Copper Air Quality Program

Testing the Energy Efficiency of Copper vs. Aluminum HVAC Equipment

Copper has a variety of benefits when incorporated into heating, ventilation, and air conditioning (HVAC) systems including reduction of odor-causing organisms and a potential for improvement in energy efficiency performance. The differences between copper and aluminum heat exchangers stem from the inability of odor-causing organisms to survive on copper. Consequently, a copper heat exchanger will inhibit the build-up of odor-causing organisms on the coil, fins and drip pan including bacteria and mold. Fewer live organisms being blown through the HVAC system into the conditioned space are believed to result in reduced odors. Additionally, the inability of organisms to live and grow on the copper keeps the coils and fins cleaner resulting in improved thermal transfer to the air flowing across the heat exchangers leading to improved operating efficiencies for the entire system.

The Copper Air Quality Program team members are researching the energy efficiency case for this technology through field trials being conducted at the U.S. Army Training Center at Fort Jackson, located just outside of Columbia, South Carolina. This study is seeking to quantify the potential benefits of using a copper HVAC heat exchanger, instead of the industry-standard aluminum coil by monitoring the operational characteristics between HVAC systems that have been retrofitted with copper and aluminum components.

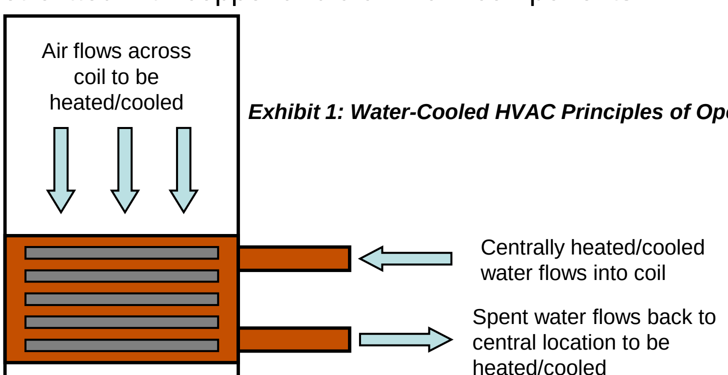
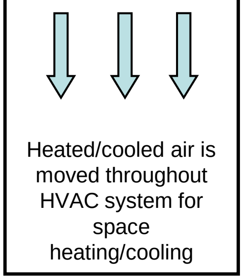
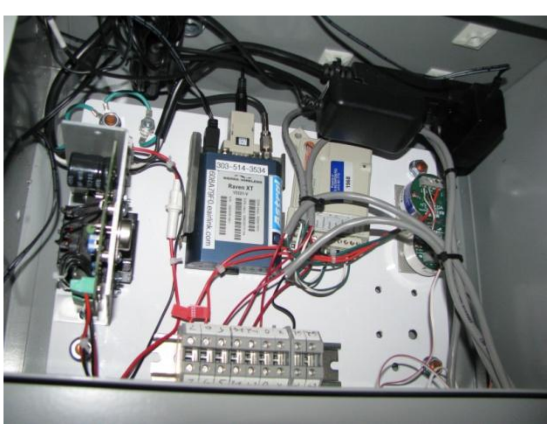



Exhibit 1: Water-Cooled HVAC Principles of Operation

Water Flow Meter



Data Logger

The HVAC systems being monitored are installed in two identical, adjacent barracks buildings use hot or cold water to heat or cool air respectively. The water is heated or cooled at a central location and then pumped to a number of individual HVAC systems. These systems then move the water through a heat transfer coil within an air handling unit. At the same time as water is flowing through the coil, air is flowing across the coil. Depending on the water temperature, as the air moves across the heat exchanger, it is either heated or cooled (*Exhibit 1*).

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To quantify energy efficiency within the HVAC systems, two main parameters must be monitored over time – *air flow* and *heat transfer*. Monitoring the change in air flow and heat transfer over time within a retrofitted copper and aluminum HVAC system will provide the necessary data to quantify any improved energy efficiency resulting from the use of copper over aluminum components.

Air Flow

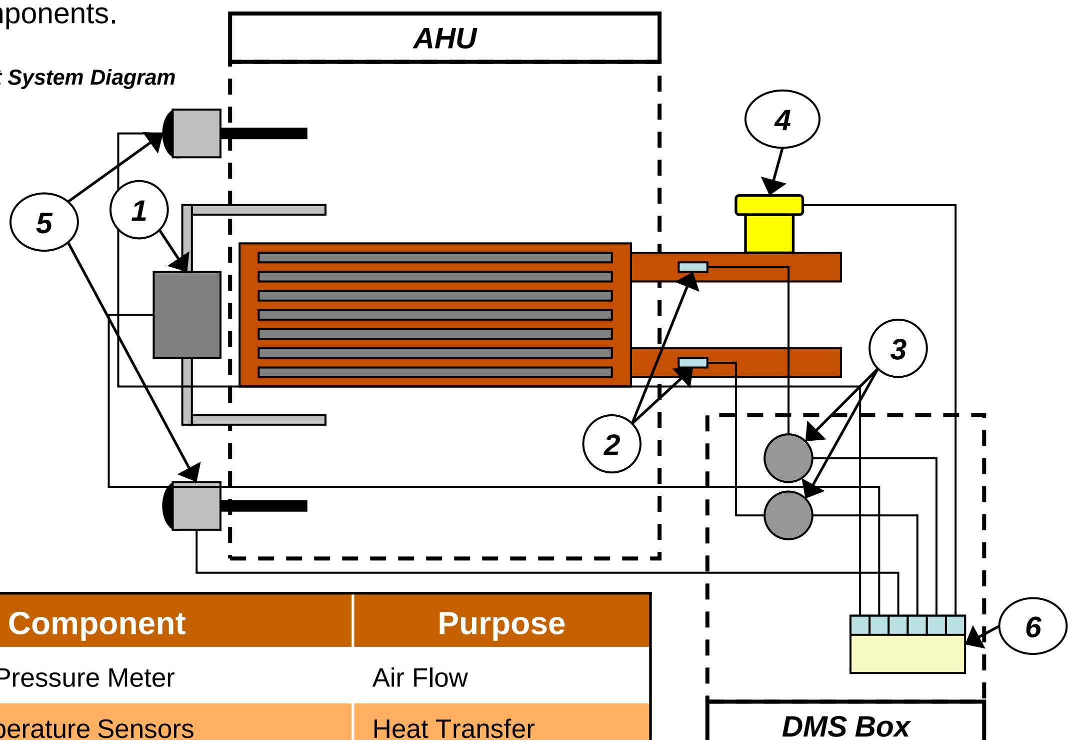
The change in air flow over time is being measured by monitoring the differential pressures across the coil. As a heat exchanger becomes dirty and clogged with organism growth, the air flow across the fins will decrease, resulting in a larger pressure drop across the coil. A greater increase in pressure drop over time will indicate a coil is hampered by organism growth.

Heat Transfer

The change in heat transfer over time is measured by monitoring water temperature and flow rates along with air temperature and humidity. Monitoring the temperature of water flowing into and out of the coil, along with the flow rate of the water, indicates how well the heat is being transferred from the water to the coil and then from the fins to the air. Air temperature and humidity measurements upstream and downstream from the heat exchangers are used to normalize heat transfer data across HVAC systems. Lower heat transfer rates over time will indicate that the system is losing its ability to move heat from the water to the air and is operating at less than peak efficiency.

Air flow and heat transfer data are being compiled by a monitoring system attached to each HVAC air handling unit (AHU). Each data monitoring system (DMS) takes the necessary measurements to determine changes in air flow and heat transfer over time. Once the data is acquired, it is then stored within a data logger to be used for later analysis. *Exhibit 2* provides a visual representation of the DMS and its main components.

Exhibit 2: Data Measurement System Diagram



Number	Component	Purpose
1	Differential Pressure Meter	Air Flow
2	Water Temperature Sensors	Heat Transfer
3	Water Temperature Transmitters	Heat Transfer
4	Water Flow Meter	Heat Transfer
5	Air Temperature/Humidity Sensors	Heat Transfer
6	Data Logger	Collect Data

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