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Desalination at low temperatures: an exergy analysis

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ABSTRACT

A new low-temperature phase-change desalination process has been presented where saline water is desalinated by evaporation at near-ambient temperatures under low pressures. The low pressure is achieved naturally in the head space of water columns of a height equal to the local barometric head. By connecting the head space of such a saline water column to that of a distilled water column, and by maintaining the temperature of the former about 15–20°C above that of the latter, fresh water is evaporated from the saline column and condensed in the distilled water column. This paper presents an exergy analysis of this process to evaluate the thermodynamic efficiency of its major components and to identify suitable operating conditions to minimize exergy destruction. Three different heat sources such as direct solar, photovoltaic energy as well as a low grade heat source were considered. It was found that the major exergy destruction occurs in the condenser where the latent heat of the water vapor is lost to the environment. Exergy performance of individual process components and recommendations to further improve the exergy efficiency of the proposed process are presented.

Keywords: Desalination; Energy; Exergy analysis; Second law of thermodynamics; Exergy destruction; Irreversibility

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