Numerical investigations on the influence of the fiber assembly and the particle shape to the separation efficiency

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The determination of the transport and separation behavior of spherical particles on the surface of a single fiber was shown on the last AFS Annual Conference in Minneapolis [1]. There, the built-up of dendrite formations was determined by coupling of CFD (Computational Fluid Dynamics) with DEM (Discrete Element Methods). The numerical results showed that the separation efficiency is dependent on the particle loading of the single fiber.

The deposited particles within the dendrite formations cause an increasing pressure drop due to the decreasing effective free flow cross section. By neglecting particle reallocation and detachment the dendrite formations are fixed during the simulation time independent of the surrounding pressure field and the local flow velocity. An unphysical increase of the pressure drop is observed. For this reason it is significant to take into account these effects especially for highly laden filter media.

Due to the complex physics of this separation process the simulation method uses a CFD-software to determine the flow field around the fiber and the separated particles. The DEM-software realizes the calculation of multi body kinematics of deposited particles within the dendrite formations. With this procedure the influence of dendrite motion, reallocation and the detachment of already separated particles to the separation efficiency can be considered in detail.

With respect to technical applications the simulation model is enhanced to determine the transport and the separation of non spherical particles. Furthermore, the computational domain is not yet restricted on a single fiber. The numerical investigations are carried out for a multilayer filter medium which consists of two filter layers (composite media). The two layers are characterized by two different fiber diameters. Depending on the assembly of these two layers pressure drop and separation efficiency are strongly different. The results based on the developed simulation method are used to characterize the separation process and to improve of the design process of filter media based on the fundamental understanding of the impact parameters to the entire separation process.

[1] Schilling, M., Schütz, S., Piesche, M.: *Coupling of CFD- and DEM-methods to determine the transport and deposition behavior of particles on filter fibers*. Proceedings AFS Annual Conference, Minneapolis, 2009

BIOGRAPHY, SHORT SKETCH

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Bio

Martin Schilling, born in 1978 started his studies of process engineering at the University of Stuttgart in 1998 and graduated with a diploma degree. Since 2004 he is working as a research assistant at the Institute of Mechanical Process Engineering at the University of Stuttgart on the field of multiphase flow simulation with volumetrically resolved discrete particles.