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Fouling Prevention in Crossflow Membrane Filtration by Dielectrophoretic Levitation of Colloids

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ABSTRACT

The ability of dielectrophoretic (DEP) forces created on a membrane surface to levitate particles in a colloidal suspension is studied experimentally and theoretically. A numerical model based on the convection-diffusion-migration equation is presented to calculate the concentration distribution of colloidal particles in shear flow under the influence of a repulsive DEP force field. The mathematical model is then used to indicate how the deposition behavior is modified in presence of a permeable surface, representative of tangential flow membrane filtration operations. The results obtained from the numerical simulations are compared against trajectory analysis results and experimental data. The experimental system employs microelectrode configuration on a porous membrane surface in a crossflow filtration cell, to apply repulsive DEP forces on polystyrene latex particles suspended in an aqueous medium. Applying a non-uniform AC electric field on the microelectrodes generates the DEP force field. The DEP controlled levitation of latex particles near the surface is observed and measured using microscopy technique. The results indicate that the repulsive dielectrophoretic (DEP) forces imparted on the particles suspended in the feed can be employed to effectively mitigate membrane fouling in a crossflow membrane filtration process.