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Featured Excerpt:

Cleaning with Liquid Nitrogen

by: Beth Foley-Saxon, Conco Services Corporation, Verona, PA

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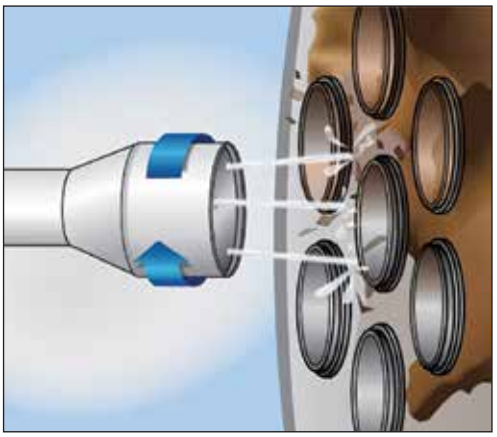

NitroLance on Tube Sheet

NitroLance Cleaning Heat Exchanger Tubes at Refinery

NitroLance Inside Tube

In the 1990s, the United States Department of Energy developed the use of high-pressure super-cooled liquid nitrogen as a tool for cutting and cleaning. They were in search of a safe method for cutting into metal storage tanks that contained radioactive material. High-pressure liquid nitrogen was an ideal agent because it did not spark and wouldn't be an accelerant, thereby allaying concerns about the contents of the storage tanks catching fire or exploding. What's more, concerns over the disposal of the liquid nitrogen residue were mitigated because after use it evaporates into the atmosphere.

Down the road a ways, in 2003, NASA went on to use high-pressure liquid nitrogen to clean the Space Shuttle. A NASA technician at the Kennedy Space Center wearing a protective face mask and protective suit aimed a nozzle at the Shuttle's surface. As a controlled stream of liquid nitrogen shot out of the nozzle, sandstone rubble flew off the surface of the vehicle like powder, leaving the valuable components clean and intact. The benefits of cleaning the Space Shuttle with high-pressure liquid nitrogen were effective and safe cleaning action, mitigated concern of fire and explosion, and no secondary waste stream or cross contamination because the system does not use water.

Like so many important innovations that have been developed by distinguished scientists and institutions and then eventually co-opted by the marketplace – use of pressurized liquid nitrogen in a variety of industries is

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NitroLance Cleaning Tube Sheet

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the next chapter in the story of this valuable technology. For our purposes, the cleaning benefits of high-pressure liquid nitrogen are well established in the petrochemical industry, where highly effective removal of tenacious fouling deposits in petroleum refinery process equipment has been achieved. Super-cooled liquid nitrogen removes deposits that conventional methods fail to eliminate. Units that are cleaned with pressurized liquid nitrogen see significant improvements in process flow rates and control, in process energy and pollution management, and a reduction of downtime associated with cleaning compared to other cleaning methods. An additional benefit of cleaning with liquid nitrogen is that it does not produce a secondary waste stream, and so issues of cross-contamination and reactivity of the deposition waste are avoided.

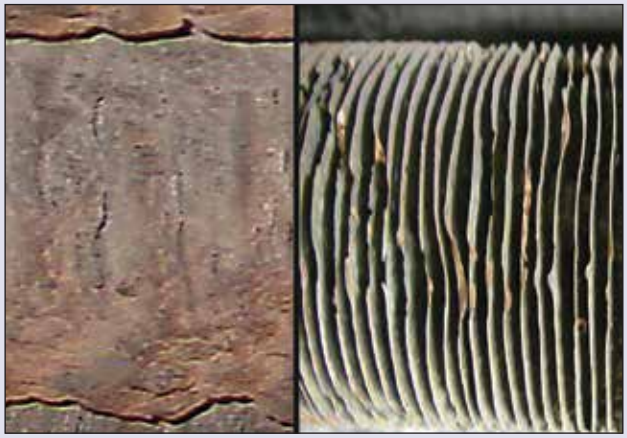
In petroleum refineries, cleaning of heat exchangers and other unit components has traditionally been performed using methods such as high-pressure water blasting, hydrodrilling, chemical cleaning and mechanical scrapers or brushes. While these methods can provide effective cleaning and improved unit performance, all of them burden the plant with the disposal of the deposits that have been removed, which can amount to tons of sometimes volatile waste matter. Moreover, the thousands of gallons of polluted wastewater that was required for cleaning must be responsibly decontaminated and disposed of. These ancillary post-cleaning responsibilities are time consuming and costly to tens of thousands of dollars, requiring additional unit downtime and additional personnel.

Conco Services Corporation of Verona, Pennsylvania, owns and operates the NitroLance™ high-pressure liquid nitrogen cleaning system. The complete system arrives on site in its own NitroLance vehicle. The truck doors open and the system is mounted on a platform that is moved in to close proximity of the unit being cleaned. The system hose and nozzle extends up to 300 feet from the platform while delivering a controlled stream of liquid nitrogen at variable pressures and temperatures. The technician will adjust the pressure and temperature in order to penetrate and break up the deposit at hand. The NitroLance cleaning system can clean internal tube surfaces and external tube surfaces like those found on economizers, as well as heat exchangers, process equipment in sulfur recovery units, waste heat boilers, sulfur condensers and catalytic reactors. The NitroLance can clean vertical or horizontal heat exchangers in place, eliminating the need for costly crane removal services.

Sulfur Recovery Unit Before Cleaning with NitroLance

Sulfur Recovery Unit After Cleaning with NitroLance

Preheater Fins Before and After Cleaning with Nitro-Lance



Preheater Before Cleaning with NitroLance

Preheater After Cleaning with NitroLance

How It Works

The NitroLance super-cooled cryogenic jet emerges from the nozzle entering solid deposit cracks and crevices and then expands,

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rapidly breaking up deposits through three mechanisms of action: mechanical pressure, super cooling and volumetric expansion.

Mechanical Pressure – Based on the equipment being cleaned and the characteristics of the deposition, the pressure exerted at the nozzle tip is adjusted between 5,000 psi to 55,000 psi.

Super Cooling – The super-cooled liquid nitrogen ranges from -160ºF to -250ºF at the nozzle, and based on the fouling characteristics that are present, the precise temperature facilitates fracturing of fouling deposits.

Volumetric Expansion – As the high-density super-cooled liquid nitrogen penetrates the cracks and crevices of the surface of the deposition material, the liquid nitrogen rapidly vaporizes into a gas, expanding by nearly 700 times. The rapid expansion of the gas combined with the mechanical pressure and super-cooled temperature causes the deposit material to break apart and detach from the metal it is bonded to. Once broken apart, the deposition waste is either vacuumed or swept away.

Liquid nitrogen cleaning systems have removed incredibly difficult deposits safely and without producing secondary waste streams. This technology has been used to restore flow to tubes completely blocked with hardened calcium carbonate quicker than high-pressure water or chemical cleaning. Because liquid nitrogen readily dissipates, only the removed deposit is left behind. This is an important qualitative distinction and where use of liquid nitrogen clearly parts ways with other cleaning methods.

The maintenance manager of HollyFrontier Refinery, Rick Scott, says of his Kansas site's liquid nitrogen cleaning application, "NitroLance is a revolutionary service for the cleaning of our thermal reactor boilers. Compared to our previous mechanical cleaning, NitroLance not only cleaned better but was 300% faster."

Testimonials like this speak to the impressive results that are achieved with liquid nitrogen cleaning, and to the desire on the part of plant personnel for maintenance to be conducted fast and effectively. More and more, plants and refineries are willing to spend more of their maintenance budget for liquid nitrogen cleaning when they do the math. Liquid nitrogen cleaning of plant components means far fewer days of maintenance downtime, smaller crew sizes, and drastically reduced post-clean disposal costs. Next generation technology inspires a next generation approach to maintenance. In a climate of leaner budgets, increased oversight and a heightened emphasis on regulatory compliance, smarter use of maintenance dollars means choosing effective and efficient maintenance technologies that yield results without collateral expense.

For more information, visit: www.conco.net or email info@conco.net.

Photographs courtesy of Conco Services Corporation, Verona, PA.

Comments Solicited on Improvements to Recommended Practices

Comments are solicited regarding improvements to the WJTA-IMCA publications, *Recommended Practices for the Use of High Pressure Waterjetting Equipment* and *Recommended Practices for the Use of Industrial Vacuum Equipment*. While both publications are reviewed periodically at the WJTA-IMCA conferences and throughout the year, your comments and suggestions for improving the publications are invited and welcome anytime.

Please address your comments and suggestions to:

WJTA-IMCA
906 Olive Street, Suite 1200
St. Louis, MO 63101-1448
phone: (314)241-1445
fax: (314) 241-1449
email: wjta-imca@wjta.org

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