Air-Conditioning and Refrigeration Technology Institute

Project Summary

Electrostatic Forces and Water Sprays for Temperature, Humidity and Air Quality Control

Spray nozzle and charging electrodes

Test chamber with droplet collection tray

This project is fundamental to development of a direct-contact air-to-coolant heat exchanger, which has the potential of being significantly more energy efficient than a conventional chilled water cooling system using typical HVAC cooling coils. Some analyses suggest an increase in overall system energy efficiency as high as 35%. For air handlers, analyses suggest a reduction in power consumption by a factor of 7.6 for a water spray/air handler vs. a traditional cooling coil air hander with the added benefit of requiring less material and providing a weight savings. With direct-contact heat exchange, air to be cooled is blown through a coolant spray allowing direct transfer of heat between the air and the coolant. There is no metal barrier between the air stream and the coolant resisting the heat transfer. There is also no cooling coil restricting the air flow as in a typical heat exchange system. Direct-contact heat exchange could be significantly more energy efficient, by allowing more efficient transfer of heat from the air stream and to the coolant and significantly reducing the fan power required.

Researchers are investigating methods for controlling water spray droplet size and electrically charging droplets to enable chilled water sprays to not only change the temperature of air flowing through them, but also to remove moisture (dehumidify) from the air as well. Theoretically, moisture from the air would condense on the chilled water spray droplets. The electrical charge on the droplets would help in the collection and removal of the droplets before they could evaporate back into the air stream. It is the delicate balance of droplet size, temperature, speed of fall, electrical charge, and collection vs. the air flow required to make this technology useful that is being investigated.

This is the initial stage in examining the potential of this technology. Results will enable other researchers to understand the basic parameters needed to further develop this technology for HVAC applications.

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