3D modeling of open-pored foams regarding particle deposition from aerosols

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Open-pored foams are highly porous and permeable materials, which are suited for a wide range of technical applications and also for particle filtration amongst others. The description of their complex spatial structure by characterizing parameters like porosity, pore diameter and link diameter is a simplification, which limits the prediction capability of models based on these parameters (Clark, 2009).

However, by using 3D pore structure models for the computation of the permeability or particle fraction deposition rates from fluids, the spatial structure of the open-pored foam is completely comprised. The 3D pore structure model can be obtained either by tomography or be generated by some algorithm (Redenbach, 2011). In both cases, at first a voxel model is obtained (i.e. a 3D pixel image). Thus, when a polyhedron mesh based flow and particle deposition simulation should be applied, the polyhedron mesh must be generated first (Skibinski, 2012).

In the presented work, tomographical open-pored foam models as well as models generated by a novel universal algorithm are used to compute air flow and NaCl aerosol deposition at a series of different open-pored foam materials. One of these is shown in Figure 1. Here, flow and particle computations are conducted directly on the voxel models, s.t. the polyhedron mesh generation step is avoided. The preparation of the models as well as the flow and particle computations are carried out with the in-house development DNSlab. The simulation results are then compared to measurements which have also been conducted by the authors. The simulated and measured particle fraction deposition rates show a very good agreement. The results for the material shown in Figure 1 are depicted in Figure 2.
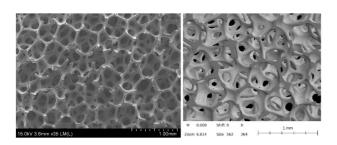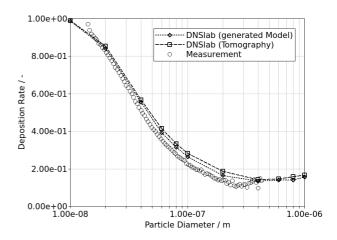

Figure 2. Comparison of NaCl particle fraction deposition rates from experiment and simulation with generated model and tomography for the open-pored foam material shown in Figure 1. The sample thickness is 16 mm, the aerosol flow rate is 0.055 m/s.

Clark, P., Koehler, K. A., Volckens, J. (2009) *Aerosol Science* **40**, 563-572

Redenbach, C., Wirjadi, O., Rief, S., Wiegmann, A. (2011) *Advanced engineering materials* **13/3**, 171-177

Skibinski, J., Wejrzanowski, T., Szumbarski, J., Kurzydlowski, K. J. (2012) *Advances in Fluid Mechanics* **IX**, 109-118

Figure 1. Real structure (left) and generated model (right) of an examined open-pored foam.