



Energy and exergy analyses of a novel multi-effect distillation system with thermal vapor compression for seawater desalination

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ABSTRACT

In this work, the first and second laws of thermodynamics were applied to conduct energy and exergy evaluations of a novel integrated multi-effect distillation with thermal vapor compression (MED-TVC) system for seawater desalination. In addition, the behavior of the MED-TVC system was analyzed for various operating conditions such as the top brine temperature, the number of effects, and the motive steam flow rate. The obtained results confirmed that the major causes of irreversibilities in the MED-TVC system are the ejector and effects, which account for 45% and 37% of the total exergetic destruction, respectively. Moreover, the results of the energetic analysis showed that maximum energy losses of about 42% occur in the condenser primarily due to heat transfer over large temperature differences. Finally, the parametric study revealed that operating the MED-TVC desalination system with reduced top brine temperature and motive steam flow is highly recommended to improve the overall efficiency while increasing the number of effects is particularly suitable for high system performance and productivity.

Keywords: Seawater desalination; Multi-effect distillation; Thermal vapor compression; Energetic analysis; Exergy efficiency; Performance

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