

Multivariable statistical analysis for enhancing performance indicators in direct contact membrane distillation

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ABSTRACT

Orthogonal experimental design, correlation analysis and response surface charts were used to identify the parameters influencing the operational efficiency of direct contact membrane distillation (DCMD). The orthogonal array design method was used to optimize the number of experimental trials required for dependence analysis. The operating factors studied were hot feed properties (temperature, salinity, flowrate) and cold distillate characteristics (temperature, and flowrate). The impact of those factors on three DCMD performance indicators - cold distillate production rate, performance ratio and recovery ratio – was investigated. The most significant factors influencing each performance indicator were obtained from the quantitative values of main and interaction effects, and confirmed by using the Pearson product-moment correlation coefficients. The main effects of feed and distillate temperatures on the performance indicators were the greatest, indicating that the most significant factors were the feed and distillate temperatures. The maximum distillate production rate was obtained at feed and distillate temperatures of 90 and 15°C, respectively. The optimum recovery and performance ratios were obtained at a feed flowrate of 1.6 L/min but when feed temperature was kept at 70°C.

Keywords: Membrane distillation; Orthogonal design; Pearson correlation; Response surface analysis; Desalination

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