Theoretical Study of Fluid Flow through Screened Channel in a Tangential Flow Filtration Process

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ABSTRACT. Design and optimization of feed screens in filtration devices assembled of layers of membranes and screens as turbulence promoters is of great importance in filtration process. In this study, performance of different screens were modeled using computational fluid dynamics in order to understand the impact of screen characteristic parameters. The screens are all made of polypropylene fibers weaved in form of warp and weft in which the feed solution passes through the free spaces between the fibers. The effect of membrane as a permeable wall was also considered in the computational models using the Brinkman equation. The radius of the fibers, the distance between fibers and different weave pattern of fibers were varied to examine their impact on the average magnitude of the flow velocity, pressure drop through the channel length and the shear rate on the membrane surface and on the fibers surface. Also, the impact of compression of layers on the performance of the feed screens was investigated using microscopic analysis along with the computational calculations. The results enable us to optimize the feed screens according to our purpose of manipulating the shear rate and the pressure drop.

Keywords: Filtration feed screens, CFD, Ultrafiltration, Optimization