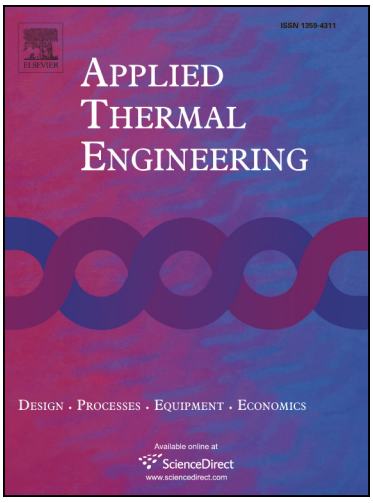

Research Paper

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Retrofit of a wet cooling tower in order to reduce water and fan power consumption using a wet/dry approach

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Abstract

A Parallel Path Wet/Dry configuration and a high-precision airflow regulation method are implemented in order to retrofit an existing wet cooling tower. The modifications are intended to reduce water requirements and fan power consumption of a 12-cell wet tower. The proposed method of airflow control takes advantage of fans with variable frequency drive to regulate airflow with high accuracy. A number of simulations are carried out to predict different operating factors of the wet and hybrid towers. Experimentally obtained values of water consumption demonstrate the validity of those obtained using the computer simulations. According to the results, the accurate airflow control prevents sudden fluctuations in requisite fan power and water consumption rate and causes up to 64.6% decrease in fan power consumption. The results reveal that using the proposed wet/dry approach results in an average 9.4% decrease in water consumption. Given the relatively low degree of modifications made to the original wet tower and preserving the condenser operating condition, the accomplished amount of water conservation is satisfactory.

Keywords: Hybrid cooling tower, Wet cooling tower, Water conservation, Power consumption, Airflow regulation

1. Introduction

Wet cooling towers have various applications in industrial power plants and air conditioning systems. Typical wet tower design employs direct evaporative cooling method, where the cooling water is cooled to a temperature above the ambient wet-bulb temperature. The significant advantage of wet cooling towers is their high cooling capacity. However, the visible plume exiting the tower and consumption of large water quantities are the major drawbacks of wet cooling towers. Thus, using wet towers in dry regions with poor water supplies could be problematic. In the recent decades, wet cooling towers have been modified to overcome these existing disadvantages. In the early 1970's, the hybrid (wet/dry) concept was introduced to implement a combination of wet and dry cooling systems. Hybrid cooling towers reduce the water requirements owing to a considerable amount of heat load rejected by the dry section. For this reason, the required water evaporation in the wet section decreases, which results in a lower water consumption of the tower.

A number of hybrid tower installations have at least 20 years of operating experience, giving the hybrid concept a level of credibility that did not exist when it was first proposed [1]. Hybrid towers are designed based on the required features for the region in which they are installed. Depending on the ratio of the size of wet to dry components, hybrid towers