By replacing an open-dip tank with a vacuum cleaning system, Greenville Tube continues to meet its customers' quality requirements with an environmentally friendly process.

Greener Cleaning at Greenville Tube

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With customers in the chemical, petrochemical, shipping, dental, medical, and machined and fabricated parts industries, and with applications ranging from food to fuel lines and from heat exchangers to engine parts, the Greenville Tube (a RathGibson company) plant in Clarksville, Arkansas, needs to produce only the highest quality small-diameter stainless steel and nickel-alloy tubing. To assure the quality of its product, Greenville Tube personnel perform all heat treatment in automatically controlled, continuous bright annealing furnaces, straighten stainless steel tubing in guideless rotary straighteners, and eddy current test all tubing produced. What's more, they'll perform hydrostatic or air-pressure testing as required, as well as any other testing required by the company's customers.

A critical characteristic of a high-quality tube is cleanliness of both the OD and ID tube surfaces. During the production of welded and drawn, and seamless stainless steel tubing and various nickel alloys (from 0.125–2-inch diameter and with lengths ranging from 4–60 ft), following the drawing process, which is performed to achieve the required outer diameter (OD) and wall thickness, it is necessary to clean the tube prior to annealing. Given that the drawing is a serial process, occurring as many as six times on a single tube, repeated cleaning operations are needed.

The cleaning process had been based on the use of an open-top dip tank measuring 110 ft long. It was filled with trichloroethylene, approximately 5,000 gal. During operation, a bundle of tubes would be lowered in via an overhead crane, and then the bundle was moved back and forth in the tank so that the solvent would be agitated in the tubes.

Based on production scheduling, it is typically necessary to bundle different lots of tubing such that there could be from two to 20 lots processed during a single hour. With the dip tank, the company was able to process a bundle of tubes in less than five minutes.

It is hard to overstate the necessity of producing clean tubes. For example, if the tube doesn't get completely cleaned, when it is processed in the furnace, defects will occur and the tubing will be rejected. Given that a lot of work has been invested in the tubing, that is an expensive consequence.

A tube cleaning vacuum system provides an effective and environmentally friendly alternative to an open dip tank.

So Greenville Tube personnel began looking for an alternative method for tube cleaning—one that wouldn't add any process steps, would clean as well as or better than the solvent dip tank, would be environmentally friendly, and would have the capacity to handle 60-ft tubes.

After assessing a variety of companies and cleaning approaches, a decision was made to go with a custom-built system—an airless cleaning system—from Tiyoda-Serec Corp. (North Kingstown, Rhode Island).

This system uses n-propyl bromide (nPB) as its cleaning solvent. What is interesting about this system is that the cleaning process occurs under a vacuum. And Greenville Tube is pleased that the system addresses all of the requirements the company had established:

PROBLEM: Stringent cleanliness requirements for both the OD and ID of tubes ranging from 4–60 feet

SOLUTION: Custom-built airless cleaning system using n-propyl bromide

RESULTS: Cleaner tubes with cleaner air and reduced chemical requirements

Benefits of Vacuum Technology

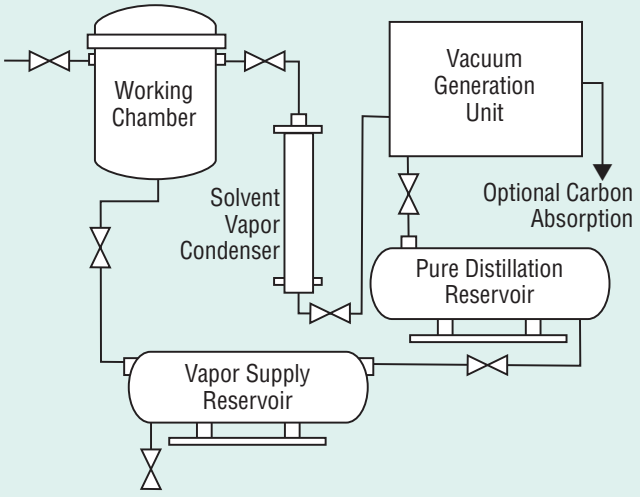
Solvent Emission Reduction
To eliminate the solvent emissions, the air in the cleaning chamber is evacuated initially so that the solvent and the air are not interfaced with each other.

De-Gassing the Solvent
When the solvent is placed under vacuum, the air dissolved in the solvent is eliminated to enhance the ultrasonic power—this means cleaner parts.

Drying the Parts Completely
In the vacuum drying process, the vacuum created in the cleaning chamber depresses the boiling point of the solvent; it becomes 75% of its boiling point at atmospheric pressure. The higher the vacuum is, the lower the solvent boiling point. The heat capacity of the parts helps boil the solvent, and the evaporated vapor is recaptured and recycled in the system.

The TSC Airless Process

Loading of the parts
Decompression, (air removal)
Warm solvent soak (static, recirculating cleaning)
Warm solvent ultrasonic cleaning (optional)
Cold solvent soak (static, recirculating rinse)
Cold solvent ultrasonic cleaning (optional)
Vapor cleaning
Vacuum drying and vapor removal
Scavenging (final air purge)
Unloading of the parts



• Tubes do not need to be specially prepared prior to processing. No additional steps are added to the process. The system is capable of meeting the 5,000 lb of tubing per hour, 24 hr/day demand placed on it.

• After running various-sized tubes through the system, it was determined that there was more consistent removal of contaminants than had been achieved with the previous dip tank system.

• Because this is a closed-loop system, there is a recapturing of the solvent and associated emissions.

• The system uses a chamber that is 34 inches in diameter and is 65 ft long, so it is capable of accommodating the bundles of tubing that are cleaned.

During the procedure, a bundle is loaded into the cleaning tanks, and a vacuum package pulls a vacuum of 1 Torr. Then nPB solvent is flushed through at a rate of 800–900 gal/min; it is filtered and then run through again as required. Each cycle generally takes 42–50 min. The process is performed automatically, with the operator loading and unloading the system.

The tubing is dried within the chamber. The chamber is externally heated with hot oil, which is sufficiently hot to evaporate the solvent. The evaporative emissions are recaptured by the system. When the chamber is opened, there are no fugitive smells of the chemical in the plant.

Because of the closed-loop design of the system, where the solvents are recovered (about 97% of the solvent), distilled, and reused, they've discovered at Greenville Tube that there is some 75% less nPB used than trichloroethylene used for cleaning.

So at Greenville Tube they are getting cleaner tubes with cleaner air and reduced cleaning chemical requirements. **PC**

TIYODA-SEREC CORP. can be reached by calling 401-667-7370 or visiting *www.tiyoda-serec.com*.
For more information from **GREENVILLE TUBE COMPANY**, call 479-754-6500 or visit *www.greenvilletube.com*.

GARY VASILASH is editor of *Automotive Design and Production*.

SOLVENT RECOVERY USING CARBON ADSORPTION
For solvent users who have switched to nPB, read about carbon adsorption technology that allows the recovery of emissive losses and lowers the ambient ppm levels in the work place.

pfonline.com/articles/pc/09-100709-pc.html

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