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Coupling Discrete and Continuum Mechanics in Low Concentration, Particle-Laden Flows PAUL BOYLE, BRENT HOUCHENS, Rice University, ALBERT KIM, University of Hawaii at Manoa — The study of particle-laden flow plays a critical role in pressure-driven membrane filtration such as microfiltration (MF), ultrafiltration (UF), nanofiltration (NF), and reverse osmosis (RO). Hydrodynamic and inter-particle interactions, coupled to the ambient crossflow field, are well documented in literature. Transport of particles is originated due to Brownian and shear-induced diffusion, and convection due to the axial crossflow and transverse permeate flow. These effects are modeled using Hydrodynamic Force Bias Monte Carlo (HFBMC) simulations to predict the deposition of the particles on the membrane surface. In addition, the particles in the simulation are also subject to electrostatic double layer repulsion and van der Waals attraction both between particles and between the particles and membrane surfaces. In conjunction with the hydrodynamics, the change in particle potential determines the transition probability that a proposed, random move of a particle will be accepted. In the current study, these discrete particle effects at the microscopic level are coupled to the continuum flow via an apparent local viscosity, yielding a quasi-steady-state velocity profile. This velocity profile is dynamically updated in order to refine the hydrodynamic interactions. The resulting simulation predicts the formation of a cake layer of deposited interacting particles on the membrane surface.

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