Project Summary

Novel Materials for Heat Exchangers: Phase II

Heat exchangers are extremely important to the energy performance of HVAC&R systems. The size of heat exchangers directly affects the size of HVAC&R systems and refrigerant charge requirements. Traditionally, heat exchanger designs rely heavily on fin-and-tube or plate heat exchanger designs, often constructed using copper and aluminum. In the Phase I study, the investigators compiled a comprehensive literature review, analysis and assessment on novel materials for heat exchangers, through which they identified new materials that hold promise for use in heat exchangers. The study indicated that polymer-metal hybrids, novel polymer designs, and metal foams hold the most promise for HVAC&R application.

However, the Phase I study shows that the lack of thermal hydraulic performance data for heat exchangers constructed of such materials is currently the most significant impediment to the pursuit of heat exchanger designs based on these materials. Information on the use of these materials in condensing and frosting environment is virtually non-existent, and information on other important factors (e.g., safety, material compatibility) is still emerging. Hence, the objectives of the Phase II study are to obtain information on material compatibility and safety, and to collect thermal hydraulic performance data for these heat exchangers.

The proposed work in Phase II includes 1) a thorough literature review with special attention on information related to material compatibility of metals and polymers with heat transfer fluids, and toxicity and safety issues, 2) collecting performance data for these heat exchangers in air-to-coolant and liquid-to-liquid heat transfer configurations, 3) construction and thermal-hydraulic testing of sample heat exchangers with selected novel materials, and 4) modeling at the component level to explore near-optimum heat exchanger designs based on these new materials.

The outcome of this research will provide essential information for the applications, and design of heat exchangers with new materials, which could make HVAC&R systems more compact and thereby reducing the refrigerant charge requirements.