Model-Based Cost Optimization of Double-Effect Water-Lithium Bromide Absorption Refrigeration Systems

This work presents optimization results obtained for a double-effect H2O-LiBr absorption refrigeration system considering the total cost as minimization criterion, for a wide range of cooling capacity values. As a model result, the sizes of the process units and the corresponding operating conditions are obtained simultaneously. In this paper, the effectiveness factor of each proposed heat exchanger is considered as a model optimization variable which allows (if beneficial, according to the objective function to be minimized) its deletion from the optimal solution, therefore, helping us to determine the optimal configuration. Several optimization cases considering different target levels of cooling capacity are solved. Among the major results, it was observed that the total cost is considerably reduced when the solution heat exchanger operating at low temperature is deleted compared to the configuration that includes it. Also, it was found that the effect of removing this heat exchanger is comparatively more significant with increasing cooling capacity levels. A reduction of 9.8% in the total cost was obtained for a cooling capacity of 16 kW (11,537.2 $·year⁻¹ vs. 12,794.5 $·year⁻¹ ), while a reduction of 12% was obtained for a cooling capacity of 100 kW (31,338.1 $·year⁻¹ vs. 35,613.9 $·year⁻¹ ). The optimization mathematical model presented in this work assists in selecting the optimal process configuration, as well as determining the optimal process unit sizes and operating conditions of refrigeration systems.

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Contributors: Mussati, S. F., Mansouri, S. S., Gernaey, K. V., Morosuk, T., Mussati, M. C.
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