Abstract Submitted
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Numerical Investigation of Filtration by Circular and Elliptical Fibers[1] JING WANG, DAVID PUI, University of Minnesota — Numerical simulation has been carried out to investigate filtration by circular and elliptical fibers. The flow field through arrays of fibers and the drag force on individual fibers are obtained. The simulation results are in good agreement with analytical solutions for the drag on circular and elliptical fibers obtained from the cell model. Our simulation covers mechanisms for particle capture due to interception, inertial impaction and diffusion. The efficiency due to interception and inertial impaction are obtained by determining the critical initial position, below which all the particles are captured. Particle capture due to diffusion is studied by solving the convective diffusion equation for the particle concentration. The simulation results for particle capture are converted into single-fiber efficiencies and compared to theoretical expressions in the literature, which are limited to circular fibers; reasonable agreement is obtained. We extend the calculation for the single-fiber efficiencies to different elliptical fibers. The figure of merit, which is defined as the ratio of the collection efficiency to the pressure drop, is computed for different elliptical fibers. It is found that the figure of merit depends on the particles under consideration. Blunt and close to circular fibers are more effective for particles dominated by the effects of interception and inertial impaction, whereas long and slim fibers are more effective for particles dominated by the diffusion effect.

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