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Complex Cooling Water Systems Optimization with Pressure Drop Consideration

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Abstract

Pressure drop consideration has shown to be an essential requirement for the synthesis of a cooling water network where reuse/recycle philosophy is employed. This is due to an increased network pressure drop associated with additional reuse/recycle streams. This paper presents a mathematical technique for pressure drop optimization in cooling water systems consisting of multiple cooling towers. The proposed technique is based on the Critical Path Algorithm (CPA) and the superstructural approach. The CPA is used to select the cooling water network with minimum pressure drop while the superstructure allows for reuse of the cooling water. The proposed technique offers the opportunity to debottleneck the cooling water systems with multiple cooling towers while maintaining a minimum pressure drop. This technique, which was previously used in a cooling water network with a single source, has been adapted in a cooling water network with multiple sources. The mathematical formulations exhibit a mixed-integer nonlinear programming (MINLP) structure. The cooling tower model is used to predict the exit conditions of the cooling towers, given the inlet conditions from the cooling water network model. The case studies showed that the circulating cooling water flow rate can be reduced by up to 26% at a minimum cooling water network pressure drop.