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# Numerical Investigation into Capture Efficiency of Fibrous Filters

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**Abstract :** Purification of gases from aerosols or airborne particles via filters is widely applied in the industry and in our daily lives. This separation especially in the micron and submicron size range is a necessary step to protect the environment and human health. Fibrous filters are often employed due to their low cost and high efficiency. For designing any filter the two most important performance parameters are capture efficiency and pressure drop. Since the capture efficiency is directly proportional to the pressure drop which leads to higher operating costs, a detailed investigation of the separation mechanism is required to optimize the filter designing, i.e., to have a high capture efficiency with a lower pressure drop. Therefore a two-dimensional flow simulation around a single fiber using Ansys CFX and Matlab is used to get insight into the separation process. Instead of simulating a solid fiber, the present Ansys CFX model uses a fictitious domain approach for the fiber by implementing a momentum loss model. This approach has been chosen to avoid creating a new mesh for different fiber sizes, thereby saving time and effort for re-meshing. In a first step, only the flow of the continuous fluid around the fiber is simulated in Ansys CFX and the flow field data is extracted and imported into Matlab and the particle trajectory is calculated in a Matlab routine. This calculation is a Lagrangian, one way coupled approach for particles with all relevant forces acting on it. The key parameters for the simulation in both Ansys CFX and Matlab are the porosity ε, the diameter ratio of particle and fiber D, the fluid Reynolds number Re, the Reynolds particle number Rep, the Stokes number St, the Froude number Fr and the density ratio of fluid and particle ρf/ρp. The simulation results were then compared to the single fiber theory from the literature.

**Keywords :** BBO-equation, capture efficiency, CFX, Matlab, fibrous filter, particle trajectory
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