Nanofiltration membranes for toxic lead removal: contribution of various mass transfer mechanisms on membrane performance

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Abstract

The performance of nanofiltration membrane process for lead retention has been modelled by the modified Donnan steric pore-flow model (DSPM). The model predictions have been used to analyse the contribution of diffusive, convective and electrical flux on ion retention. A good agreement was found between the experimental and modelling data at various operating conditions. The influence of various process parameters, such as the permeation flux, feed solution concentration and cross-velocity, on lead (Pb) ion retention, was investigated. Maximum lead ion rejection was 93.8% at permeate flux of 1.25 * 10−5 m/s. It was found that the lead retention increases initially with permeate flux and then decreases with further increase in permeate flux due to the developed concentration polarisation layer. Furthermore, the rejection drops by ~ 80% when the uncharged membrane is used, revealing the important role of electrical potential on the performance of the nanofiltration membrane. Finally, it is confirmed that the diffusion phenomenon is the dominant mechanism for ion transfer through the membrane.