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Water Desalination using Air Gap Membrane Distillation

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By

Fatima Adnan Hashim

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Supervised By

Prof. Dr.Qusay F. Alsalhy ***Asst. Prof. Dr. Salah S.Ibrahim***

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Abstract

In this work, an experimental investigation of the performance of Air Gap Membrane Distillation (AGMD) system was performed for laboratory prepared salt feed water solutions. The influences of system operating parameters such as feed temperature (45-65℃), feed flow rate (0.25-0.55 L/min) and feed concentration (0-45 g/L) on permeate flux were studied. The rejection factor was found greater than 99.9% and the permeate conductivity was less than 20μS/cm. The performance of the AGMD unit was statistically optimized using design of experiment (DOE). Furthermore, theoretical model describing heat and mass transfer analysis in AGMD using **Matlab** program was developed and discussed in details. The permeate flux was found to increase with increasing feed temperature and feed flow rate. However, it decreased with increasing feed concentration. The system performance was mostly dominated by the effect of feed temperature. Feed flow rate and feed concentration had relatively considerable effect on flux. In general, the theoretical model results were found to be in a good agreement with the experimental data as the maximum deviation of model results was within ±20%. The maximum thermal efficiency of the system was 96% at (65℃, 0.45 L/min and 35 g/L) and the gain output ratio (GOR) was 4.87. The model was also used to predict temperature polarization of the AGMD system. The obtained temperature polarization coefficient is within 0.85 to 0.91. This is an indication that the used module is well designed. Taguchi method was employed to optimize the performance of an AGMD unit for water desalination and the best regression model for calculating the permeate flux is given by:

$Flux = 1.35 - 0.0766*T + 0.509*F - 0.00714*C + 0.00124*T^2$