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SPECIALTY HEAT EXCHANGERS 101:

CONSIDERATIONS FOR CHOOSING THE RIGHT ONE FOR YOUR APPLICATION

Tips for Selecting the Right Heat Exchanger for Your Needs

Numerous types of heat exchangers cover a broad range of applications. However, this guide covers only the smaller scale, specialty heat exchangers often found in industrial applications, and focuses on the relationship between heat exchangers and sample coolers.

A heat exchanger is a device used to transfer heat from one medium to another. They can heat within a process, and may be used within a process to cool a liquid, vapor or gas (referred to as fluid within this guide) to make it safe to handle or transfer.

When a heat exchanger is used to cool a representative sample within a process for accurate analysis, it commonly is referred to as a sample cooler. Power plants and industrial boilers expressly use sample coolers to condition steam and water samples for accurate chemical analysis.

HOW HEAT EXCHANGERS ARE USED

Heat exchangers are used in a variety of industries, including:

- Power generation, to cool steam and water within the steam and water analysis system
- Petrochemical and chemical, to cool hot process liquids or to heat two-phase materials like liquefied petroleum gas (LPG) from liquid to gas phase after transport
- Refineries, to cool volatile hydrocarbons that can exceed temperatures of 500°F (260°C), or to heat cold fuels like diesel
- Food and beverage production facilities, including dairies, where a sanitary model can be employed
- Pharmaceutical production facilities, to cool sanitary water before use
- Professional carpet cleaning providers, to instantly heat water with cleaning solution

The right heat exchanger can cool or heat any fluid within a process. For safety and efficiency, it is critical to choose the right heat exchanger for the right application. **Heat exchanger choice depends on:**

- Amount of heat to be exchanged
- The specific type and thermophysical properties of both the process and cooling fluids
- The temperature of the fluid
- Liquid or gas phases, and whether a phase change is required
- Process pressure and flow rate
- Characteristics of the cooling water, such as chlorides, calcium or hardness, or high total dissolved solids
- Efficiency relative to size
- Physical space within the process for the heat exchanger
- Budget

It's important that the right heat exchanger is selected for the right application using the above criteria. Selecting a one-size-fits-all heat exchanger for a process may seem to be less expensive at first, but can end up being inefficient, uneconomical and hazardous to operators, equipment and assets.

TYPES OF HEAT EXCHANGERS

Heat exchangers use proven technology. In an indirect heat exchanger, the fluid to be cooled or heated flows through one side of the device, and the cooling fluid, usually water, flows through the other side. When the fluid is to be used for representative sampling, it then is taken to a laboratory for analysis or piped to in-line process instrumentation for continuous monitoring of properties.

The most common types of heat exchangers include:

Single helical tube or coil

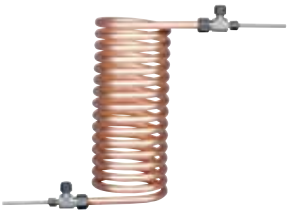
A compact heat exchanger that is highly effective in cooling high temperature and/or high pressure fluid samples, this type of specialty heat exchanger is most commonly referred to as a sample cooler. This design handles temperatures to 1100°F at 5000 psig (593°C at 345 bar) and can be made to specification in a wide range of materials and configurations to meet EPRI/ASTM/ASME guidelines, with many models available with the ASME section VIII code stamp, CE or CRN registrations.

Spiral tube or coil

Spiral tube or coil – Offering high efficiency in a small footprint for high pressure applications, this type of heat exchanger consists of a multi-tube spiral assembly inserted into a shell, where two paths are created for counterflow heat transfer that is more efficient than a typical shell and tube heat exchanger. Its spring-like design can handle pressure ratings up to 5000 psi (344 bar), and temperature ratings up to 1000°F (540°C). It is compact and highly resistant to thermal and pressure shock.

While sample coolers are limited to one to five square feet of heat transfer surface area, spiral heat exchangers provide more heat transfer surface to meet tougher application requirements.

Dual tube coil (DTC) or tube-in-tube



This helically wound tube-in-tube design handles a variety of lower flow applications. It features a fully drainable inner and outer coil with no dead spots or crevices and is available in a wide variety of materials.

Shell and tube

This design features a series of tubes (called a tube bundle) that typically contain the fluid to be cooled, and are installed in a cylindrical pressure vessel, called the shell. In some designs, the tubes are bent (U-tube), which allows the tube bundle to be removed completely for mechanical cleaning of the tube exterior and shell interior. The shell and tube heat exchanger has a long dimensional profile, which can be a problem if space is limited. This type of heat exchanger is not used as a sample cooler due to the high flow rates, but can be used for boiler blowdown heat recovery – where heat from the boiler blowdown water is used to heat the incoming makeup water.

Plate heat exchanger

This type of heat exchanger uses metal plates to transfer heat between two fluids. The fluids spread out over the large surface area of the plates, which facilitates transfer of heat at a fast rate. They offer high heat transfer efficiency for a small physical size. Larger commercial versions use gaskets between the plates, whereas smaller versions can be brazed (for copper) or welded (for stainless steel) for more reliable sealing. The gasketed design can be taken apart and cleaned, whereas the brazed or welded type cannot.

This lower-cost type of heat exchanger handles only low to medium pressures, but can handle higher flows. As high flows are not suitable for sampling, this design is not used as a sample cooler to cool representative samples for analysis. However, with its larger capacity and reduced tendency for plugging compared to a helical coil sample cooler, it often is used to transfer heat from a closed loop cooling water system of several sample coolers to an open loop of dirty cooling water, such as from a river or lake.

CERTIFICATIONS

Different heat exchanger designs offer different tube and shell diameters and materials, wall thicknesses or lengths, and can be designed to meet varying requirements for your application, such as:

- CRN – Canadian Registration Number
- PED – Pressure Equipment Directive (or CE – "Conformité Européene"/European Conformity certification)
- ASTM – American Society for Testing and Materials certification
- TÜV SÜD – global testing certification
- ASME Section VIII – American Society of Mechanical Engineers codes and standards
- MTRs – material test reports
- TEMA – Tubular Exchanger Manufacturers Association

HEAT EXCHANGER MATERIALS

Materials for a specific heat exchanger are specified based on application and budget. For instance, copper and carbon steel are common and durable materials used in industrial heat exchangers, while sample coolers are typically stainless steel. However, some applications require different materials.

For example, dissolved minerals can affect the shell of a heat exchanger if there is a great temperature difference between the material being cooled and the cooling fluid, or if a medium like seawater is used as the cooling fluid. In that case, stronger and more durable materials are needed. One material, Alloy 625, has proven durable for applications that require it due to chemistry or temperature of the fluid to be cooled as described – but it also is more costly.

Your heat exchanger supplier partner will be able to recommend the appropriate heat exchanger size and type, and advise on materials available, for your specific application. Based on customer application experience, our application engineering experts are familiar with the types of heat exchangers that work best for different applications, and can run detailed calculations based on the fluid temperature the customer needs to obtain as well as the physical or thermal properties of the fluid being heated or cooled.

CHOOSING THE RIGHT HEAT EXCHANGER FOR YOUR APPLICATION

This guide is intended to provide basic information on heat exchangers so you have a framework on how to choose the best type of heat exchanger suited to your application. Please contact us for guidance and recommendations on your specific application requirements.

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