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A new approach for process optimization of a METVC desalination system

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ABSTRACT

Making potable water through desalination plants is a very important process in areas where clean water is highly required. One of the most common and acceptable desalination processes is multiple effect evaporation desalination (MED) process. The main objective of this paper is optimization of MED desalination with thermal vapor compression (METVC) from economical and thermodynamic point of view. Hence, first, a comprehensive thermodynamic model for METVC is developed and then the effect of operating parameters on thermal performance of the system is analyzed. Since the values of operating parameters have a great effect on both thermal performance and cost of the plant, the optimization of these parameters is very important. In this regard, some researchers have focused on improving the economical or thermodynamic aspect of the system. However, in practice it is reasonable to optimize both these criteria simultaneously. Based on this, in order to optimize the process of METVC and show influence of objective function on optimization results, four objective functions are chosen as four cases for optimization. These cases include 1) minimizing specific heat transfer area, 2) maximizing exergy efficiency, 3) maximizing performance ratio (*PR*) and 4) minimizing specific heat transfer area and maximizing *PR*. In fact, cases 1 to 3 are single objective problem while case 4 is a multi objective problem. All of the optimization problems are solved by a heuristic optimization problem, namely, Genetic Algorithm (GA). From optimization study, it can be seen that the results of multi objective problem are perfect and more reasonable than other cases. In other words, the results of cases 1 to 3 demonstrate some improvement in either thermodynamic or economical aspects of the system although multi objective optimization satisfy both thermodynamic and economical aspects of METVC and exhibit a rational system that could be applied for a real design approach.

Keywords: Multi effect thermal vapor compression desalination; Thermodynamic model; Exergy analysis; Genetic algorithm; Sequential quadratic programming; Optimization

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