PM for Plate/Frame HEAT EXCHANGERS

Breaking down the basics of plate and frame heat exchangers and preventive maintenance tips to keep these “silent machines” running at their optimum.

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The plate and frame heat exchanger is an engineered piece of equipment that serves as a means of energy transfer. Heat transfer involves bringing two fluids at different temperatures closer to each other, so that one either heats or cools the other. This means that energy already paid for is simply transferred to another part of the process. This saves energy and reduces the overall environmental impact of the production or system.

This exploded view of a plate and frame heat exchanger shows all its internal components. Despite not having moving parts, preventive maintenance is critical to ensuring production and system uptime and will help to avoid equipment failure.
The basic plate heat exchanger consists of a series of thin, corrugated plates that are gasketed or welded together (or a combination of these) depending on the liquids passing through them. The plates are then compressed together in a frame to create an arrangement of parallel flow channels. One fluid travels in the “odd numbered” channels, and the other in the “even” channels.

A plate and frame heat exchanger can be used in almost any environment and for multiple applications. Its compact design allows for mounting where space is limited. The plates in the heat exchanger are used for both heating and cooling—they are generally made of stainless steel, but can also be made of any pressable material that is resistant to aggressive media, like geothermal water or seawater. Plate heat exchangers are also adjustable and can be modified to adapt to process changes over time—the number of plates can be easily expanded or reduced to meet application requirements.

The plate and frame heat exchanger consists of three main components—plates, gaskets and a frame. They can also be fitted with additional features for different applications, including insulation, drip tray and a protection sheet.

Plate and frame heat exchangers are flexible and feature a compact design, allowing for installation in many different types of applications. Plate heat exchangers can be used for indoor climate control—for cooling during the summer (or in tropical zones) and for heating in colder climates, as well as for heating of tap water or swimming-pool heating or cooling. Plate heat exchangers can also be used to recover excess heat in industrial plants as well as for environmentally friendly climate control. Typical applications include:

- District cooling;
- Local cooling;
- Free cooling;
- Pressure interceptor;
- Glycol saver; and
- Chiller bypass.

**PM for optimal performance**

The heat exchanger is a silent machine with no moving parts and is often regarded as a “no maintenance needed” piece of equipment, but this not the case. Although the maintenance
Plate and frame heat exchangers are available in a variety of sizes based upon the application.

can be relatively low compared to chillers and pumps, it is still needed and it should be performed at regular intervals.

Planning maintenance is critical to ensuring production and system uptime and will help to avoid equipment failure. The cost of prevention can be budgeted and is normally lower than emergency repairs. Without regular maintenance, a system can be subjected to unpredictable shutdowns, resulting from fouling or scaling of the plates, clogging of the plate pack or even gasket failure.

If neglected for many years, gaskets can become brittle, and over time this will affect their sealing performance across the plate pack, causing fluid to leak into the environment.

Fouling and clogging issues force the fluids to make their way through a reduced space. This increases the overall pressure drop of your system, and can result in higher energy bills. These together with scaling will also affect the heat-transfer efficiency of the plate heat exchanger, because the plate surface will not have direct contact with the fluid—reducing the convection effect.

A clean unit runs efficiently at optimal conditions, which can result in energy savings. A clean heat exchanger produces less pressure drop on the system, requiring less effort on the pumps and other components. This helps in lowering energy bills, while increasing the heat-transfer rate and operating more efficiently.

Consider this scenario: A data warehouse employs plate and frame heat exchangers in connection with chillers to keep a constant cool load in its server rooms. By design, a FHE produces a certain pressure drop (normally not higher than 10 psi) when the fluids flow through the plate pack.

An estimate of the energy cost is calculated by multiplying the hydraulic horsepower required by the average cost of energy within a defined timeframe. So, the following can be assumed:

- Pressure drop = 10 psi
- Flow rate = 500 gpm
- Energy cost = $0.07/kWh
- Time = 365 days
- Conversion rate = 1,714
- Mechanical efficiency (ME) of the pump = 0.90

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Cost = [(10 psi x 500 gpm) ÷ (1,714 x 0.90 ME)] x $0.07/kWh x 24 hours x 365 days = $1,987.55/year x 2 sides of the PHE = $3,975.11

If the heat exchanger is not maintained in a clean condition, it will foul, decreasing the heat-transfer efficiency and increasing the pressure drop. If pressure drop rises to 20 psi, the cost will become:

Cost = [(20 psi x 500 gpm) ÷ (1,714 x 0.90 ME)] x $0.07/kWh x 24 hours x 365 days = $3,975.11/year x 2 sides of the PHE = $7,950.21

This estimate does not account for the lost thermal efficiency that results in higher temperatures, and requires running at a higher flow rate. Those conditions represent even higher costs, which could be contained by opening...
the PHE and cleaning it during a planned 5–10-hour shutdown.

PM guidelines
Follow these preventive measures to avoid unexpected downtime, failures and high operating costs:

1. Ironically, the plate heat exchanger can become one of the best filters in a system. If it is connected to an open loop without a filtration system (such as open cooling-tower water, river water or seawater), the narrow gaps between the plates of the heat exchanger will trap all kinds of debris and materials—including silt, sand, rocks, leaves and shells. Over time, the sub-micron particles can build up on the plates, resulting in decreased thermal performance and increased pressure drop. Make sure the system has adequate filtration to keep the fluids clean and prevent clogging. Some manufacturers can help with custom filter solutions developed just for their plate heat exchanger units.

2. Regularly back flush the system or heat exchanger every week to push debris back to the source. Some manufacturers can provide back-flush valves.

3. Regularly check the plate heat exchanger for leaks, especially during intense running periods. Simply remove the protective shroud and visually inspect the side and particularly the bottom of the plate pack with a flash light.

4. Plan your downtime to take the heat exchanger offline and perform a mechanical cleaning every one to three years, depending on the condition of the process waters. If the water is clean and regular back flushing of the system is performed, the unit may not need to be taken offline for up to 10 years.

5. Check the gaskets as often as possible to look for softness and elasticity, as brittle gaskets are not good.

6. Install a water-cleaning system. Be mindful of the chlorination volume. A good cleaning system will soften the water and prevent hard scaling and fouling from coating the plates, but too much chlorine will affect the stainless-steel plates and can possibly cause corrosion.

In brief:
- Back flush the plate heat exchanger once a week;
- Perform a mechanical cleaning every two to three years if the water is dirty and every five to 10 years if the water is clean.
- Change gaskets every five to 10 years (depending on the application, temperatures and fluids); and
- Send the plates back to the factory for a reconditioning process every 10–15 years (not all manufacturers offer this service).

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