World Academy of Science, Engineering and Technology
International Journal of Chemical and Materials Engineering
Vol:8, No:12, 2014

Efficiency of Membrane Distillation to Produce Fresh Water

Authors : Sabri Mrayed, David Maccioni, Greg Leslie

Abstract : Seawater desalination has been accepted as one of the most effective solutions to the growing problem of a diminishing clean drinking water supply. Currently, two desalination technologies dominate the market – the thermally driven multi-stage flash distillation (MSF) and the membrane based reverse osmosis (RO). However, in recent years membrane distillation (MD) has emerged as a potential alternative to the established means of desalination. This research project intended to determine the viability of MD as an alternative process to MSF and RO for seawater desalination. Specifically the project involves conducting a thermodynamic analysis of the process based on the second law of thermodynamics to determine the efficiency of the MD. Data was obtained from experiments carried out on a laboratory rig. In order to determine exergy values required for the exergy analysis, two separate models were built in Engineering Equation Solver – the 'Minimum Separation Work Model' and the 'Stream Exergy Model'. The efficiency of MD process was found to be 17.3 %, and the energy consumption was determined to be 4.5 kWh to produce one cubic meter of fresh water. The results indicate MD has potential as a technique for seawater desalination compared to RO and MSF. However, it was shown that this was only the case if an alternate energy source such as green or waste energy was available to provide the thermal energy input to the process. If the process was required to power itself, it was shown to be highly inefficient and in no way thermodynamically viable as a commercial desalination process.

Keywords : desalination, exergy, membrane distillation, second law efficiency
Conference Title : ICCBE 2014 : International Conference on Chemical and Biochemical Engineering
Conference Location : Istanbul, Türkiye
Conference Dates : December 05-06, 2014