2019 Award Nomination

Title of Innovation:

New, High Tg Internal Pipe Coating System

Nominee(s)

Dustin Traylor, MSE- Axalta Coating Systems
Charles Zhou, PhD- Axalta Coating Systems

Category:

Coatings and Linings

Dates of Innovation Development:

from January, 2016 to February, 2018

Web site:

www.axalta.com

Summary Description:

Within the environments currently being explored today by oil and gas operators, higher temperatures and concentrations of H2S, CO2, and other gas contaminates may warrant the use of significantly more expensive metal chrome alloys to avoid corrosion and failure. Coatings are a lower cost alternative that have been used within the industry for years; however, most anti-corrosion coatings cannot perform in environments with high temperatures, pressures, and high levels of gas contaminates. This new fusion bonded epoxy (FBE) coating developed by Dustin Traylor, MSE and Charles Zhou, PhD of Axalta Coating Systems represents a new generation of more functional high Tg systems. The new system is more flexible, has better adhesion, and is easier to apply than current high Tg FBE systems available today.

Full Description:

(Please provide complete answers to the questions below. Graphs, charts, and photos can be inserted to support the answers.)

1. What is the innovation?

The innovation is a new, high Tg fusion bonded epoxy (FBE) powder coating system designed to protect the internal diameter of piping assets in extremely high temperatures with high concentrations of H2S and CO2.

2. How does the innovation work?

The new FBE system is applied similarly to the internal FBE systems currently available. The internal pipe diameter is sandblasted and primed with a liquid phenolic. The pipe is then preheated in an oven and the FBE powder coating is applied by lance or suction system. After FBE application, the coating system must be cured by post-baking.

3. Describe the corrosion problem or technological gap that sparked the development of the innovation? How does the innovation improve upon existing methods/technologies to address this corrosion problem or provide a new solution to bridge the technology gap?

Temperatures above 110 °C (230 °F) start to represent a conflict in selection of protective coating systems for corrosion control because many of the most popular internal pipe FBE coating systems available today have a glass transition temperature (Tg) of around 109 °C (228 °F). When coatings operate at temperatures above their Tg, their molecular structures become more permeable. This allows the ingress of fluids and gas contaminants such as CO2 and H2S into the coating and leads to blistering, swelling, and ultimately, disbondment.

Axalta's new coating system has a Tg of over 180°C. Therefore, penetration of fluids and gasses in most Oil and Gas environments is minimized, extending the life of the coating and protecting the assets for longer.

Another issue with high Tg internal pipe coatings is functionality. High Tg pipe coatings are typically brittle, have lower pull-off adhesion values, and are not flexible. Axalta's new coating system has a much better flow state, allowing for the coating to penetrate into the anchor pattern created when the pipe is sandblasted, improving the adhesion. The new generation resins the new system is formulated with are much more flexible and less brittle than older technology.

4. Has the innovation been tested in the laboratory or in the field? If so, please describe any tests or field demonstrations and the results that support the capability and feasibility of the innovation.

Yes, this innovation has been tested in the laboratory and in the field. When Axalta began research and development work on this new FBE internal pipe coating system, researchers examined many specifications from end-users in order to find the most difficult required autoclave qualification testing to pass. The JO Wafra "Test Condition 4" was agreed upon as the most difficult testing environment. The autoclave test conditions are:

- Temperature: 400±2 °F (205±1 °C)
- Duration: 96 Hours
- Pressure: 755±10 psi
- Gas Phase: 20% (20% H_2S, 15% CO_2, and 65% CH_4)
- Hydrocarbon Phase: 40% (Toluene/Kerosene @ 1:1 by Volume)
- Water Phase: 40% (25% NaCl Solution).

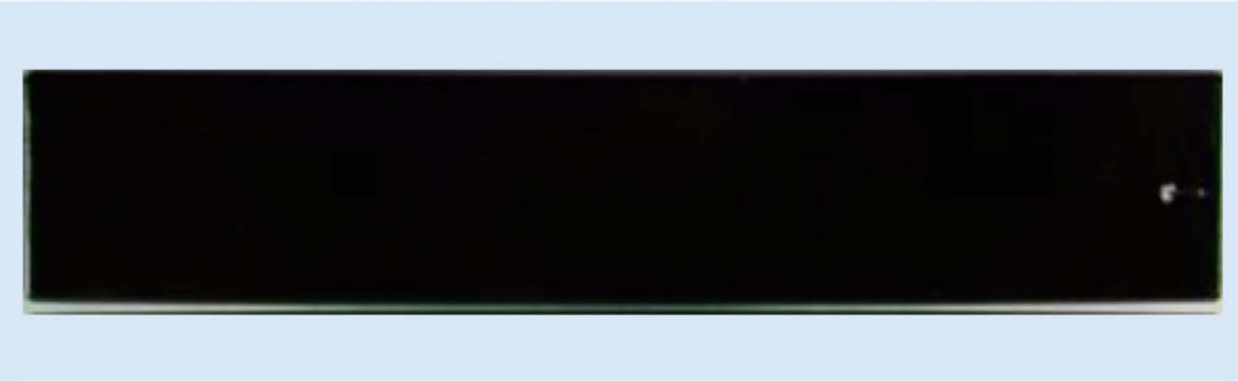
Here is a photo of the results and a comparison with one of the most popular coatings available on the market today.

Coating "C"
Pre-Autoclave Exposure

Coating "C"
Post-Autoclave Exposure

Experimental Axalta Coating System
Pre-Autoclave Exposure

Experimental Axalta Coating System
Post-Autoclave Exposure



As you can see, Axalta's new coating system exhibited excellent resistance to the environment, while the competitive sample disbanded completely.

The new coating system is currently being tested in the Vaca Muerta of Argentina and the Permian Basin of Texas, USA.

5. How can the innovation be incorporated into existing corrosion prevention and control activities and how does it benefit the industry/industries it serves (i.e., does it provide a cost and/or time savings; improve an inspection, testing, or data collection process; help to extend the service life of assets or corrosion-control systems, etc.)?

Most internal FBE pipe coating facilities will be capable of applying this system to oil and gas tubing and casing. There are no special parameters that are required to apply the system.

This innovative coating system will extend the life of expensive steel piping assets by resisting fluid and gas ingress that will lead to coating failure. This will reduce the downtime, tubing pull, and steel replacement costs associated with failure and tubing leakage.

6. Is the innovation commercially available? If yes, how long has it been utilized? If not, what is the next step in making the innovation commercially available? What are the challenges, if any, that may affect further development or use of this innovation and how could they be overcome?

The new coating system has been commercially available for about one year. The FBE system is manufactured at our production facility in Houston, TX, USA.

7. Are there any patents related to this work? If yes, please provide the patent title, number, and inventor.

No patents have been issued at this time.