465e Theoretical Analysis of the Effect of Membrane Morphology on Fouling

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Previous studies of membrane fouling have often employed one of the classical blocking laws to describe the variation of filtrate flux with time. These models implicitly assume that the membrane has straight-through noninterconnected pores, even though most commercial microfiltration and ultrafiltration membranes have a highly interconnected pore structure. Ho and Zydney have developed a theoretical model for the effects of pore blockage on the fluid velocity and pressure profiles within homogeneous membranes. Although most microfiltration processes use homogeneous (or symmetric) membranes, there is growing interest in the use of both asymmetric and composite membranes for particle removal applications in the semiconductor industry and virus clearance in biopharmaceutical applications. In order to account for the spatial variation in pore connectivity within asymmetric or composite membranes, Darcy permeability in the directions normal to and parallel to the membrane surface were varied through out the membrane. The velocity profile and flux decline due to pore blockage were described using Darcy's law. Flux decline data were obtained using composite membranes formed with highly interconnected polyvinylidene fluoride membranes (PVDF) and straight through pore polycarbonate track etched membranes (PCTE). Model composite membranes were formed by layering PCTE or PVDF membranes with different pore sizes on top of each other. Flux decline data for the composite membrane were in good agreement with model calculations. The results provide important insights into the effects of asymmetric membrane pore structures on flux decline.