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Spring Newsletter

SPECIALISTS IN HEAT TRANSFER

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Welcome to our **Shell & Tube vs. Plate & Frame** newsletter! In our continuing effort to share a solution for a challenge experienced in the field of Heat Transfer, we offer this newest issue of our newsletter.

Please read on while we identify advantages and disadvantages, as well as proper application of shell & tube heat exchangers and plate heat exchangers.

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SHELL & TUBE VS. PLATE HEAT EXCHANGERS

INSIGHTS INTO THE ADVANTAGES, DISADVANTAGES, AND PROPER APPLICATION

Heat Exchangers have been used to satisfy fluid heating and cooling needs in commercial and industrial applications for many years. In addition, the ever increasing cost of energy finds heat exchangers used more often to extract and conserve energy that was previously wasted.

The two most common types of heat exchangers used to satisfy these requirements are the shell-and-tube and plate-and-frame.

Shell-and-Tube

The shell-and-tube heat exchanger has the greatest flexibility when it comes to choice of material, temperature and pressure limitations and specific design features. There are three main designs available. Fixed-Tube designs are usually the most economical, allow limited serviceability and virtually no means for thermal expansion.

Removable Bundle U-Tube designs are economical alternatives for applications which create thermal expansion but allow limited serviceability.

U Tube Exchanger

Removable Bundle Floating-Tubesheet designs are the most serviceable because they are cleanable on both tube and shellside. While they provide means for thermal growth, they are not as economical.

Applications such as close approach and temperature crosses are not the best fit for a shell-and-tube exchanger due to the fact that this would require a long, single pass design that is costly and requires considerable space for installation.

Floating Tube Exchanger

Plate-and-Frame

Plate heat exchangers have emerged as a viable alternative and are generally available in three designs.

The traditional gasketed plate-and-frame exchanger is by far the most popular and versatile allowing disassembly for mechanical cleaning and inspection as well as future expansion. Multi-circuit, double-wall and sanitary designs are available in many plate and gasket combinations, which are suitable for applications requiring moderate thermal expansion.

Brazed-Plate (mainly copper or nickel brazed) designs are very economical and compact gasket-less designs, that do not allow for mechanical cleaning and do not tolerate thermal growth.

Brazed Plate Exchangers

Spiral plate heat exchangers are very versatile and can be designed to allow partial mechanical cleaning while creating a natural 'scrubbing' action which reduces and delays fouling. This design is also ideal for applications that will experience high thermal stresses.

Spiral Exchanger

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Shell-and-Tube or Plate?

This is one of the most asked questions when it comes to selecting a heat exchanger for an application. Assuming that the application is within the pressure and temperature limits of both designs, the issue usually centers around initial cost, maintenance cost and future operating conditions.

Initial cost is usually dictated by the approach temperatures of the application. Close approach temperatures and temperature crosses require a true counter-current design and favor a plate exchanger. Generally, wide temperature approaches favor the shell & tube heat exchanger. Materials of construction can influence this relationship,especially if the application requires stainless steel or titanium. With the extensive use of computerized selection programs, it requires little effort to obtain prices for each type of exchanger to compare initial cost quickly.

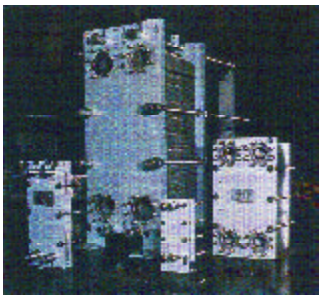
With respect to maintenance cost, much depends on the characteristics of the fluids involved. If the fluid has a tendency to foul, the gasketed plate heat exchanger offers somewhat easier and direct access to the heat transfer surface for mechanical cleaning. In addition, because of the high turbulances in the plate units, there is less scaling or fouling compared to the shell-and-tube.

Spiral and brazed plate Exchangers can't be disassembled for mechanical cleaning. Chemical cleaning is possible if the proper cleaning agents are used.

If the gasketed plate exchanger has a weakness compared to the shell-and-tube, it lies in the amount of gasketing in the unit. Compared to the shell-and-tube, the amount of gasketing is magnitudes larger, and therefore the potential for leakage is much higher. In addition, the gaskets are elastomers, which means they do have a service life. On average, gasket life of a plate heat exchanger is approximately 6 to 7 years with operating temperatures having a significant effect on the average. Units operating close to the temperature limit of the gasket will experience shorter gasket life.

Another aspect of an elastomer gasket that must be considered is the phenomenom of cold leakage. Cold leakage is due to the cooling of a plate heat exchanger from high operating temperatures when there is differential pressure between the hot and cold media in the unit. The plate unit has a tendency to weep through the gasket interface. The weeping normally stops after the gaskets reset or the unit is brought back up to operating temperature. Basically, if the application requires a high probability against leakage, the better choice is a shell-and-tube design.

While gaskets may be a weakness in a plate-and-frame exchanger, the ability to expand its



Gasketed Plate-and-Frame Exchangers

thermal capacity by adding channel plates to the existing design is one of its major strengths. If it is known that a particular application needs to be expanded in the future, a plate-and-frame exchanger is by far the easiest and most economical design for such an expansion.

Other noteworthy guidelines when choosing the right heat exchanger for an application. Gasketed plate-and-frame exchangers are a poor choice for most sensible air and/or gas heating and cooling applications. A better choice for this would be a brazed plate or spiral plate exchanger. Steam, condensing and evaporating applications are often an ideal fit for a plate-and-frame exchanger. Low temperature cryogenic and other applications creating high thermal expansion should be limited to the spiral plate heat exchanger.

In summary, a little design compatibility investigation can go a long way towards eliminating many common heat exchanger problems. A heat exchanger, properly selected, installed and maintained can be the most troublefree piece of equipment in a fluid system.

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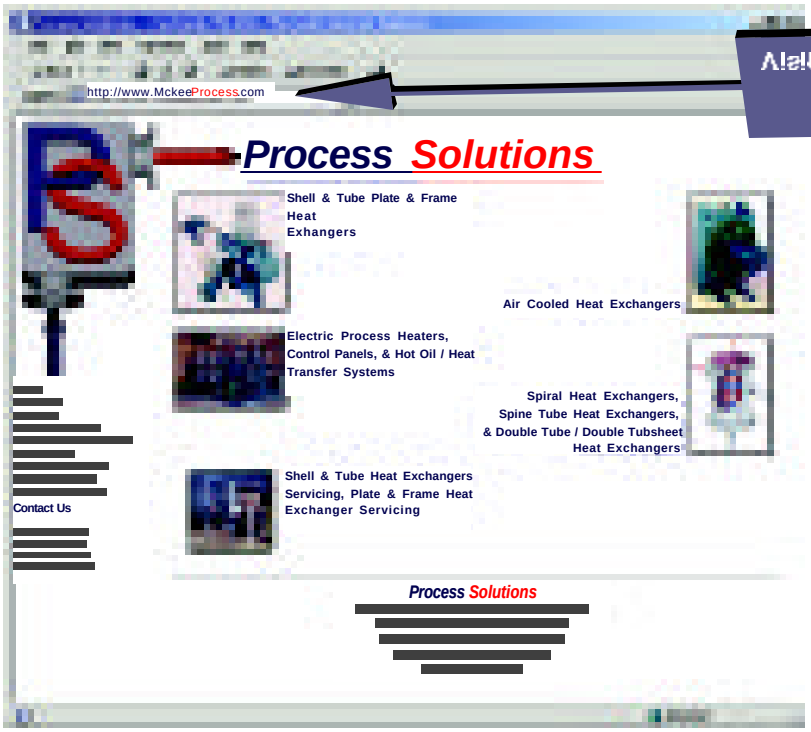

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Coming up in future issues:

- Continued discussion of Heat Exchanger failures Including:
  - *Chemical Induced Corrosion*
  - *Chemical/Mechanical Induced Corrosion*
  - *Scale, mud, and Algae Fouling*
- Process Heater Maintenance Issues
- Extending Electric Heater life with proper controls

[Source: Article by Joseph L. Madejczyk, Manager of Marketing, and Michael J. Stephan, Product Manager, ITT Fluid Handling Division, Buffalo, NY, "Shell-and-Tube vs. Plate Heat Exchangers"

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