**Research Reveals Design Opportunities for HVAC Systems and Heat Pumps**

Studies find small-diameter copper tube reduces weight and volume of heat exchangers

Heat exchanger manufacturers can reduce material costs while maintaining optimal performance by using small diameter copper tube ≤5mm in diameter, also known as Microgroove ™. New research from Optimized Thermal Systems, Inc. (OTS) revealed increased possibilities for small-diameter copper tube provide equal performance to microchannel designs with a significant lower refrigerant charge.

“This research gives heat exchange designers and manufacturers new opportunities for improving the form factor of HVAC heat exchangers and heat pump systems,” said Dale Powell, project manager and piping application specialist at the Copper Development Association (CDA). “The OTS studies demonstrate that small-diameter copper tube provides opportunities to reduce weight and volume at the source for better performance. New manufacturing processes take advantage of copper’s superior malleability to allow for an increase in shapes, sizes, and general configurations to meet the demands of future heat exchanger designs.”

OTS found significant reductions in internal tube volume over the baseline. The best five-millimeter design provided a reduction in internal tube volume of 41 percent and a 57 percent reduction in coil footprint. The best four-millimeter design provided an internal tube volume reduction of 62 percent and a coil footprint reduction of 68 percent. The best three-millimeter design provided an internal tube volume reduction of 78 percent and a coil footprint reduction of 81 percent.

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| **Tube Diameter** | **Internal Volume Reduction** | **Footprint Reduction** | **Tube Material Reduction** | **Fin Material Reduction** |
| 5 mm | 41% | 57% | 61% | 68% |
| 4 mm | 62% | 68% | 74% | 58% |
| 3 mm | 78% | 81% | 79% | 65% |

Using a heat exchanger design and simulation software tool, CoilDesigner ®, OTS evaluated the performance of various designs and conducted an optimization study using a multi-objective genetic algorithm. The primary objective of the project was to design a condenser coil that could provide equal performance to aluminum microchannel designs with a lower refrigerant charge, and to reduce the total footprint of the coil as well as the mass of the tube and fine material.

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