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Direct observation of fouling phenomena during cross-flow filtration: Influence of particle surface charge

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ABSTRACT

Membrane fouling is inherent in all types of membrane filtration. In microfiltration, particles are often deposited on the membrane surface, forming a filter cake whose structure and behaviour play crucial roles in the filterability of suspensions. Filter cake formation is often measured or calculated indirectly from pressure flux data. In this study, filter cakes were characterized by direct optical observation of the surface of a single hollow-fibre membrane during cross-flow filtration. Monodisperse polymer model particles with varying surface charge densities were suspended in water and filtered. Results indicate a significant difference in the behaviour of filter cakes formed by differently charged particles. Increasing the particle surface charge generally increases both the specific resistance and compressibility of the filter cake, whereas lowering the charge increases the filter cake growth rate and steady-state thickness. Attempts to remove fouling were made using relaxation, backwash, and cross-flow shear. Relaxation alone did not remove the filter cake and recompression happened quickly. Effectively removing the filter cake required a combination of backwash and high cross-flow shear. However, a thin layer of particles remained on the membrane after cleaning, and it was demonstrated that this layer accounts for a significant amount of the overall filter cake resistance.

Keywords: Microfiltration; Particle fouling; Direct observation; Charge effects; Filter cake

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