LIQUID FILTRATION: EFFECTS OF CHEMICAL AND PHYSICAL FACTORS ON FILTRATION PERFORMANCE FOR MICRO- AND ULTRAFILTRATION MEMBRANES – MODELING AND EXPERIMENTS

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Micro- and ultra-filtration are being widely applied to remove nanoparticles in drinking water and chemicals. So far, micro- and ultra-filtration filters are usually characterized by their geometric pore size. However, significant discrepancies between the prediction and experimental data are often observed especially for nanoparticles due to the complex surface interactions between filter and particle. Nanoparticle deposition experiments under unfavorable conditions were conducted experimentally and theoretically. In the experiments, particles with different particle sizes (down to 1.7 nm), materials (Au and PSL) and several types of membranes with different nominal pore sizes were used. To measure liquid-born particle concentrations, we employed Nanoparticle Tracking Analysis (NTA) and electrospray-scanning mobility particle sizer (ES-SMPS), which provide accurate particle concentration results in the low concentration range and are considered to be promising candidates for micro- and ultrafiltration studies. Based on the experimental data, we developed simulation methods for predicting particle deposition behavior on the Nuclepore filter with straight pore structures and fibrous filters using the Lagrangian particle tracking method in Ansys Fluent. We calculated the interaction energies between particle and membrane filter surfaces utilizing the extended Derjaguin-Landau-Verwey-Overbeek (DLVO) theory. Moreover, adhesive and hydrodynamic torques were considered for particle detachment. We found that experiment and theory were in very good agreement under different chemical (e.g., ionic strength and zeta potential) and physical (e.g., fluid velocity and membrane structure) conditions.