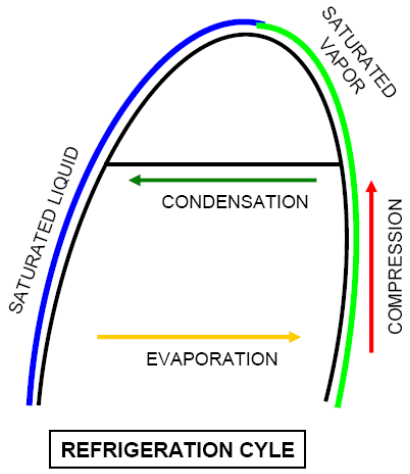
Air-Conditioning and Refrigeration Technology Institute

Project Summary

Void Fraction Measurement and Modeling for Condensing Refrigerant Flows in Small Diameter Tubes



To optimize condenser designs, engineers need to accurately predict the heat transfer and pressure drop as a refrigerant flows through the tubes of a condenser. To do this they need a full understanding of the complicated flow behavior of refrigerant as it changes from a vapor to a liquid state as it moves through the condenser.

During the condensation process, refrigerant flowing through a condenser tube changes from a vapor state to a liquid state resulting in refrigerant flow that contains a changing mixture of bubbles and liquid slugs. Void fraction is the portion of the tube occupied by the refrigerant vapor. The void fraction changes as the refrigerant flows along the length of the tubes. Since refrigerant vapor and liquid have different mass densities and flow at different speeds in the tube, void fraction affects both the heat transfer and pressure drop in the condenser.

This project will characterize, through measurement and modeling, the local void fraction of a refrigerant during condensation. Testing will be conducted with R-410A in small smooth circular tubes with diameters ranging from 0.5 mm (0.02 inch) to 3 mm (0.12 inch) at typical heat rejection conditions for air-conditioning applications.

This project will develop predictive models to enable air-conditioning and refrigeration equipment designers to better optimize condenser designs for use with newer refrigerants and smaller diameter tubes.

Contractor: Department of University of Wisconsin, Madison, WI
Principal Investigator: Timothy A. Shedd, Ph.D.
Start-date: 1 September 2005; Current End-date: 31 December 2007. Project will be extended through August 2008.
Revised: 8/02/2007