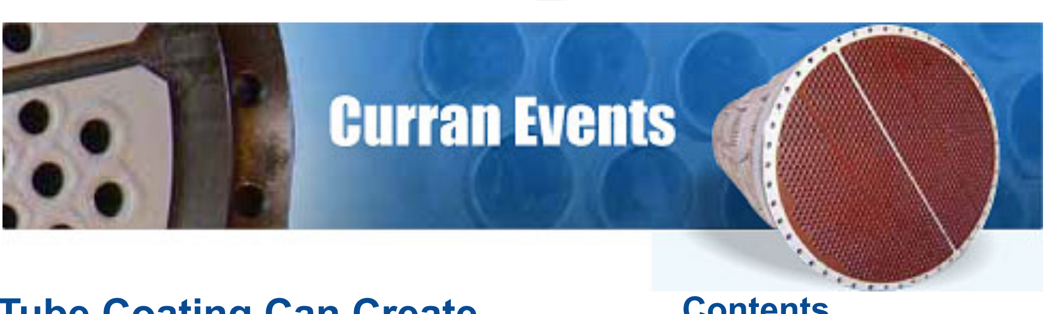

Tube Coating Can Create *Perpetual Life* For Exchangers

Dear Friends:

For a number of years now, exchanger tube ID coating has been a value-add for new fabrication and in-service exchangers. A significant benefit of exchanger tube ID coating is how it contributes to a *perpetual* operating life of some fixed assets.

Curran's highly functional tube ID coating is ideally suited for tubes where corrosion pitting is found. The coating's thin homogenous film encapsulates pitted areas down tube and protects from new deposits and fouling. This is a material that can be field or shop applied.

There has been keen interest in tube ID coating from power generation clients, especially where the future plan of operating mature assets is being considered. The economic advantages of tube ID coating versus a tube replacement are compelling.

The cost of recoating existing shell and tube exchangers is a fraction of the asset replacement cost.

Here is a recent example of *perpetual* life extension of shell and tube exchangers. The subject exchangers operated for nearly 10 years and at the time of the original application the use of coating was approved to mitigate tube side cooling water corrosion. During a planned maintenance outage a recent inspection resulted in satisfactory NDE data, minor mechanical repairs were performed. A visual inspection of the coating found small holidays in the downtube coating, but overall the tube ID coating was mostly undisturbed. Based on the client's existing maintenance cycles, however, it was recommended that the exchanger be recoated prior to return to service.

The cost of recoating existing shell and tube exchangers is a fraction of the fixed asset replacement cost. The new application incorporates the benefits of our advance formula coating, and we expect even better long term operating results, maintaining the *perpetual life* of these exchangers.

Thank you for thinking of Curran. We are at your service.

Yours,

Ed Curran
Ed Curran

Contents

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Meet the Professionals from Curran:

CORROSION 2015
Collaborate. Educate. Innovate. Mitigate.

NACE Corrosion 2015 March 16 – 19 in Dallas

AFPM

The 2015 AFPM Reliability and Maintenance Conference May 19 – 22 in Austin

Condenser Life Cycle Seminar August 17 – 19 in Chicago

Curran International
(281) 339-9993
www.curranintl.com

Please visit our website (www.curranintl.com) to download Curran's updated Service brochure.

Extend the Useful Life of Your Heat Exchangers with Full-length Liners

Picture 1 (Top Left): Hydraulic mandrel is activated to pressurize the liner.

Picture 2 (Bottom Left): A hydraulic liner seals off two tube defects.

Picture 3 (Right): End view of a liner installed through a fin fan box header.

HISTORY: Hydraulic expansion of tube and sleeves was developed by engineers at Westinghouse. These engineers were looking to fix tubes inside steam generators to the tubesheet more quickely than they could using mechanical expansion.

Hydraulic expansion is accomplished by introducing water at a high internal pressure within a sleeve, between 2 end-seals, to expand the sleeve to a point of contact between the sleeve and the parent tube.

This method of expansion offers 4 main benefits over mechanical expansion:

1. No step-expanding. Any length can be done in one quick operation.
2. Minimal work hardening of the tube material during expansion means even difficult tube materials such as titanium or superduplex stainless can be easily expanded successfully.
3. Less wall reduction and less stress concentration from the expanded to the unexpanded portion of the tube. This results in longer tube life.
4. Improved quality – each tube expansion is controlled by the system parameters and not influenced by the operator.

- **FULL-LENGTH LINERS:** Full-length liners are installed as an alternative to full re-tubes of straight tube heat exchangers. The liners are installed into leaking tubes to recover them and bring the unit back close to original design parameters. The full- length liners are also installed into tubes that have been found by NDE to be close to failure. Such installation eliminates the need for an emergency shutdown required to plug the tubes. The liners are hydraulically expanded the full length of the tube to make contact with the tube. The liners also add wall thickness.
- **BENEFITS OF FULL-LENGTH LINERS VS RE-TUBING:**
  - **TIME.** For a full re-tube, the time required to perform the work includes time for removing the existing tubes. The removal and cleaning of the support plates for tube installation makes up 75% of the time required for a re-tube. Full-length liners are installed without removing the existing (parent) tubes. Instead of 4 to 6 weeks required for a re-tube, full-length liners can be installed in every tube in 1 to 2 weeks making the unit available for service more quickly.
  - **COST.** A full re-tube requires the purchase of replacement tubes for the whole unit. The installation of full-length liners only requires the purchase of material that is needed to repair the leaking and damaged tubes. This results in a considerable difference in cost.
  - **RELIABILITY.** Full-length liners are every bit as reliable as a new tube.
- **SLEEVES:** Sleeves are short (6" to 18" long) tubes hydraulically installed on the inlet end of parent tubes. Sleeves are installed to act like a wear plate that decreases the damage done to the parent tube by inlet erosion. The newly installed sleeves can be replaced after they have outlived their usefulness. Sleeves can also be used to make repairs to tubes where the defect is directly behind the tubesheet. This can keep tubes that normally would have to be plugged, open and performing as intended.
- **BENEFITS:**
  - Increase the life expectancy of tubes
  - Can be used in straight and U-tubes
  - Bring old tubes back into service
- **CONCLUSION:** Full-length liners can be used in a variety of different types of heat exchangers. Full-length liners can be installed in places where a full re-tube would be difficult due to room or elevation constraints. There is never the need to cut into the shell side of the heat exchanger as may be the case with a re-tube. The performance difference between a re-tubed bundle as compared to installing full-length liners is almost negligible.

  Sleeves are a useful way to help stop inlet erosion and extend the life of your tubes. Sleeves can be installed relatively quickly with a small lead time on material.

To learn more about full-length liners and sleeves, contact Dave Grimes at Curran International at (281) 339-9993 or dgrimes@curranintl.com

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Clean Tube IDs Produce High integrity NDE Data

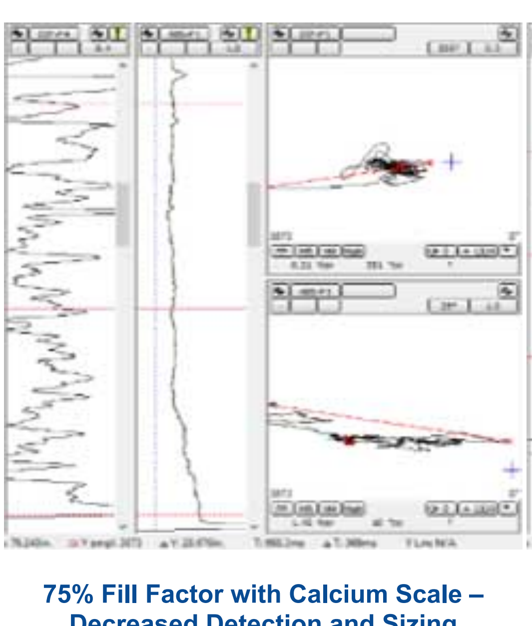
The performance of heat exchangers are affected by surface conditions inside small diameter tubes.

Heat transfer, back pressure or tube flow and energy consumption are metrics that can indicate how exchangers are being impacted by tube ID condition. In water-service, over time, mineral precipitates and particulates form a scale on tube substrate and organic deposits create an insular barrier to thermal capacity. Such deposits cause certain areas to become susceptible to corrosion. This suspectibility is due to ionic imbalances, which create an environment for accelerated corrosion.

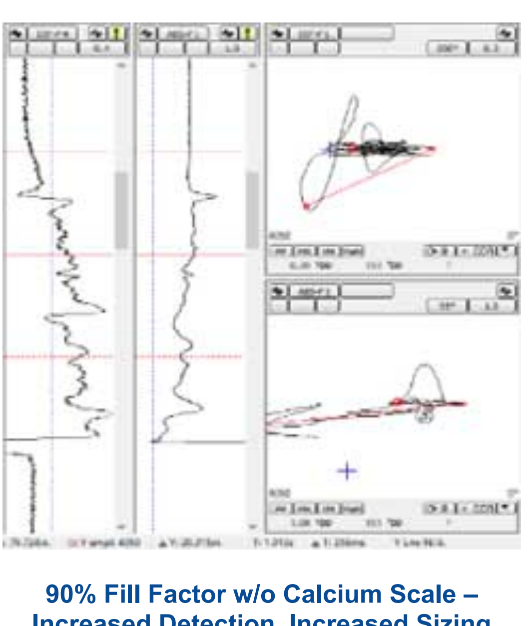
Deposits also create limitations for visual, electromagnetic, and ultrasound inspections. Iron deposits may gnerate magnetic interference which results in *noise*, instead of accurate information. Tube ID scale limits ultrasonic signals and restrictions to inspection probe dimensions create a significant challenge in data collection. The limited inspection probe dimensions, sometimes called *fill factor*, is especially relevant to RFT or ECT inspections. For example, if a 0.60" ID tube is only clean enough to that a 0.42" diameter probe fits down tube, a 70% *fill factor*, a significant gap, or annulus, exists between the probe and substrate. This annulus may contribute to inspection data being incomplete and not as accurate as a probe with 80-90% *fill factor*.

When an inspector is unable to acquire good data, the inspector's ability to accurately assess the tube condition is limited. Such a limitation can lead to a report that often incorrectly identifies the tube's condition as dirty.

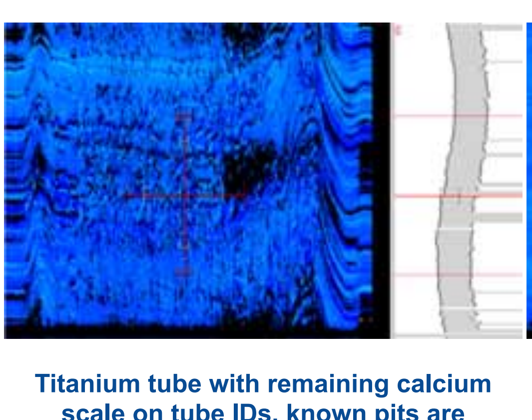
Below are images of data affected due to poor *fill factor* or scale decreasing detection and sizing for eddy current and IRIS.



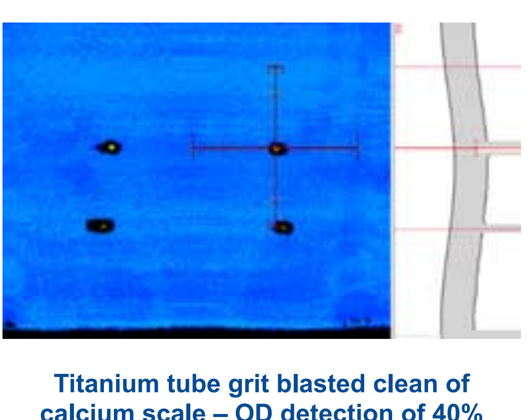
75% Fill Factor with Calcium Scale – Decreased Detection and Sizing (Eddy Current)



90% Fill Factor w/o Calcium Scale – Increased Detection, Increased Sizing (Eddy Current)



Titanium tube with remaining calcium scale on tube IDs, known pits are obscured by scale in IRIS inspection



Titanium tube grit blasted clean of calcium scale – OD detection of 40% pits using IRIS inspection

Exchanger tube ID cleaning for operations and tube ID cleanliness for NDE are often two separate criteria. NDE clean tubes result in higher integrity data and more accurate inspections. Another likely result of NDE clean tubes is higher thermal performance of the exchanger when returned to unit operations.

To learn more about high integrity data, please contact Brett Davis at Curran International at (281) 339-9993 or bdavis@curranintl.com

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Inspections Right in Curran's Shop

Shop *baseline* NDE available.

Curran International provides NDE inspection of new fabrication and *in–service* heat exchangers at Curran's shop near Houston, Texas.

When NDE inspection of new fabrication and *in-service* heat exchangers is required by end clients, Curran's inspections meet the baseline assessment for new fabrication. For *in-service* exchangers, tubes are grit blasted clean prior to inspection. Work can be performed prior to a coating application. All work is supervised by a Curran Level III ASNT Specialist.

RFT, ECT, Phased Array and IRIS inspection methods are available.

To learn more about NDE and Curran's inspection capabilities, please contact Ed Deely at Curran International (281) 339-9993 or edeely@curranintl.com

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