

Experimental and simulation study of an air gap membrane distillation module with solar absorption function for desalination

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ABSTRACT

Being capable of directly utilizing solar thermal energy, the solar driven membrane distillation desalination system has evolved as a promising technology for alleviating the energy and water resource problems. An innovative device for desalination, which is a hybrid of a solar collector and a membrane distillation, called SAF-AGMD (air gap membrane distillation with solar absorption function) is proposed. The experimental and simulation results are reported. The experimental results validate the feasibility of the design and the water production rate is enhanced by 2–8% compared to the simple AGMD module. The mathematic model takes into account the heat and mass transfers via correlations from the literature. The model is verified by the experimental data under different conditions, including the temperature and flow rate of inlet fluids, the air gap thickness and the solar radiation. The differences between the model predication and the experimental results are within 10%. The model is further incorporated with the experimental design method and response surface method for the optimization study. Considering water production and exergy loss, the optimal operation should use hot fluid of 325 K, cold fluid of 298 K and air gap thickness of 1.9 mm.

Keywords: Air gap membrane distillation; Desalination; Modeling; Optimization; Solar energy

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