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Prediction of metal ion rejection in electro-cross-flow ultrafiltration using an artificial neural network

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ABSTRACT

We studied an electro-cross flow ultrafiltration system that uses charged and neutral ultrafiltration membranes and changes in pH and voltage to Pb^{2+}, Ca^{2+} and Fe^{2+}. Simulation of the experimental data was performed with the aid of an artificial neural network (ANN), to obtain a mathematical model to predict metal ion remotion. Analysis of the experimental data indicates that the surface charge of the membrane does not affect the removal process. However, the neutral membrane (SP1) has a higher flux (0.293 L/m^2 s) than the charged membrane (AC1) (0.271 L/m^2 s). Our results also indicate that the metal ions studied are efficiently removed by applying voltage. In all cases, by applying a voltage of 1.0 V for 30 min to an AC1 membrane, metal ion removal was well over 90%. The ANN model developed properly adjusted the experimental data with a non-linear model and allowed us to predict with a standard deviation no greater than 10% the removal rate as a function of voltage and time. In addition, a simplified model prediction suggests that the removal percentage is dependent only with time at a fixed voltage. This model allowed us also to observe the speed with which the system stabilizes to achieve the maximum removal percentage.

Keywords: Electro-cross flow; Neural Networks; Heavy metal ions; Ultrafiltration

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