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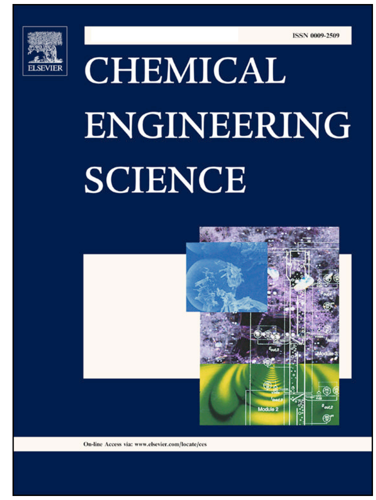

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Gerd Mikolajczyk, Li Huang, Michaela Wilhelm, Wolfgang Dreher, Stefan Odenbach

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Colloid deposition in monolithic porous media – Experimental investigations using X-ray computed microtomography and magnetic resonance velocimetry

Gerd Mikolajczyk[a], Li Huang[b], Michaela Wilhelm[c], Wolfgang Dreher[b], Stefan Odenbach[a]

[a] Chair of Magnetofluiddynamics, Measuring and Automation Technology, Institute of Fluid Mechanics, Technical University of Dresden, 01062 Dresden, Germany

[b] In-vivo-MR Group, Faculty 02 (Biology/Chemistry), University of Bremen, 28359 Bremen, Germany

[c] Advanced Ceramics Group, Faculty 04 (Production Engineering – Mechanical Engineering and Process Engineering), University of Bremen, 28359 Bremen, Germany

Abstract

For experimental investigations of colloid retention in porous media, also denoted as deep bed filtration, X-ray computed microtomography (µCT) has become a basic tool within the last decade. On the one hand, µCT can spatially resolve particle deposition at discrete points of filtration time. On the other hand, the topological information of the porous media including the porosity and the pore size distribution can be obtained. Aside from structural parameters, the velocity field of the fluid within the pores, which cannot be measured by means of µCT, plays an important role in the underlying mechanisms of particle transport and immobilization. In a given structure, a high flow rate will result in increased velocity gradients as well as increased shear forces compared to a lower flow rate. High shear forces are in turn unfavorable for particle deposition. Another imaging modality, magnetic resonance velocimetry (MRV), is capable of quantifying the desired velocity maps. We demonstrate an experimental approach that combines both, MRV and µCT. In contrast to the majority of other investigations about colloid retention, the porous media investigated in this work are monolithic foam-like structures. The evaluation of colloid deposition in those monolithic filters is based on analyzing individual pores. Particle deposition in a pore is expressed by the volumetric fraction of particles while the pore flow is described by the Reynolds number. Results indicate that pores with high Reynolds numbers are not among the pores with the highest or lowest volume fraction of particles for a given time. The particle volume fraction in pores with low Reynolds numbers is mainly a function of the axial position of the pore.

Keywords:
Deep bed filtration
X-ray Computed Microtomography
Magnetic Resonance
Image Registration