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8 STEPS TO IMPROVE AND MAINTAIN HEAT EXCHANGER EFFICIENCY

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8 STEPS TO IMPROVE (AND MAINTAIN) HEAT EXCHANGER EFFICIENCY

Are you tired of feeling like your heat exchanger is draining your wallet like a car engine left running all night? Wasting energy and money is never fun, and an inefficient heat exchanger can be a major culprit. Don't let it continue to drain your resources and pose potential safety risks. Instead, optimize the conditions of your heat exchanger to ensure an efficient and effective operation. Our guide walks you through the steps you need to take – from pre-purchase and design to maintenance – to get the most out of your heat exchanger.

PROCESS DESIGN RECOMMENDATIONS

WHEN YOU BUY YOUR HEAT EXCHANGER, HOW CAN YOU BUY IT (DESIGN IT) SO IT RUNS AT MAXIMUM EFFICIENCY?

THERE ARE A FEW PRINCIPLES TO FOLLOW:

MAXIMIZE THE PRESSURE DROP (WHILE BAXLANCING PUMPING COSTS)

A higher pressure drop in your heat exchanger results in higher efficiency because it leads to a greater rate of heat transfer. The greater the rate of the heat transfer, the more heat can be transferred between the fluid streams – resulting in a more efficient heat exchanger (but with higher pumping costs). Conversely, a lower pressure drop would require more plates to achieve the same heat transfer rate but with lower pumping costs.

Therefore, the goal is to find the optimal balance between pressure drop and pumping costs that maximizes the efficiency of your heat exchanger while minimizing your plant's operating costs.

PRO INSIGHT:

A COMMON STANDARD FOR HEAT EXCHANGERS IS A MAXIMUM PRESSURE DROP OF 10 POUNDS PER SQUARE INCH (PSI) ON EACH SIDE. THE COMMON STANDARD OF 10 PSI IS BASED ON A BALANCE BETWEEN ACHIEVING A SUFFICIENT HEAT TRANSFER RATE AND MAINTAINING AN ACCEPTABLE FLOW RATE WITHOUT INCURRING EXCESSIVE PUMPING COSTS.

2 SELECT THE CORRECT PORT SIZE

When designing your heat exchanger, it would be ideal to have the whole pressure drop occur in the channels and none of it in the ports (heat transfer occurs in the channels, not the ports). A good design has 10% or less of the total pressure drop occurring in the ports. Following this principle ensures your exchanger will achieve its maximum heat transfer rate for your application and will help minimize fouling and other problems.

To achieve this, a good design key is to select the right port size. A heat exchanger with 2-inch ports is more narrow and less expensive than a 4-inch unit. But if the 4-inch unit has a better port-to-channel pressure-drop ratio, it might be the most efficient choice for your application – albeit a bit more expensive. Choose the largest port size that is consistent with proper velocity (see next step).

It's important to note that exceeding ⅓ of the overall pressure drop in the ports can be risky, resulting in uneven fluid distribution (also known as maldistribution). All heat exchanger calculations are based on even fluid distribution, and if it's not even, your required heat transfer levels may not be accomplished.

3 ENSURE GOOD VELOCITY

Have you ever experienced the frustration of trying to cool down a hot beverage with a slow trickle of water? It seems like it takes forever, right? The same concept applies to a heat exchanger with low velocity.

It's crucial to ensure that the velocity of the fluid is adequate to promote efficient heat transfer in your heat exchanger. A good rule of thumb is to design for a minimum velocity of 1 foot per second channel velocity, although you can go lower in some cases.

Essentially, higher velocities promote turbulence in the fluid, leading to better heat transfer and higher resistance to fouling. On the other hand, low velocity means the fluid doesn't get pushed hard enough through the heat exchanger. And when the velocity is low, the fluid has less kinetic energy to overcome any obstructions or deposits that may have accumulated on the surface of your heat exchanger. This leads to the formation of fouling patterns, where deposits or build-up accumulate on the surface of the plates, reducing the exchanger's ability to transfer heat effectively. This not only reduces the efficiency of your heat exchanger but it can also cause damage to the equipment in the long run.

PRO TIP:

IF YOUR DESIGN SITUATION LEAVES YOU NO CHOICE BUT TO HAVE LOW VELOCITY IN ONE OF THE STREAMS, ENSURE THE LOW-VELOCITY STREAM IS FLOWING UPWARD THROUGH THE HEAT EXCHANGER. THIS WILL ASSIST WITH PROPER FLOW DISTRIBUTION.

4

AIM FOR HIGH-SHEAR STRESS

It's essential to consider the shear stress (a measure of the force of fluid flowing over a surface) of your heat exchanger. Higher shear stress is a good indicator of the exchanger's ability to clean itself.

You should aim for shear stress of 50 Pa or higher to ensure your heat exchanger has a good self-cleaning ability. However, keep in mind that the appropriate shear stress level may vary depending on the fluid being used. For example, a shear stress of 50 Pa is sufficient for crude oil, which is a very fouling fluid, but other applications may require higher or lower shear stress. One effective approach is to consult your vendor or an expert to determine the appropriate shear stress level for your specific application.

5

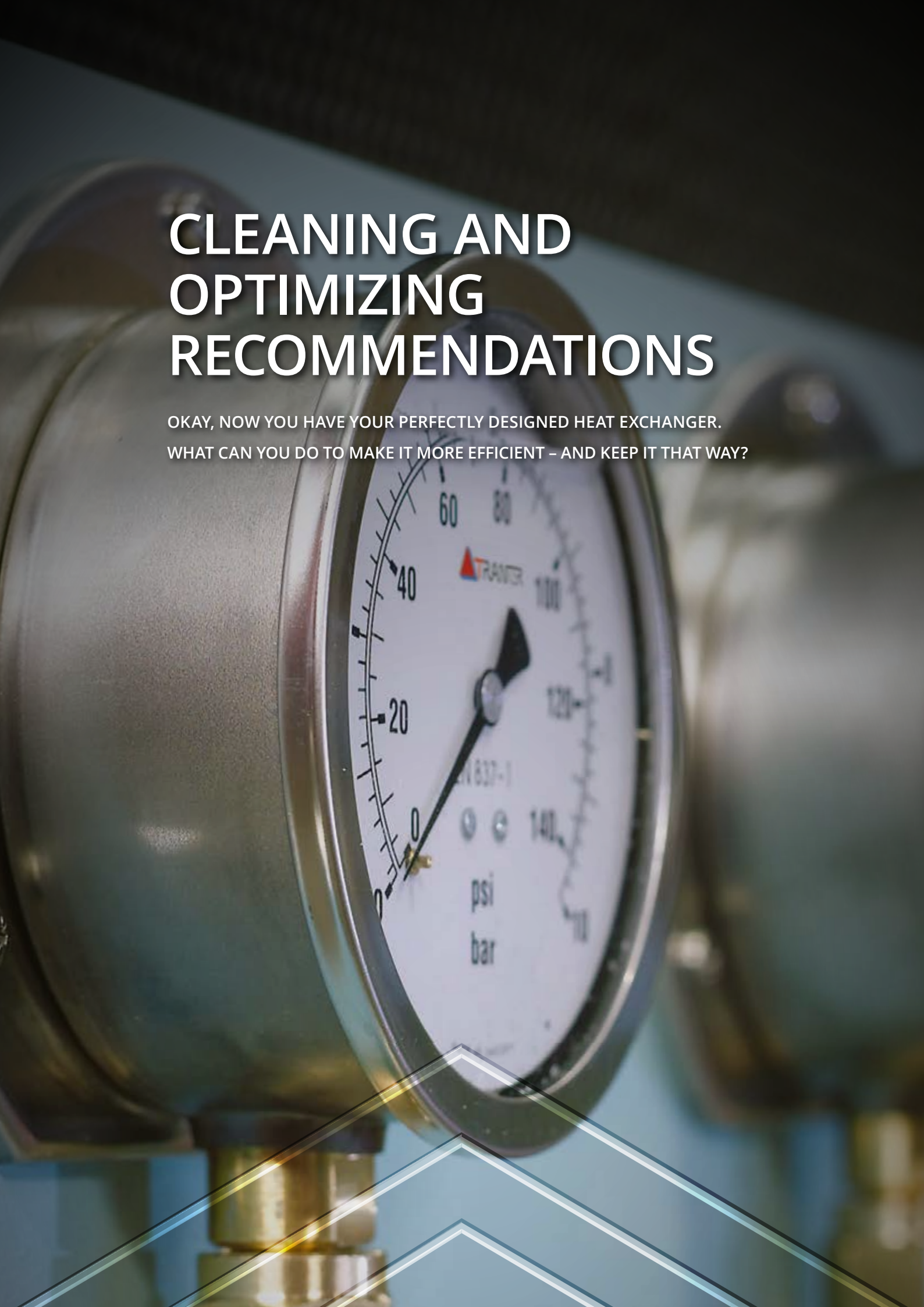
DON'T USE A FOULING FACTOR

A fouling factor is based on mathematical tables and is used to account for the additional surface area needed in shell-and-tube heat exchangers to maintain effective heat transfer over time as fouling occurs. But this factor is unsuitable for plate heat exchangers as it leads to excessive oversizing, poor velocity and quick fouling.

Instead, when designing a plate heat exchanger, it's better to use a surface margin of 10% rather than a fouling factor. This means designing your heat exchanger with 10% extra surface area to account for fouling over time. This provides a safety margin, ensuring that even if your heat exchanger experiences some fouling, there will still be enough surface area to transfer heat effectively.

PRO TIP:

IF YOUR DESIGN SITUATION LEAVES YOU NO CHOICE BUT TO HAVE LOW VELOCITY IN ONE OF THE STREAMS, ENSURE THE LOW-VELOCITY STREAM IS FLOWING UPWARD THROUGH THE HEAT EXCHANGER. THIS WILL ASSIST WITH PROPER FLOW DISTRIBUTION.



CLEANING AND OPTIMIZING RECOMMENDATIONS

OKAY, NOW YOU HAVE YOUR PERFECTLY DESIGNED HEAT EXCHANGER. WHAT CAN YOU DO TO MAKE IT MORE EFFICIENT – AND KEEP IT THAT WAY?

MONITOR YOUR HEAT EXCHANGER'S PERFORMANCE

If you're a plant engineer not tracking your heat exchanger's operational parameters, you're putting your job at risk. Without monitoring them, how will you know it's working as it should?

To monitor your heat exchanger's temperature and pressure drop, connect it with temperature and pressure gauges (if you haven't already). Ideally, you would be monitoring flow rates as well. Study the gauges and take a baseline measurement of both the cold and hot sides to create a temperature and pressure-drop profile. This lets you clearly see the degradation in its overall performance over time.

By always being aware of what and how it's doing, you can prevent both unexpected failures and process upsets. It's like putting an activity tracker on your heat exchanger to take its pulse. Every heat exchanger needs an activity tracker.

KEEP IT CLEAN

A clean heat exchanger is a happy heat exchanger. And a happy heat exchanger is essential for optimal heat transfer efficiency. Dirt, fouling, calcium, and other debris hinder heat transfer, making it important to keep track of the buildup and clean your heat exchanger when needed.

There are two non-invasive methods for cleaning: method one involves flushing your exchanger with a cleaning solution, which is effective for fouling and cleaning plates. Method two involves back flushing, which is effective for removing debris that has become lodged in the equipment.

A more invasive method is to open the heat exchanger to clean the plates. You can either clean them in place, remove them for cleaning offsite, or replace the dirty plates with clean ones. If you keep a spare plate pack on hand, you can open the heat exchanger and swap in the clean plate pack. You can then send your dirty plates out for cleaning and regasketing to be ready for the next cleaning cycle.

The trick to optimizing the efficiency of your heat exchanger is only to clean it as often as necessary. While some can go one or two years between cleanings, the frequency of cleaning should always depend on use. There is no universal rule of thumb, so the key is to keep track of usage and clean your exchanger exactly when needed.

PRO TIP:

IT'S HIGHLY RECOMMENDED TO KEEP YOUR HEAT EXCHANGER INDOORS OR IN A SHADED AREA IF AT ALL POSSIBLE. EXPOSURE TO SUNLIGHT CAN CAUSE DAMAGE TO GASKETS, WHICH LEADS TO LEAKAGE AND REQUIRES MORE FREQUENT CLEANING. SIMILARLY, EXPOSURE TO FRIGID TEMPERATURES CAN CAUSE WATER TO FREEZE AND POTENTIALLY DAMAGE THE HEAT EXCHANGER. BY KEEPING YOUR HEAT EXCHANGER IN A CONTROLLED ENVIRONMENT, YOU CAN MINIMIZE THE RISK OF DAMAGE AND EXTEND ITS LIFESPAN.

ANALYZE POTENTIAL AREAS OF IMPROVEMENT

One way to optimize the conditions of your heat exchanger is to evaluate if you're able to increase the flow rate of the fluid. And if you can do it, the increased velocity will be helpful. However, it's important to seek expert analysis before making any changes. This type of audit is helpful in identifying opportunities to optimize the conditions of your exchanger.

Employ engineers to back-calculate the heat transfer coefficient and pressure drop of your exchanger and analyze the impact of different flow rates and other process changes. With this information, they can determine the most effective and efficient modifications to improve the performance of your exchanger.

It's essential to keep in mind that optimizing the conditions of your heat exchanger is an ongoing process. Even small changes in your process or system can affect its performance. Therefore, it's recommended to periodically review and make adjustments accordingly. Doing so ensures that your heat exchanger is always operating at peak efficiency and saving you money in the long run.

DO YOU NEED HELP TO IMPROVE AND OPTIMIZE YOUR HEAT EXCHANGERS?

WHATEVER BRANDS OF PLATE HEAT EXCHANGERS ARE INSTALLED IN YOUR FACILITY, OUR TEAM OF EXPERTS CAN HELP YOU WITH MAINTENANCE, REPAIRS, AND UPGRADES TO ENSURE THAT YOUR HEAT EXCHANGERS ARE CONTINUALLY OPERATING AT THEIR OPTIMAL LEVEL.

CONTACT US TODAY TO LEARN MORE ABOUT OUR OEM SERVICES AND HOW WE CAN HELP YOU.

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