Genetic programming for modeling and optimization of gas sparging assisted microfiltration of oil-in-water emulsion

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ABSTRACT

Genetic programming (GP) is an orderly method based on natural evolution rules for getting computers to regularly solve a problem. In the present study, GP is presented as a novel approach for modeling the gas sparging assisted microfiltration of oil-in-water emulsion process. The effects of gas flow rate ($Q_G$), oil concentration ($C_{oil}$), transmembrane pressure (TMP), and liquid flow rate ($Q_L$) on the permeate flux and oil rejection were studied and the GP models were developed to predict the membrane performance. $C_{oil}$ and TMP showed significant effects on both permeate flux and rejection. An interaction between $C_{oil}$ and TMP was detected, at low $C_{oil}$ and high TMP, in which the permeate flux increased considerably. It was found that $Q_L$ has a low effect on permeate flux, but its impact on rejection was significant. Increasing $Q_L$ from 0.5 to 2.75 L/min led to a considerable increment in rejection; however, further increase in the liquid flow rate decreased the oil rejection. On the contrary, $Q_G$ showed a small effect on oil rejection, but its effect on permeate flux was notable. To determine the optimum conditions, the performance index was maximized using the developed genetic algorithm. Under the obtained optimal conditions, maximum permeate flux and rejection (%) were 121.6 (Lm$^2$/h) and 93.0%, respectively.

Keywords: Oil-in-water emulsion; Microfiltration; Gas sparging; Genetic programming; Optimization

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