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Soft computing method for modeling and optimization of air and water gap membrane distillation — a genetic programming approach

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ABSTRACT

An empirical genetic programming (GP) model is developed to predict the performance of air and water gap membrane distillation (AGMD and WGMD) processes. Feed temperature, T_f, feed concentration, C_{feed}, feed flow rate, Q_f, and coolant flow rate, Q_c, were considered as input parameters, and the permeate flux was considered to be the output. The gap width is kept constant for both configurations (AGMD and WGMD) so the comparison between these two designs is based on the fixed gap width. In order to evaluate the accuracy of model, the effects of operating factors on the permeate flux were studied and compared to the experimental data. Moreover, some statistical analysis was done and exhibited a good agreement between predicated and experimental results. Using the obtained model, the impact of different variables on the process performance calculated and it was found that T_f, has the most important effect on the process performance. Finally, the optimum conditions were found by Genetic Algorithm (GA) as: Q_f = 4.512 L/min, C_{feed} = 0.145 g/L, T_f = 90°C, Q_c = 3.132 L/min with a maximum permeate flux of 38.972 L/m² h and 83.621 L/m² h for AGMD and WGMD, respectively.

Keywords: Membrane distillation; Air and water gaps; Genetic programming; Optimization

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