Research topics

Design of Cooling Water Systems

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Abstract

Re-circulating cooling water systems are the most common method used to reject waste heat to the environment. The majority of designs employ networks of cooling water coolers that operate in parallel. Novel arrangements allow lower re-circulation rates and better cooling tower performance. This can be a critical issue in debottlenecking studies.

Project description

Air coolers, once through cooling using cooling water and re-circulating cooling water systems are all used for the rejection of waste heat to the environment. Of these methods, re-circulating cooling water systems are by far the most common. Cooling water is supplied from the cooling tower to a network of coolers that operate in parallel. Yet, not all of the cooling duties require water at the exit temperature of the cooling tower. Some of the duties can be supplied with cooling at higher temperatures. If this is the case, then it is possible to re-use cooling water between different cooling duties. This will lead to series cooling arrangements. Operating coolers in series reduces the cooling water re-circulation rate and increases the cooling water return temperature. This allows better cooling tower performance. In debottlenecking situations, where cooling tower capacity is limiting, it can allow increased capacity without investment in new cooling tower capacity.

In this project, process integration has been used to provide a novel systematic design procedure that takes into account of the interactions between the thermal performance of cooling towers and the design of cooling water networks. Development in the present work has followed pinch analysis to provide fundamental insights of the design problems in cooling water systems. With the conceptual design method, incentives to improve performance of cooling systems and reduce capital have been identified.

Also automated design methods have been developed to deal with more complex problems, such as pressure drop constraints and economic use of cooling towers. As a number of design alternatives are available for cooling system design, the suggested mathematical programming approaches are useful to decide an optimal system configuration under a set of design constraints and objectives.

With the aid of the new design method, the efficiency of cooling water systems could be increased. And it helps process engineers to design and evaluate cooling systems for grassroot or retrofit design.