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PROCESS COOLING

A microchannel coil is composed of flat, extruded aluminum tubes. The tubes have precision ports that allow refrigerant or fluid flow and provide high heat transfer. Working pressures of 300 to 650 psig are typical.

Using Microchannel Coils for Process Cooling

Used in process cooling equipment such as condensers, chillers and environmental chambers, microchannel coils provide process benefits.

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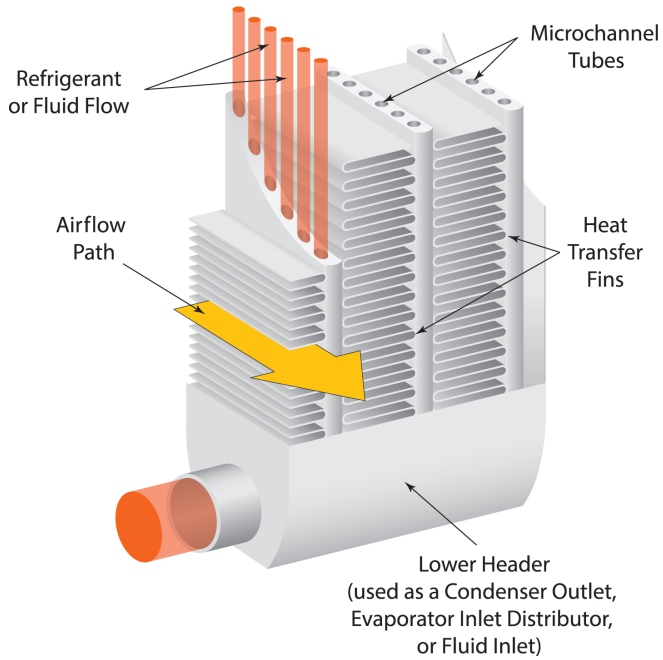
As emergent technology for the process industries, microchannel air-side coils are having a favorable impact because their performance exceeds traditional copper tube/aluminum fin coils in many OEM applications. Long term, microchannel coils have a bright future in process cooling, process chillers, cooling coils, environmental chambers and rooftop system air-handling equipment. Microchannel coils are used as refrigerant condensers (ranging in size from 0.5 to 400 ton systems), evaporators (cooling coils), and fluid coils for air-side cooling and dehumidification.

The microchannel coil story began approximately 30 years ago in the automotive industry. Design engineers needed an air-side heat exchanger for condensers, evaporators and radiators that weighed (and cost) less than the traditional copper tube/aluminum fin design. The microchannel heat exchanger was developed as a result. The all-aluminum microchannel heat exchanger coils have a flat-tube design and air-side fins. Since their introduction into the automotive industry, four variations in their design have been developed to serve as radiators, air-conditioning condensers, evaporator/cooling coils and cabin heaters.

Beginning in the mid-2000s, the microchannel coil technology progressed into use in process cooling

MICROCHANNEL CUTAWAY



Microchannel technology combines three aluminum parts: air-side fins, microchannel tubes and headers. They are integrally brazed in a furnace to form a leak-tight performance heat exchanger.

and HVAC/R applications. At four to 50 times larger than the original automotive designs, they are designed to provide robust performance (and less susceptibility to galvanic corrosion) for more demanding conditions, yet they are lighter weight and smaller in physical size. When integrated into process equipment, the microchannel coils may provide better energy efficiency with closer thermal approach temperatures.

Heat Rejection in Process Equipment

With improvements in compressors, variable-speed fans and plate heat exchangers, process equipment energy efficiency has increased rapidly over the past 30 years. Microchannel air-side coils help continue that progress as they have been put to use in the process cooling and chiller equipment industries. Applications include refrigerant condensers, process chillers, environmental chambers and other compressor-driven systems.

One application where microchannel air-side coils are helping to provide energy efficiency advantages is process chillers with mechanical refrigerant cooling systems, where the microchannel coils are used as condensers. It is estimated that up to 30 percent of the process chillers worldwide use microchannel coil technology, and some industry insiders expect this value to increase in the next five to 10 years.

With microchannel heat exchangers, the integrally brazed air-side fins achieve high heat transfer rates, close approach temperatures and low air-side pressure drops. This results in lower required compressor horsepower, improved energy efficiency and higher cooling capacities.

An attribute of all-aluminum microchannel heat exchangers is size. Microchannel coils can have a smaller coil-face dimension, depending upon the design conditions, and generally are thinner. This is important to manufacturers of process cooling equipment because it directly affects the equipment size and performance. Also, the smaller size and all-aluminum construction reduces equipment weight and, depending upon the equipment size, minimizes equipment structural support requirements. Finally, small size means less refrigerant charge, which can mean lower long-term maintenance costs.

Applications in Air-Handling Equipment

Also, microchannel coils are engineered for use in air-handling equipment such as evaporators and chilled water coils used for process cooling, makeup air systems, dehumidification units and high load cooling for data centers. Even newer applications include microchannel coils for evaporators for refrigerant-to-air cooling and fluid-to-air water coils.

Refrigerant-to-Air Cooling. As refrigerant evaporators, the coil is used as a direct-expansion refrigerant

Microchannel coils are used in process chillers to provide process cooling for plastics, lasers and food processing, among other applications.

The air-side heat exchangers can be configured as refrigerant condensers ranging in size from 0.5 to 400 ton systems.

evaporator, providing air-side cooling and dehumidification. Microchannel coils designed for refrigerant-to-air cooling applications have a built-in refrigerant distributor device to provide uniform refrigerant injection into the coil. The air-side fins provide uniform cooling, dehumidification and moisture removal. The refrigerant injection and moisture/water shedding features allow the microchannel coil to exceed the performance of older technologies in overall cooling and dehumidification. Process equipment manufacturers are now just beginning to evaluate and use microchannel coils for refrigeration evaporators at 32°F (0°C) and higher temperature applications.

Fluid-to-Air Water Coils. These coil applications include chilled water coils and free cooling coils in air-handling and rooftop systems. When used as chilled water coils, the microchannel coils accommodate chilled water or glycol temperatures as low as 32°F (0°C) with frosting problems. With chilled water applications, a close approach temperature of 10°F (5.5°C) is possible. (Older technologies provide approach temperatures of 20°F [11°C] typically.) This feature is a key reason many manufacturers of process cooling systems are evaluating and using more microchannel coils.

As dry coolers, microchannel heat exchangers can be used as outdoor coils to reject process heat from process fluids. They can be used with glycols when ambient temperatures are below 32°F (0°C) and provide free cooling for the process. Typical fluid-to-air and dry cooler coils have 5 to 15°F (2.8 to 8.3°C) approach temperatures for efficient heat removal. They can be used in glycol, water and other fluid loops for process or data centers.

Reliability and Corrosion Resistance

It is worth repeating that unlike fintube designs, microchannel coils are all aluminum and do not contain copper. With dissimilar metals such as is found in the fintube coils, the natural copper-to-aluminum eutectic is susceptible to galvanic corrosion. This is especially true in marine environments and processes with various vapors in the airstream.

The galvanic copper/aluminum corrosion potential is not present in all-aluminum coils because there is no copper to make the aluminum anodic. As such, there is less potential for the aluminum to corrode and fail over time.

Microchannel coils specified for highly corrosive applications with vapors that can cause corrosion on copper or aluminum should be ordered with an epoxy electrocoating. This type of coating, which is widely used on traditional fintube coils, also can protect all-aluminum microchannel coils from a range of chemicals and vapors. The coating can extend the coils' durability and maintain efficiency over the useful lifetime.

When it is time for maintenance, microchannel coils can be cleaned and washed with a regular water hose or low pressure spray. Soap and water can be used instead of harsh chemicals. Routine maintenance allows process equipment to be maintained at peak performance and reliability.

Today, microchannel coil technology has shifted from your car to process cooling and beyond, being integrated into process chillers, cooling coils, air-handling equipment and more. Where microchannel coils will go in the next five to 10 years as equipment providers recognize the benefits of this new technology remains to be seen. **PC**

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