microgroove™ Update

Attain High Energy Efficiency with Less Materials Using Smaller-Diameter, Inner-Grooved Copper Tubes

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MICROGROOVE MANUFACTURING STEPS UP AS INDUSTRY TRANSITIONS TO LOW-GWP REFRIGERANTS

Versatile equipment for producing a wide range of heat exchanger coils from various MicroGroove smaller diameter copper tubes is available now. High-volume production of MicroGroove coils for residential air-conditioner has been an accomplished fact for more than five years and the successful production of coils for refrigeration systems and commercial applications is ever broadening.

For any manufacturer, a major attraction of MicroGroove is the versatility of the production lines. Equipment today is capable of short runs of specialty products as well as high-volume production. Either can be accomplished with speed and precision. Coils for commercial applications typically are not produced in high volumes, so fast-yet-flexible production is paramount.

Round copper tubes laced through optimized plate fins are the basis for highly efficient evaporators, condensers and gas coolers for countless applications in refrigeration and air conditioning. The ease with which such conventional coils can be made has made them attractive for use for many decades in the past.

The use of smaller-diameter tubes with inner grooves allows for even more efficient coils. Once the tubes became available from ICA member companies, the supply chain developed equipment and processes that could handle the smaller diameter tubes. The type of equipment remains basically the same. Tube benders, lacers and tube expanders are still at the heart of such production but these steps had to be adapted to smaller tube diameters. Equipment makers responded quickly and admirably so that today a manufacturer can purchase and/or build the equipment necessary to establish a reliable and versatile production line for the manufacturer of coils from smaller diameter copper tubes.

RESULTS OF AUDIENCE POLL

During a recent MicroGroove webinar, members of the audience were polled about their greatest concern with moving to smaller-diameter coil production. Their two biggest concerns were centered around "technology/innovation in this area" and "manufacturing process changes."

"The audience responses suggest that many manufacturers are on the brink of transitioning from conventional copper tubes to MicroGroove," says Nigel Cotton, MicroGroove Team Leader for the International Copper Association. "The early adopters are already in production and demand is increasing. Current equipment is proven in production environments and is ready for adoption by the mainstream industry."

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PRESENTATIONS

UPCOMING EVENTS

6th IIR International Conference on CO2 and Ammonia Refrigeration Technologies

April 16–18, 2015
Ohrid, Republic of Macedonia
(More info on "Events" page)

TECHNICAL PAPERS

Ohrid Conference

1. Yoram Shabtay, John R.H. Black and Nigel D. Cotton, "New Copper-Based Heat Exchangers For R744 Refrigerant, Part I: New Technologies For Tubes and Coils"
2. Yoram Shabtay, John R.H. Black and Nigel D. Cotton, "New Copper-Based Heat Exchangers For R744 Refrigerant, Part II: System Design And Case Studies"

MAGAZINE ARTICLE

RSES Journal

"Heat Exchangers for Alternative Refrigerants: How small-diameter inner-grooved copper tubes affect refrigerants in exchangers" By Yoram Shabtay and Nigel Cotton

WEBINARS

"The Manufacture of High-Efficiency Coils with MicroGroove Copper Tubes," with Brian McConnell, President, Burr Oak Tool.

View webinar now on YouTube.
https://youtu.be/YdSCto6FEVU

For more information, see the MicroGroove "Webinars" webpage www.microgroove.net/webinars on microgroove.net; and the MicroGrooveTech channel www.youtube.com/user/MicroGrooveTech on YouTube.

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REFRIGERANT FRIENDLY COILS

Heat exchangers made with copper tubes are highly compatible with most of the eco-friendly refrigerants under consideration for refrigeration systems, air conditioners and heat pumps globally.

In both laboratory and manufacturing environments, smaller-diameter copper tubes are proving to be a good match for eco-friendly refrigerants. Candidate refrigerants include Low Global Warming Potential (GWP) hydrofluorocarbons (HFCs) such as HFC-32, which has a GWP of 675; and ultra-low GWP hydrofluoroolefins (HFOs), such as HFO-1234yf and HFO-1234-ze, which have GWPs of 4 and 6, respectively.

Scores of refrigerants that are blends of HFCs are HFOs are also under consideration for various applications. Such refrigerant blends can be tailored to the application by making tradeoffs between performance, cost, GWP and flammability.

Traditional copper tubes with plate-fins are well suited for these new blends of eco-friendly refrigerants. The use of smaller-diameter tubes further reduces the effective GWP in applications since less refrigerant charge delivers the same capacity. Copper also excels when used in heat exchangers for natural refrigerants, including hydrocarbons (e.g., propane, R290) as well as carbon dioxide (R744).

According to the laws of mechanics, the "hoop stress" exerted on a tube decreases with diameter (when pressure and wall thickness are held constant). Consequently, higher pressures can be applied without increasing the wall thickness; or lower wall thicknesses can be used. When a manufacturer uses a smaller-diameter copper tube, he can save on materials and increase performance in more ways than one.

MANUFACTURING INFRASTRUCTURE

Fortunately, the development of smaller-diameter copper tubes and the manufacturing technology for the production of MicroGroove heat exchanger coils coincides with the regulatory need. MicroGroove technology has been steadily advancing for more than a decade now. The manufacturing infrastructure for supplying evaporators, condensers and gas coolers to the industry has already developed to the point where it is available for use. "For OEMs who want to use smaller diameter copper tubes, the equipment is available," says Cotton. "That is true for nearly all of the Low-GWP and ultra-low GWP refrigerants and refrigerant blends."

According to experts at Burr OAK Tool, the equipment to build small diameter tubes into all sizes of coils is already available, and manufacturing processes are familiar, economical and reliable.

The Copper Alliance recently provided a webinar presented by Brian McConnell, President of BOTI, in which the manufacturing technology to produce heat exchanger coils from MicroGroove Copper Tubes was described.

IN THE SPOTLIGHT

CEEE'S COILDESIGNER NOW INCLUDES MICROGROOVE

CoilDesigner® software is a proprietary heat exchanger simulation and design optimization tool developed by the Center for Environmental Energy Engineering (CEEE) at the University of Maryland. It is a highly customizable software tool that allows designers to simulate and optimize the performance of heat exchangers. Using CoilDesigner simulations, OEM users can shorten product development costs and bring products to market more quickly.

And now CoilDesigner can simulate the performance of coils designs made with MicroGroove tubes!

Research at the Shanghai Jiao Tong University (SJTU) resulted in the development of new airside and refrigerant-side correlations, particularly for 5-mm MicroGroove tubes. To make such correlations readily available to HVAC&R system designers and heat exchanger engineers, the ICA worked with Optimized Thermal Systems Inc. (OTS) to implement the newly developed correlations into its software design tool.

For information on CoilDesigner, visit www.ceee.umd.edu. Also, visit www.microgroove.net. Or join the MicroGroove Group on LinkedIn to share your ideas about research directions and product development. www.linkedin.com/groups/Microgroove-4498690.

The Center for Environmental Energy Engineering (CEEE) is a leader in research and education in environmentally responsible, economically feasible integrated energy conversion systems for buildings and transportation. Research focuses on air-conditioning, refrigeration and heat pumping and integrated cooling heating and power systems. The Center also provides software for the design and analysis of such systems with integrated optimization capabilities for lowest cost and best performance.

OTS has an exclusive license agreement with the University of Maryland to provide customized versions and assist in the development of CoilDesigner software. OTS works with various HVAC&R designers around the globe to optimize heat exchanger geometry, including investigation of the use of small diameter tubes.