Experimental and simulation study on the performance of counter flow closed cooling tower systems

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Cooling towers are required in building HVAC systems that use water as the cooling condenser fluid. Cooling towers used in this study are of the forced draft, counter flow, indirect/closed evaporative type. This study sought to demonstrate the performance characteristics of a closed system cooling tower by its effectiveness value, Number of Transfer Units (NTU), cooling capacity, and overall heat transfer and mass coefficient of the cooling tower. Experiments were performed on a heat exchanger coil intercrossed with ? inch diameter intersections on parallel lines. Results of the experiment were then compared with the heat and mass transfer correlations taken from previous studies, and also combined with Computational Fluid Dynamics (CFD) simulations to examine the physical processes that occur in the cooling towers. All the experimental results, theoretical calculations and CFD simulations used variations of warm water mass, cold air, and water spray to present a clear description of the performance characteristics of a closed system cooling tower. The results of this study have shown that an increase in the amount of water spray mass flow causes an increase in the effectiveness value, heat transfer and overall mass transfer, as well as the cooling capacity of the cooling tower. The waste heat typically utilizes up to 80% of latent evaporation heat, and 20% of sensible air heat; however, waste heat in the closed system cooling tower utilizes 100% of latent evaporation heat. The mass transfer coefficient rate tends to be stable for a small mass of water spray.