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Population balance models for particulate flows in porous media: breakage and shear-driven events

Thursday, 3 June 2021 19:00 (15 minutes)

Population Balance Equation (PBE) successfully describes particle evolution in different flow conditions (Di Pasquale et al., 2012). However, despite predictive macroscopic models for polydisperse particulate flows are relevant for many Porous Media (PM) applications (Municchi and Icardi, 2020; Municchi et al., 2020) such as subsurface (water, oil) reservoirs and industrial filtration, there is still limited use of the PBE framework in the PM community. In this talk, we will explore a general population balance model for particle transport at the pore-scale, including aggregation, breakage and surface deposition. Using dimensional analysis, we analyse the different terms in the equations and we here propose to split the various mechanisms considered in the PBE to describe the evolution of a population of particles into one-and two-particles processes.While the former are linear processes, they might both depend on local flow properties(e.g. shear). This observation has important consequences for the problem we are considering, since the upscaling (via volume averaging and homogenisation) to a macroscopic (Darcy-scale)description now requires closures assumptions. Here, we show how to obtain such closures for specialised cases, pure breakage without aggregation caused by shear forces on the transported particles. We obtain, in arbitrary periodic geometries, accurate models for the upscaled breakage and collision frequencies, starting from non-linear power-law dependence on the local fluid shear rate. Results are presented for a two-dimensional channel flow and a three dimensional regular arrangement of spheres, for arbitrarily fast (mixing-limited) events. This work represents the foundation of a new general framework for multiscale modelling of particulate flows in porous media.

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Time Block Preference

Time Block A (09:00-12:00 CET)

References

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