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The impacts of operational conditions on phenol removal by nanofiltration membranes

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ABSTRACT

The main purpose of this study was to investigate the effectiveness of various nanofiltration (NF) membranes in rejecting phenol from waters. The impacts of operational conditions and water chemistry on phenol rejections in model solutions were studied. Single-solute phenol model solutions were prepared in distilled and deionized water. All membrane tests were conducted using a lab-scale cross-flow flat-sheet configuration test unit. For all the tested NF membranes, the main factor affecting phenol rejections was solution pH. Increasing solution pH from 7.0 to 10.5 significantly increased phenol rejections. Both the enhanced negative membrane surface charge at higher pH and the dominance of negatively charged phenolate species led to higher phenol rejections at pH 10.5 compared to neutral pH. No significant changes in flux values were observed at neutral pH and pH of 10.5. There was not a correlation among salt and phenol rejections by the tested polyamide NF membranes. The initial phenol concentrations (50 and 200 mg/l) did not affect permeate flux and phenol rejections. Phenol rejections increased by increasing the pressure from 100 to 200 psi. The results overall indicated that although both size exclusion and electrostatic repulsion mechanisms play role in phenol rejections by NF membranes, electrostatic repulsion mechanism contributes more to rejections than size exclusion mechanism. Supporting the electrostatic repulsion mechanism through pH increase in NF applications may result in both enhanced phenol rejections and prevention of phenol adsorption and further diffusion inside the membranes. On the other hand, the pH adjustments should be within the range of manufacturer specifications since increased membrane degradation could occur at higher pH values in polyamide membranes.

Keywords: Membrane; Nanofiltration; Phenol; Water treatment

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