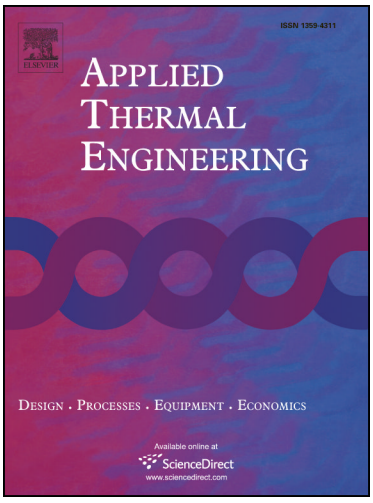

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Simultaneous optimization of pump and cooler networks in a cooling water system

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Abstract: A cooling water system requires a large amount of energy to transport the cooling water. It contains two subsystems, namely, a cooler network and pump network. Conventionally, these two subsystems are optimized separately. The intrinsic connections between the pump cost, cooler cost, and cooling water flow rate, require the cooler and pump networks to be optimized simultaneously. This paper presents an optimization model for a cooling water system in which both the subsystems are simultaneously optimized. For the cooler network, a series–parallel superstructure is employed to reduce the cooling water flow rate for decreasing the pumping cost. A main–auxiliary pumps structure is applied in the pumping system for reducing the energy consumption. The intrinsic relationship between the cooler network and pumping system is investigated. The model is formulated as a mixed-integer nonlinear programming (MINLP) problem. The objective is to determine the cooling water system by minimizing the total annual cost. A case study is employed to demonstrate the effectiveness of the proposed model. The results show that the simultaneous optimization method can lead to a 6.3% TAC reduction in comparison with the two-step sequential optimization method.

Key words: cooling water system, pump network, cooler network, MINLP.