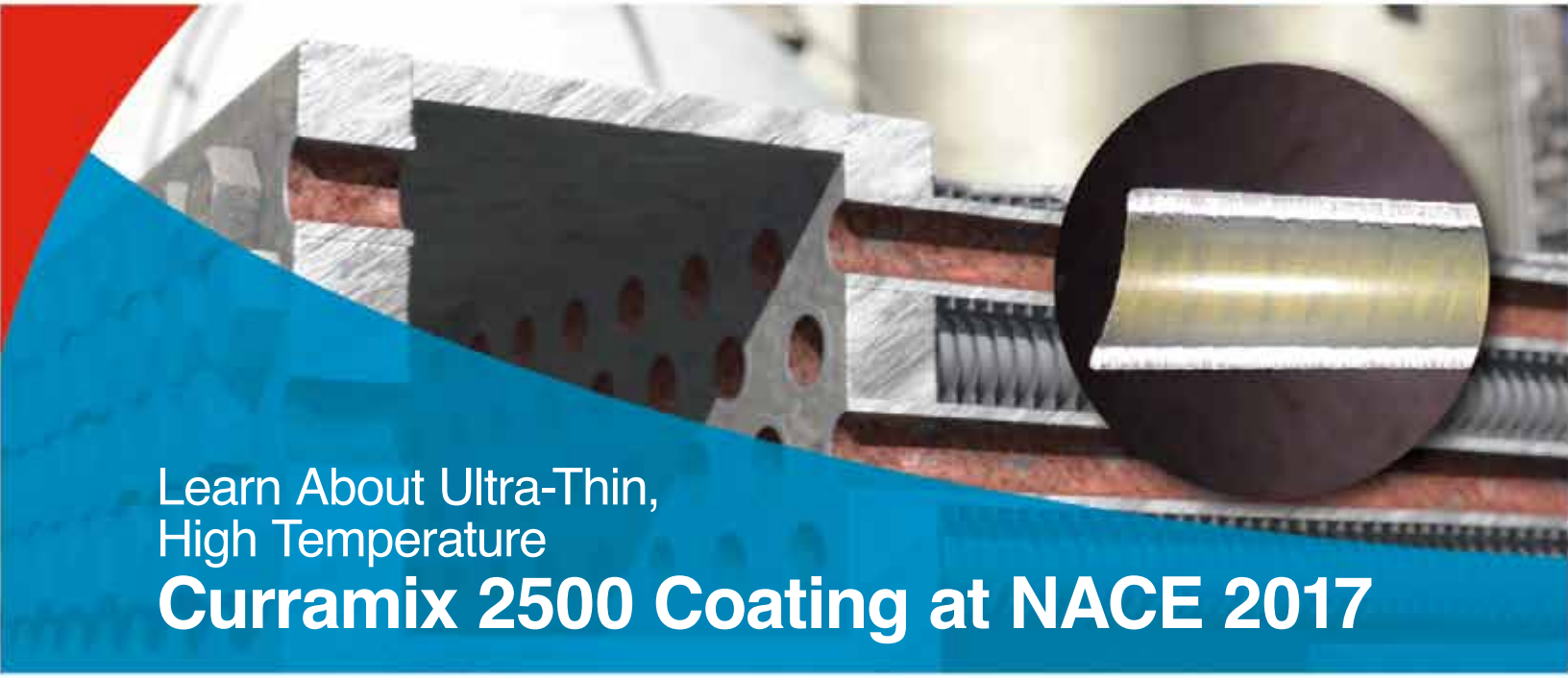
Curran international
Tubular Heat Transfer Services.

March, 2017



Learn About Ultra-Thin, High Temperature **Curramix 2500 Coating at NACE 2017**

Curran will introduce a new tube ID coating technology for ultra-thin film exchanger applications, at NACE Corrosion 2017.

This material is designed to provide state-of-the-art foul release performance in hydrocarbon and coking services where process foulant has a high impact to unit efficiency.

Initial tests of Curramix 2500, a high temperature inorganic coating, have shown promising results in mitigating fouling in crude exchangers of distillation units.

Curramix 2500 is radically different than polymer tube ID coatings used for cooling water. As an inorganic coating, Curramix 2500 survives refinery hydrocarbon services well beyond the temperature limits of traditional tube coatings and retains surface lubricity to 1200F.

Applied in one to two coats totaling about 25 microns DFT, Curramix 2500 has been proven effective in laboratory testing in crude test loop at 700F.

Curran's tests show the coating has oleophobic properties, cannot be wetted with inks, and is designed for non-aqueous services. Curramix 2500's temperature limits make it suitable for pre-crude heaters, and ethylene transfer line exchangers (TLEs).

Reducing fouling in crude-distillation units significantly reduces operational energy costs.

"Our refinery partners have observed encouraging results," Ed Curran, CEO, Curran International, noted. "The prospect of this coating contributing to more efficient operation of process critical exchangers has gained momentum."

Curran International had samples coated with Curramix 2500's innovative technology. The coating has low surface-energy and superior release. Additional tests are ongoing, and separate coupons have been field-installed in a refinery crude coker unit, in a gas service, and in an exchanger subject to alloy scaling downstream of a catalyst reactor.

By eliminating tube-fouling and coking, as a result of the low surface-energy of the coated tube, the exchanger can be operated more efficiently between maintenance shutdowns.

Curran International is known globally for its exchanger thin film exchanger tube ID coating applications.

These applications use Curran 1000T, PFA and ETFE fluoropolymers, and baked phenolic coatings and are applied to 200-250 microns. The homogenous thin film coating protects steel tubes from corrosion and fouling. Curran exchanger tube ID coating applications are found in plants globally.

Visit Curran International in New Orleans at NACE Corrosion 2017, Booth 1031 and learn more about cutting-edge tube ID coating applications and discuss a trial using Curranmix 2500.

Contact your Curran sales rep for more information about CurraMix 2500, or contact Ed Deely edeely@curranintl.com, 281.339.9993.

Eddy Current Tube Testing

Reliable, inexpensive testing that improves heat exchanger availability and promotes equipment longevity.

How Eddy Current Testing Works…

Eddy Current Testing (ECT) is based upon the principle that an alternating current (AC) magnetic field will induce a flow of electrical current in non-ferrous materials. These circulation currents, or eddies, follow the geometry or shape of the conductor and will not flow into nonconductive areas.

Therefore, cracks, pits, holes or general metal or tube wall-loss act as nonconductive areas and can be detected by their effect on the normal flow of the eddy currents.

Variations in these currents are measured by the eddy current instrument after the equipment has been calibrated against a known standard. This allows the NDE Technician to quantify the defects based on the characteristics of the signal, such as amplitude, phase angle and shape.

Recent Case Study

Recently a Curran customer was experiencing several tube leaks in their feedwater heaters.

Upon arrival, a preliminary walk-down of the heater (vertical) did not show any abnormal conditions or indicators. Next, Curran conducted a 100% eddy current inspection. Initial results indicated several tubes showed signs of cracking at or just above several support locations.

Discussions with plant management indicated it was virtually impossible for stress corrosion cracking (SCC) to be the cause of the leaks because chlorides had not been introduced into their system.

However, Curran's technician was convinced the indications were classic signs of SCC. Further investigation, with additional maintenance personnel, revealed new information.

Apparently, back-in-the-day, to control algae their cooling towers, the facility had used a biocide. A review of the labels of the biocide containers revealed the biocide contained trace amounts of chlorine.

Further, it was common practice, when a tube leak in the condenser appeared, the plant maintenance team would take a day or so to act; and most often just add sawdust into the intake to plug any leaks.

Curran concluded chlorides in the condensate from the biocide caused the cracking which led to the condenser leaks.

The decision was made to pull a tube-sample for metallurgical analysis. *(See examination results below)*

After finding cracks in the feedwater heater, it was decided to open all the heaters in the system and perform a 100% eddy current exam. The exam revealed cracking condition in four of the five heaters examined. Tests of the other unit's heaters are planned for later outages.

After a detailed examination of the information, Curran defined what was happening within the four heaters and developed a plan for corrective / preventative measures.

These measures were implemented to prolong the useful life of these heaters; until the utility could support retubing the heaters with a more chloride-resistant tube material.

As a result of these findings, a more comprehensive testing program was recommended for the condenser, as well as a change in biocide chemistry and retubing of all for four heaters.

If you are experiencing issues with premature tube failures or failures of an unknow origin, call the professionals at Curran.

Curran can identify the root cause(s) of tube failures and work with you to implement corrective actions that will halt of minimize any future damage.

Please contact David Grimes at dgrimes@curranintl.com or via phone at 513-222-1501.

Examination Results

Fig 1: Cross-section view of tunnel pits and crack tube. Magnification ~200X

Fig 2: Highly-branched transgranular cracks penetrating form OD tube wall. Magnification ~100X

The Cold Facts About
Dry Ice Non-Abrasive Blasting

As the company best known for using dry-abrasive grit blasting as our primary method for tube ID cleaning and surface preparation, some might be surprised to learn that CO2 (dry ice) non-abrasive blasting is another Curran expertise.

Why use dry ice?

Dry ice is best when the surface to be cleaned in intricate and when a softer touch is needed. Another strength of non-abrasive, dry ice, blasting is effective decontamination.

Since dry ice is non-abrasive, it can be used for cleaning objects, such as circuitry, machinery and parts. Even wood and stone can be cleaned without any damage to their surface. Dry ice is nonconductive and can be used for cleaning while equipment is running.

After use, dry ice leaves no waste media for disposal. The once-solid, dry ice turns into a gas, leaving nothing but a polished surface. This is ideal when project contamination options are not a practical option when clean-up of abrasive media is too difficult.

Some items well-cleaned by dry ice include: steam and gas turbine fixed shells; electric motor windings and armature; processing plant alloy tower and trays, sub stations, switch gears, transformers.

Grit blasting has its place in the industry, as does dry ice blasting.

Dry ice will not create a profile on metal and is excellent for removing a substance from a substrate. Dry ice can be delicate. Dry ice is very effective due to two key principles: thermal shock and kinetic energy.

According to an equipment OEM, the combined impact energy dissipation and extremely rapid heat transfer between the dry ice pellet and the surface cause instantaneous sublimation of the solid CO2 into gas.

In milliseconds, the gas expands to nearly 800 times the volume of the pellet. This rapid expansion creates what is effectively a micro-explosion at the point of impact.*

The especially-designed nozzle spraying the dry ice pellets creates the intense velocity. The tight spray pattern, however, means a small blasting radius of about a square inch. This mean dry ice blasting can take some time to cover large areas.

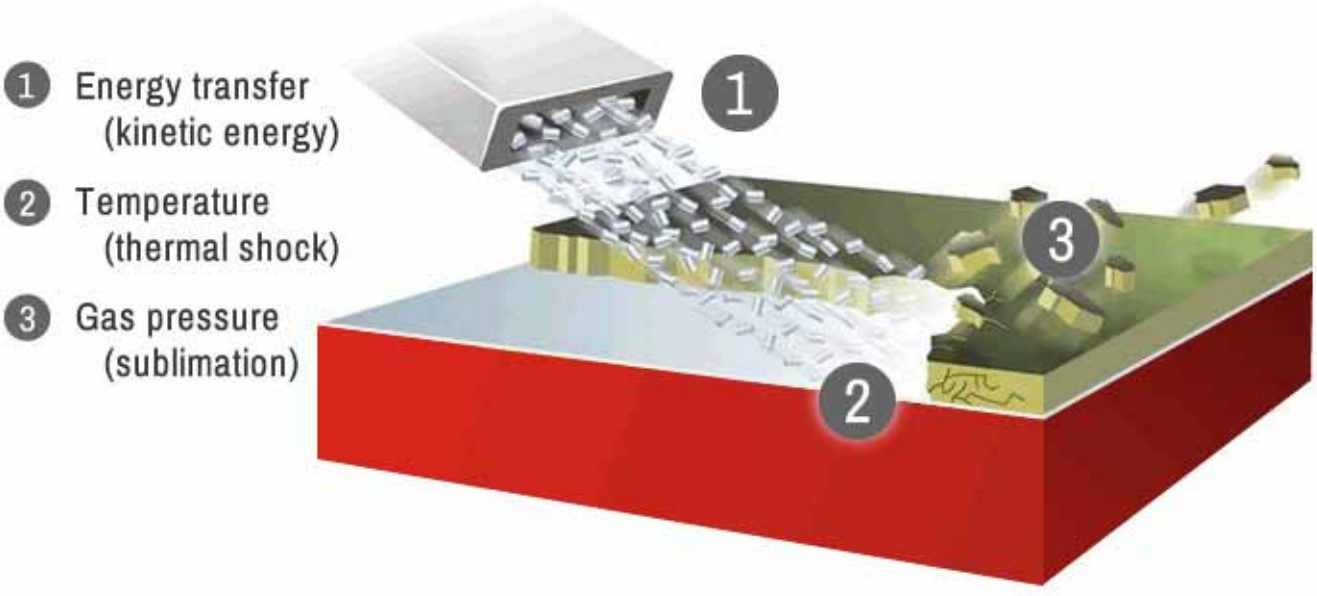
The need for high-pressure air compressors is another thing to consider when using dry ice blasting because blasting takes place at 140-180 psi.

There are special conditions when dry ice is used.

Dry ice can be tricky to keep cold – to keep the pellet or block from sublimating before it can be used. Softened dry ice compromises the blast-effectiveness. There are CO2 pellet makers available, but these can be very expensive.

Curran has extensive blasting experience, be it grit or dry ice.

For more information on Curran International's dry ice blasting capabilities, please call David Lopez (213) 268-7648 or email dlopez@curranintl.com



* http://www.coldjet.com/en/information/how-does-it-work.php; image: http://www.arcticfox.co.uk/dry-ice-cleaning/how-does-dry-ice-cleaning-work/

Curran is Hardwired to Spray Metal.

Spraying metal – combusting and atomizing wire alloys – has been known to industry for years. Using sacrificial coating protects insulated steel and unpainted steel in coastal atmospheric and splash zone areas.

When it comes spraying hot-combustion-coating applications, even where critical path projects call for in-situ turnkey scope execution, Curran has a cool hand.

Curran's application experience ranges from using zinc alloys for galvanic protection of structural steel to improving corrosion resistance of crude drums using nickel alloys. Our application portfolio also includes the use of surface hardening materials having chromium and boron to coat mild steel in reactor towers and trays, and stainless steel to line large diameter pipe ID.

An application of a precious metal – 99% pure silver – was used to protect exchanger tube sheets at welded joints in hot corrosive service.

High temperature liquid sealers are available to improve application service life in hot immersion services.

Thermally sprayed alloys are applied using these methods.

- **Gas combustion**, commonly known as flame spray method, uses oxygen and a fuel gas (acetylene) and a wire fed to combustion nozzle, where the wire is atomized; charged by oxygen and gas and propelled onto the substrate.

  Gas combustion method is ideally used where obstacles require agility in the application. This method requires a lower cost of capital and can be used in the field where power utility resources are limited.

- **Electric arc application**, uses high voltage and amperage current – similar to arc welding. Wires are dual-fed to the combustion nozzle where the wires are atomized into fine particles and sprayed onto the substrate using compressed air.

  The electric arc method atomizes wire at higher temperatures and results in a denser deposition onto substrate. This creates a high-tensile adhesion strength. Electric arc is suitable for high-volume applications.

Curran can meet your coating specification for shop and field thermal spray applications.

Contact your Curran International sales rep to discuss your corrosion challenges and thermal spray coating applications and materials, 281.339.9993; www.curranintl.com.

Curran application of "pure silver" using gas acytelene combustion method.

Electric arc facilitates use of broader range of materials, including surface hardening "alloy" to protect mild steel in oxidizing service

Catch Curran

NACE Corrosion 2017 Conference & Expo

March 27 – 30

Ernest N. Morial Convention Center
New Orleans, Louisiana.

Plant Maintenance, Inspection, Engineering Society Expo and Conference

April 20

Pasadena Convention Center
Pasadena, Texas.

American Fuel & Petrochemical Manufacturers Reliability and Maintenance Conference and Exhibition

May 23 – 26

Ernest N. Morial Convention Center
New Orleans, Louisiana.

AFPM
American
Fuel & Petrochemical
Manufacturers

Why Guess, When You Can Know?
Coupons Are a Great Answer.

Field-test coupons, in plant operating service, add a lot of confidence to the selection of a protective coating for your immersion service.

Curran has partnered with clients to facilitate these field tests, often resulting in custom fabricated fixtures.

Trident-style fixture mounts with coated rods on a threaded blind are attached to a flanged head. These custom coupons were made to test two coatings.

The corrosion of the two coated rods is measure against an uncoated control-rod. Multiple tests can be performed using this style coupon by simply removing the head.

Contact Curran International about coating evaluations and test capabilities. Curran welcomes opportunities to field test Curran coatings at your plant. Contact your sales rep at Curran International, 281.339.9993; www.curranintl.com.