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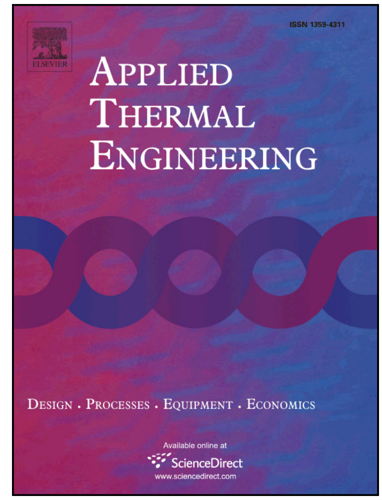

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Abstract

This study presents an advanced exergy analysis of a single-state absorption heat transformer operating with a lithium bromide water solution. A traditional exergy analysis was also conducted to identify the components with the highest contribution to the exergy destruction, and an advanced exergy approach was developed to estimate a realistic design and improve the operating conditions of the system. According to the base case of this study, when calculating the total reversibility of the cycle, only 14.78% could be reduced by improving its design and configuration. In addition, a parametric study was presented to discuss the sensitivity of splitting exergy destruction concepts taking into account temperature variations in the heat source, sink, and seawater outlet. Considering improvements to the generator a top priority, followed by improving the absorber, the condenser and finally the evaporator. The numerical results of this work have been developed to help design engineers experiment and assemble future equipment.

Keywords: Lithium bromide solution, absorption, avoidable exergy destruction, endogenous exergy destruction.

1. Introduction

The purpose of this research is to provide a thermodynamic study through an advanced exergy analysis of a single-stage absorption heat transformer, which splits the exergy destruction into its endogenous or exogenous and avoidable or unavoidable parts in order to estimate a potential improvement of a heat transformer.

This is an attractive method to estimate the degree of improvement of a thermodynamic cycle. Initially, Morosuk and Tsatsaronis [14] presented the advanced exergy methodology as a new development in the analysis of energy conversion systems; they performed both, the traditional and the advanced exergy analyses for an absorption refrigeration machine, concluding that 65.8% of the total exergy destruction was unavoidable, consequently the remaining 50.1% depended on the design and operating conditions of the components themselves. Afterward, several authors have studied energy systems based on advanced exergy analysis approaches. For example, Gong and Goni [12, 13] developed a theoretical and parametric analysis of an absorption refrigeration machine through an advanced exergy approach, in which the influence of the temperature of the heat source, the heat sink, the refrigerated environment; and the difference between the condensation and absorption temperatures in the avoidable endogenous exergy destruction were reported with special interest. Chen et al. [5] conducted an advanced exergy destruction analysis of the main components of the thermodynamic cycle of an ejector refrigeration system and determined that the exergy destruction of the ejector and generator could be reduced by improving the efficiency of the ejector and other components. In this regard, Janghorban-Esfahani et al. [4] presented an advanced exergoeconomic analysis for a multi-effect evaporation-absorption heat pump desalination system, by splitting the exergy

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