



Equipment Expertise eBook

Equipment Expertise: Inspecting a Heat Exchanger

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Introduction

This eBook will focus on another highly common piece of equipment that can be found in most manufacturing facilities around the world, known as a heat exchanger.

This equipment's main task is to transfer heat from one medium to another. However, it does serve other functions, for example in some chemical facilities liquids are heated up during the production process in order to create a necessary gas.

Since this gas is a key ingredient, companies will make sure it is passed through a heat exchanger, so any excess gas is captured, and reverted back to a liquid, ultimately ensuring that none of their product goes to waste.

Who We Are

EquipNet is a global leader of surplus asset management solutions. We're recognized for our proprietary asset management platform, our revolutionary industrial equipment marketplace, and our results-driven project management services. Our diverse roster of clients include Fortune 500 multi-national corporations, leading regional manufacturers, financial institutions, and corporate renewal professionals.

EquipNet solutions deliver maximized financial return while improving our client's corporate image, adhering to their safety standards, and contributing to their sustainability initiatives.

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Starting Your Research

When starting your search for a heat exchanger, you want to consider the following:

- High/Low pressure limit
- Square footage of surface area
- Thermal performance
- Temperature ranges
- Product mix (liquid/liquid, particulates or high-solids liquid)
- Pressure drops across the exchanger
- Fluid flow capacity
- Cleanability, cost of maintenance and repair
- Materials required for construction
- Ability and ease of future expansion

Types of Heat Exchangers Used in Industrial Applications

There are several types of heat exchangers on the market today; however the following two are most used in industrial applications:



Shell & Tube Heat Exchanger:

A shell and tube heat exchanger is the most common type of heat exchanger used in chemical processing facilities. This type of heat exchanger consists of a series of interior tubing, encased in a shell, constructed of mild steel or stainless steel. If the shell is in contact with a corrosive material, then an alloy such as hastelloy is used. The tubes, or tube bundle, are generally constructed of stainless steel or another alloy, and contains the fluid to be either heated or cooled.

Within the heat exchanger's shell, but on the exterior of the tube bundle, flows a liquid that will pass over the tube bundle's exterior surface to either heat the tube bundle, or absorb the heat being emitted from the bundle. This type of heat exchanger is capable of maintaining pressures more than 30 bar and temperatures higher than 260 degrees Celsius.

Design of the Shell & Tube Heat Exchanger

When considering a used shell and tube heat exchanger, you will want to know as much about its design as possible. The following is a brief overview of all the design elements of a shell and tube heat exchanger:

a) Tube Length

Tube length is important to take note of because generally, the longer a heat exchanger is, the smaller the shell diameter is, which translates to an overall less expensive heat exchanger. But be careful, and always keep in mind that the thinner a tube is, the more difficult it is to efficiently clean.

b) Tube Layout

There are four different tube layouts used in heat exchangers: square, rotated square, triangular, and rotated triangular. The square layouts are generally used when the application will cause the heat exchanger to be cleaned frequently. The square pattern allows for an easier cleaning experience. The triangular layouts are used to provide a greater heat transfer.

c Baffle Design

A baffle is an artificial obstruction used for checking or deflecting the flow of either a liquid or gas. With regard to heat exchangers they are used to direct the shell's fluid over the tube bundle. It is important to note the spatial distance between the baffles, because it plays a major role in the conversion of pressure drop and heat transfer.

It is suggested that the baffles are spaced no closer than 20% of the shell's interior diameter to achieve optimal thermo economic conditions.

Types of Heat Exchangers Used in Industrial Applications



Plate Heat Exchanger:

The second most common heat exchanger found in industrial facilities is a plate heat exchanger. This version of a heat exchanger is made of multiple slim plates with large surface areas and fluid flow passages to allow for the transfer of heat.

This style of heat exchanger, featuring multiple plates stacked on top of each other, can be more efficient than a shell and tube alternative, since these heat exchangers are generally compact in design.

Two forms of a Plate Heat Exchanger

a) Plate & Frame Heat Exchanger

A plate and frame heat exchanger is not bonded, and is modular by design. Plate and frame heat exchangers can be easily disassembled for maintenance and cleaning purposes. This type of heat exchanger is generally used in what is called an open loop application.

b) Permanently Bonded Plate Heat Exchanger

A permanently bonded plate heat exchanger does not feature a modular design, and is permanently bonded together, making it more difficult to clean and maintain. Plate heat exchangers, including the plate and frame type, can be constructed of all sorts of metals and alloys, depending upon the process in which it is used.

Inspection Techniques

At EquipNet, we highly encourage you to perform your due diligence and visually inspect the heat exchanger. While doing so, you will want to closely inspect the equipment's exterior surface, looking for signs of corrosion, rust, and most importantly, any cracks in the heat exchanger's shell. However, even if a unit passes your visual inspection, it does not mean that the equipment is in good condition; the most important aspect of the heat exchanger is the tube bundle within the shell. To ensure there are no cracks in the tubing, you will need to perform a hydrostatic test.

Hydrostatic Test

A hydrostatic test entails filling the shell and the tubing with water; usually a dyed water to achieve increased visibility. This type of test is performed on pressurized vessels only, as it is the pressure that essentially reveals and cracks in the shell or tubing.

When performing a hydrostatic test, the shell cavity and tubing is first filled with a nearly incompressible liquid, such as water or oil, and then the internal pressure is raised to one and a half times the manufacturer's suggested operating pressure. It is set this high so the water or oil is forced out of any accessible cracks in the vessel. A hydrostatic test is very reliable, and is used by most organizations that utilize pressurized equipment in their day to day operations.

There are many heat exchanger manufacturers and fabricators. It is important to purchase one that is National Board certified and is constructed using A.S.M.E. specifications.

For assistance finding or inspecting the heat exchanger for your needs, please contact your local EquipNet Representative:

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