Master's Thesis Defense Announcement
Mechanical and Aerospace Engineering Department
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Development of a test method for characterizing an indirect evaporative cooling module for data center cooling application

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[Teams Meeting Link]

Abstract

Evaporative cooling is a smarter way of maintaining optimum operating conditions in data centers. IEC provides the advantage of cooling without changing the humidity of the DC air. We analyze and develop a method of testing to help build IEC modules at larger scales with improved characterization that is intended to help DC operators achieve stringent PUE targets by operating at minimum power.

We study the design parameters pertinent to sizing an indirect evaporative cooling (IEC) module used in data center cooling and develop a test method while technically selecting the components involved. The module is planned with centrifugal plug fans on both primary and secondary sides selected to deliver 8000cfm of air at 2.5 in-wg of static pressure, an air-to-air crossflow heat exchanger, a water distribution system to deliver and distribute water to the wetted channels of the secondary side, a sump for collecting water, and a recirculation piping. The primary side air is set to simulate a typical data center return air.

We use 6Sigma software as a tool to size the cabinet, visualize air velocities across different parts such as inlets and outlets, and observe effects of using volume control dampers on the secondary side, that is connected to an auxiliary unit designed to supply air at desired temperature and humidity to simulate ambient climatic conditions. The heat exchanger considered in this study is a commercially available plate heat exchanger made of Al 8009 alloy and epoxy coated of size of 48" x 48" x 48". Face velocities up to 800 FPM are considered. Based on the literature surveyed, we recommend two types of spray headers, namely full cone spray nozzle and 360 deg rotating type water sprinkler in arrangements that fully wet the heat exchanger cross section.

Cooling capacity and cooling effectiveness can be documented for several air speeds across the heat exchanger channels. Additionally, evaporation rate, pressure drop, and wet bulb effectiveness for the secondary side can be estimated. Thus, we associate the cooling effectiveness for various ratios of primary and secondary air with the fan-motor power and water utilization.

We build correlations between several distinct parameters for rating the performance of an IEC module. The results from this design and test method will be invaluable in developing phenomenological models of IEC modules which can subsequently be used for developing IEC units at scale to help size and optimize equipment for Data Centers.