How Automated Water Jetting Improves Tube Bundle Cleaning Efficiency

NLB Corp. “The Leader in Water Jet Productivity”

29830 Beck Road
Wixom, MI 48393-2824
Phone: (248) 624-5555
Fax: (248) 624-0908
e-mail: nlbmkrg@nlbusa.com
www.nlbcorp.com
Introduction

To keep today’s ultra-efficient heat exchanger systems operating at peak efficiency, petrochemical and refining facilities must clean their tubes thoroughly and regularly to keep them clear of process-related deposits. Such deposits can drastically limit the system’s ability to transfer heat, driving operating costs substantially higher. Add indirect costs like downtime and compliance with safety and environmental regulations, and the pressure on tight operations budgets is intense.

To meet this challenge, more and more companies today are cleaning tubes with high-pressure water jetting (20,000 to 40,000 psi, or 1,400 to 2,800 bar). Water jetting has been widely used for product removal and industrial cleaning for some 40 years. It removes even hardened deposits thoroughly and cost-effectively, often saving thousands of dollars while significantly improving productivity. Semi-automated systems, for example, can clean 100 tubes 75% faster than manual methods, depending on the size of the tube bundle and the material being cleaned out. Fully-automated systems can clean them 90% faster than manual methods.

A high-pressure water jet tube cleaning system typically involves 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). High-pressure water from a pump unit is fed through the tube or hose and exits the nozzle at a speed and pressure that removes even the hardest residues, rust and scale. Then the waste material is flushed out of the tubes and rinsed away.

Traditional Manual Methods

One of the most common and most economical methods for cleaning tubes is manual water blasting. There are a number of variations on this, but all generally require an operator to manually feed the nozzle into each tube that needs to be cleaned. Once the nozzle is positioned in the tube, the operator starts the flow of high-pressure water by depressing a foot pedal. This process, while effective, has drawbacks. First, it can be time-consuming. Second, holding on to a hose as high-pressure water rushes through can lead to operator fatigue over time. Third, the operator may not always feed the nozzle into the tube at the same speed, which can result in uneven cleaning.
Automated systems clean several tubes at once while the operator stands clear.

Automated systems are a superior method for removing product build-up from heat transfer tubes. Not only do they save many hours compared to manual methods (see Table 1, page 4), but more importantly they eliminate the variables an operator brings to the process while removing him or her from the immediate vicinity of the high-pressure water.

Automated systems for cleaning tubes typically have multiple lances or hoses, a means of moving them across the face of the tube bundle, and a system for feeding them in and out of the tubes without manual labor. The operator typically controls the actions of the system from a remote position nearby. Hoses and lances are usually provided in different sizes to suit a variety of tube diameters; changeover should be simple to minimize downtime.

Types of Automated Systems

There are two basic types of automated tube lancing systems: those that use flexible hoses and those that use rigid tubing. Each has advantages and disadvantages, and choosing the right system can go a long way to assuring a user of the most efficient, productive tube cleaning possible.

Flexible Lance Systems

Automated systems with flexible hoses have two major advantages: the flexible lances can go around bends in the tubes and offer more positioning flexibility during the cleaning process. The larger of these types of systems will often have an X-Y positioning device that lets the operator put the hoses into position for the cleaning cycle. These systems often feed as many as three individual hoses into the tubes at the same time. Smaller flexible hose systems typically have only one or two hoses, with a hand-held device so the operator can manually move them from tube to tube.

When flexible hoses are used, hose management must be considered. Older systems generally used a hose reel to roll up the hoses and move them forward or backward as the lances were fed in and out of the tubes. While this kept the hoses under control, the material being cleaned out of the tubes often found its way back into the reel, ultimately causing the system to bind up. This made the reel one of the most problematic portions of the system.
The newest generation of automated flexible tube cleaning systems has solved this problem with a track drive system that captures each hose and drives the back-and-forth motion required for cleaning. The hoses are allowed to feed out behind the device and simply lie on the floor. The elimination of hose reels greatly reduces the amount of space required for a flexible lance system, especially compared to a rigid lance system.

**Rigid Lance Systems**

Rigid lance systems are not as flexible as automated systems, but make up for it in sheer performance. These systems have small-diameter pipes with high-pressure nozzles on the ends to clean tubes. Since the piping is rigid, the system can literally force the nozzles through the obstructed tubes, adding mechanical force to the cleaning action of the water jets. However, the piping tends to be quite long (30 feet is not uncommon), so a rigid lance system can require up to 6 times more operating space than a flexible lance system.

Fully automated systems can clean more tubes at a time, providing the highest level of productivity. They also provide the most protection and comfort for the operator. The system shown here has an operator station above the tube bundle with full controls. It gives the operator a full view of the cleaning process, a comfortable seat and a climate-controlled environment. From here he can control the in-and-out movement of the lances and the up/down movement of the levelers. If the system has a bundle roller option, he can also rotate the tube bundle as needed.
Productivity

As the examples in Table 1 demonstrate, semi-automated and fully automated water jetting systems require about half as much time per pass as manual water jetting, and this advantage increases as lances are added. A fully-automated 5-lance system can clean 100 tubes in a little over an hour, compared to 16 hours with labor-intensive manual cleaning. Actual cleaning times can vary greatly, depending on the length of the tubes and the type of material being removed.

Table 1

<table>
<thead>
<tr>
<th>Tube Cleaning Method</th>
<th>Number of Lances</th>
<th>Number of Tubes to Clean</th>
<th>Time per Cleaning Pass</th>
<th>Total Cleaning Time</th>
<th>Time Saved</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual Water Blasting</td>
<td>1</td>
<td>100</td>
<td>10 Min</td>
<td>16 Hours</td>
<td>NA</td>
</tr>
<tr>
<td>Semi-Automated Dual Flex Lance System</td>
<td>2</td>
<td>100</td>
<td>5 Min*</td>
<td>4 Hours</td>
<td>12 Hours</td>
</tr>
<tr>
<td>Semi-Automated Triple Flex Lance System</td>
<td>3</td>
<td>100</td>
<td>5 Min*</td>
<td>2.75 Hours</td>
<td>13.25 Hours</td>
</tr>
<tr>
<td>Automated Quintuple Rigid Lance System</td>
<td>5</td>
<td>100</td>
<td>4 Min*</td>
<td>1.3 Hours</td>
<td>14.7 Hours</td>
</tr>
</tbody>
</table>

* Automated systems allow the operator to clean on both the in and out stroke of the cleaning lance.

In addition to increasing productivity, automated water jet systems can improve the quality and consistency of the cleaning process. The systems discussed in this white paper allow tubes to be cleaned both on the inward and outward passes, so more material is removed in less time. They also allow the operator to set the feed rate so that each tube will be cleaned in an even, repeatable manner.

Safety and Ergonomics

Automated tube cleaning systems have benefits for operating personnel as well. Manual hose or lance feeding can be tiring over time (as previously noted) and can expose operators to backsplash and debris. With a semi-automated system, the operator has complete control without coming near the waterblasting, using a remote (even wireless) control.
Conclusion

Tube bundle cleaning plays a key role in maintaining heat exchanger efficiency, which is a critical factor in petrochemical quality and productivity. High-pressure water jetting is a proven method for keeping tubes clear of deposits, and today’s automated systems are more effective — and more operator-friendly — than ever before. They can reduce cleaning time by 75% to 90% vs. manual water jetting, and processors can choose from different levels of automation to suit their specific needs.