group at MVM. For further information please contact Dr. Marco Gleiß

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