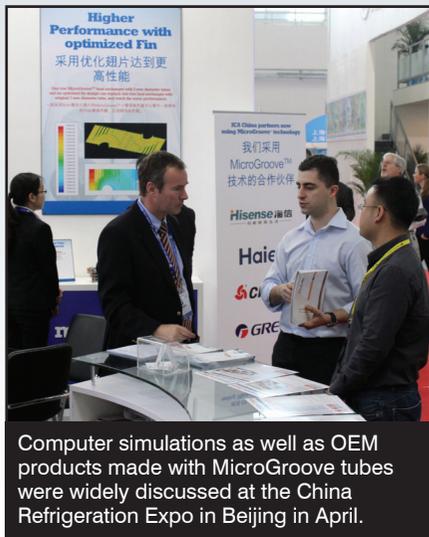


New Research Underscores Best Practices in Coil Design



Computer simulations as well as OEM products made with MicroGroove tubes were widely discussed at the China Refrigeration Expo in Beijing in April.

Computer simulations and case studies illustrate how to design heat exchangers using smaller diameter copper tubes. The International Copper Association supports several research initiatives that are exploring the design space for coils made from smaller diameter copper tubes both in the US and China.

Scientists at the Institute of Refrigeration and Cryogenics (IRC) at Shanghai Jiao Tong University (SJTU) have been researching ways to minimize refrigerant volume for safe room air conditioners with R290.

The latest results will be presented at two international conferences this year, including the Tenth Gustav Lorentzen Conference on Natural Refrigerants at Delft University of Technology; and the Fourteenth International Refrigeration and Air Conditioning Conference at Purdue University. In each of the case studies, the refrigerant volume is significantly reduced by reducing the diameter of the copper tubes while still meeting performance objectives.

RTPF or BAM

In addition, new research sponsored by ICA compares a round-tube, plate fin (RTPF) heat exchanger with a brazed-aluminum multichannel (BAM) heat exchanger. Performance specifications of

a best-in-class brazed aluminum heat exchanger were identified and set as a target for the RTPF heat-exchanger. The design space was searched for candidate RTPF designs that met the performance specifications. The research results will be presented this summer at the Purdue Conferences.

This latest research is considered vital by many system designers who wish to compare the best RTPF designs directly with the best BAM designs in terms of size, weight and refrigerant charge reduction.

Other factors such as manufacturing costs, durability and drainage must also be considered when selecting a heat exchanger for any particular application.

Evolving Principles

From this research, various design principles have emerged of great value to anyone seeking to optimize material usage in air conditioning and refrigeration applications, whether for an evaporator or a condenser. The design and optimization of heat exchangers requires the use of computational fluid dynamics (CFD) methods to analyze the airflow around the tubes and fins and also involves computer simulations of refrigerant flow and temperatures inside the tubes. The ICA research has refined several useful design principles as applied to smaller diameter copper tubes. In particular, the knowledge-based evolution method (KBEM) has been developed into a step-by-step procedure that simulates and optimizes every aspect of the heat exchanger design, from tube spacing to fin type to tube circuitry.

Step-by-Step Design

A methodical approach to the design of heat exchangers using smaller diameter copper tubes is summarized by the following steps.

Step 1: Determine the best ratio of transverse tube pitch to longitudinal tube pitch by fin efficiency analysis.

Step 2: Optimize transverse tube pitch and longitudinal tube pitch by analysis of performance and material cost.

Step 3: Optimize fin pattern by comparing performances of fins with different patterns through CFD-based simulations.

Step 4: Test the performance of heat exchanger with smaller diameter tubes.

Step 5: Develop empiric equations for predicting performance of heat exchanger with smaller diameter tubes.

For details about the design principles, attend the Gustav Lorentzen Conference or the Purdue Conferences or see the conference proceedings. Visit www.microgroove.net for information about smaller diameter copper tubes and where to obtain them. 

Forthcoming Technical Papers

The Tenth IIR Gustav Lorentzen Conference on Natural Refrigerants

1. "Developing Low Charge R290 Room Air Conditioner by Using Smaller Diameter Copper Tubes" by Guoliang Ding, Wei Wu, Tao Ren, Yongxin Zheng, Yifeng Gao, Ji Song, Zhongmin Liu and Shaokai Chen.

The Fourteenth International Refrigeration and Air Conditioning Conference

1. "Principle of Designing Fin-And-Tube Heat Exchanger with Smaller Diameter Tubes for Air Conditioner" by Wei Wu, Guoliang Ding, Yongxin Zheng, Yifeng Gao and Ji Song.
2. "Simulation-Based Comparison of Optimized AC Coils Using Small Diameter Copper and Aluminum Microchannel Tubes" by John Hipchen, Robert Weed, Ming Zhang and Dennis Nasuta.