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Paper

HOW AUTOMATED WATER JETTING IMPROVES TUBE BUNDLE CLEANING EFFICIENCY

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ABSTRACT

This paper documents the improved efficiencies realized by utilizing high production automated waterjet tools for cleaning tube bundles. Manual water jetting, which has been the preferred method of removal, is able to clean the tubes, but has two major problems. Firstly, manual blasting fails to meet the required production rates. Secondly, manual blasting puts the operator into direct contact with the high pressure hoses used for the cleaning process, which can lead to operator fatigue.

1. Water Jets as used for Tube Cleaning - A Brief History

To maintain a consistently high level of process efficiency, today's facilities must ensure that the tubes in their heat exchanger and processing systems are thoroughly cleaned on a regular basis. The direct expenses involved can be substantial, and adding indirect costs (e.g., downtime and compliance with safety and environmental regulations) puts extreme pressure on tight operations budgets.

To meet this challenge, more and more companies today are cleaning tubes with high-pressure water jetting. It removes even hardened deposits thoroughly and economically (often saving thousands of dollars).

A high-pressure water jetting tube cleaning system typically consists of a small nozzle placed on the end of either a rigid tube (for straight line cleaning) or a small flexible hose (for tubes with bends). The high-pressure water is fed down the tube or hose and exits the nozzle at a speed and pressure that removes even the hardest residues, rust and scale. In addition, the waste material is flushed out of the tubes and is rinsed away.

2. Traditional Methods for Cleaning Tubes.

2.1 Traditional Methods

One of the most common methods for cleaning process tubes is manual water blasting. There are a number of variations on this, but all generally require an operator to manually index a cleaning nozzle through the tube to be cleaned

2.2 Problems Associated with Traditional Methods

This process, while effective, has a number of drawbacks. First, it can be time consuming and requires the operators to directly interface with the high pressure water leading to operator fatigue. Second, the operator can very the speed at which the nozzle moves through the tube, resulting in an uneven cleaning.

The manual cleaning processes also require operators to directly interface with the high pressure water leading to operator fatigue.

3. Using Automated Systems

Automated systems are an excellent method for removing product build up from heat transfer tubes. Not only do they lessen the amount of time that manual methods require; they more importantly eliminate the variables an operator brings to the process and serve to remove the operator from the immediate vicinity of the high pressure water.

Automated systems for cleaning tubes typically combine multiple lances or hoses, a means to move those hoses across the face of a tube bundle, and a system for feeding the lances or hoses in and out of the tubes. The operator typically controls the actions of the system from a remote position.

3.1 Types of Automated Systems

The new automated systems typically consist of a lance and nozzle assembly that is indexed through the tube to be cleaned. The lances can either be of a flexible type, which allows for the cleaning of tubes with bends, or of a rigid type which typically provides the ultimate it productivity, but are limited to straight tubes.

3.1.1 Flexible Lance Systems

Automated systems that use flexible hoses offer increased flexibility in where the system can be positioned during the cleaning process. The larger of these types of systems will often use an X-Y positioning device that the operator can use to manipulate the hoses into position for the cleaning pass. These systems often include as many as three individual hoses that can be fed into the tubes at the same time. Smaller flexible hose systems actually use a hand held device that the operator manually moves from tube to tube. These systems typically have only one or two hoses.

Older flexible hose cleaning system often relied on a hose reel that the hose would be rolled up on. The reel would move in either a forward or backward motion to correspond with the lances being fed into or pulled out of the tubes. At first glance a system that uses a reel would seem like a good idea, as it would provide a means of managing the hoses, but in practice, the reel itself often becomes one of the most problematic potions of the system. The material that is being cleaned out of the tubes often finds it way back into the reel, ultimately causing the system to bind up.

The newest generation of automated flexible tube cleaning systems actually employ a track drive system that captures the individual hoses and drives the backwards and forwards motion required for cleaning. The hoses are allowed to feed out behind the device and simply lie on the floor.

The real advantages of a flexible lance system both relate to the hoses. The lances have the ability to go around bends in the tubes. Also, because the excess hose can be allowed to simply lie on the floor, the amount of space needed to set-up and run a flexible lance system is much less than a rigid lance system.

3.1.2 Rigid Lance Systems

What rigid lance system lack in flexibility they make up for in sheer performance. These systems use small diameter pipe with high pressure nozzles on the end to clean tubes. Since the piping is rigid, the system can literally force the nozzles through the obstructed tubes, creating a system that uses mechanical force along with the cleaning actions of the water jets.

But, because the piping is rigid, the system required a larger area for the cleaning process to take place.

4. Productivity

Cleaning Technique	Number of lances	Number of Tubes to Clean	Time per cleaning pass	Total Cleaning Time	Time Saved
Manual Water Blasting	1	100	10 Min	16 Hours	NA
Semi-Automated Dual Flex Lance System	2	100	5 Min*	4 Hours	12 Hours
Semi-Automated Triple Flex Lance System	3	100	5 Min*	2.75 Hours	13.25 Hours
Semi-Automated Quadruple Rigid Lance System	5	100	4 Min*	1.3 Hours	10.7 Hours
* Automated systems allow the operator to clean on both the in and out stroke of the cleaning lance.					

Actual cleaning times can very greatly depending on the length of the tubes and the material being removed, but the above example provides an idea of the increased productivity that automated systems can provide over a manual method. What is not readily apparent in the example provided is the improved quality and consistency of the actual cleaning process. The Automated systems discussed in this document allow the tubes to be cleaned both on the inward and outward passes. This gives a superior result and helps to improve productivity. The automated systems also allow the operator to set the feed rate such that each tube will be cleaned in an even and repeatable manor.

5. Conclusion

Advancements in automation have made the cleaning of tube bundles easier and safer.