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North America Pipelines News

Ceramic Coating Aims to Protect Exposed Pipelines

by Del Williams Pipeline & Gas Journal
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A new category of anti-corrosion coating is considered ideal for corrosion protection of oil and natural gas pipelines. Chemically bonded phosphate ceramics (CBPC) can create a passivation layer that stops corrosion while being mechanically protected by a tough ceramic outer layer.

The new category of anti-corrosion coating can create a long-lived passivation layer that stops corrosion. The coatings solve the most serious issues facing pipeline operators and contractors: 1) personal safety, 2) environmental safety, and 3) pipeline integrity. It is further protected by a tough ceramic outer layer. The new CBPC is an excellent insulator because it is a ceramic, so it is a good fit for places, like pipelines, where cathodic protection will also be used.

The Limits Of Traditional Corrosion Protection. For generations, polymer paints have acted as a physical barrier to keep corrosion promoters such as salt water and oxygen away from steel and aluminum substrates. This works until the paint is scratched, chipped, or breached and corrosion promoters enter the gap between the substrate and polymer coating. Then, the coating can act like a greenhouse trapping water, oxygen and other corrosion promoters—allowing corrosion to spread.

Placing sacrificial, reactive elements next to steel that will corrode first, such as zinc and galvanized coatings, is another strategy. This works until the sacrificial elements are used up and recoating must be done, usually after a few years.

Cathodic protection, where a negative voltage is imposed on steel, can limit corrosion on pipelines or other stationary, continuous metal structures where voltage can be attached. But this can fail if it is not properly insulated and the current goes to ground.

For assets that demand long-term corrosion protection, stainless steel alloys work. But with stainless steel costing up to six times more than mild steel, this option is often cost prohibitive.

A New Approach To Corrosion Protection. Ideally, engineers, facility managers, pipeline installers and industrial paint contractors would want the long-term corrosion-resistance of a stainless steel part with the lower cost of coating application. A new category of CBPCs such as EonCoat, for instance, is now basically making this possible.

"Unlike polymer paints that simply cover a substrate, CBPCs essentially 'alloy' the surface," said Tony Collins, CEO of EonCoat.

Dr. Arun Wagh, a former materials engineer at Argonne National Lab, and lead developer of the technologies underlying EonCoat ceramics, explained it like this, "When a dual-component spray gun mixes an acid phosphate with base minerals and metal oxides in a water slurry, a chemical reaction occurs on the surface of the steel substrate."

Dr. Wagh continued, "A hand-held thermometer indicates a 10-12 [degrees]F temperature rise, as iron becomes a corrosion-resistant passivation layer of iron oxy hydroxide. Because the passivation layer is electrochemically stable, like gold and platinum, it does not react with corrosion promoters such as water and oxygen."

Scanning electron microscopy indicates this passivation layer is about 20 microns thick. X-ray diffraction indicates this passivation layer is about 60% iron with components of phosphate, magnesium, silicon, hydrogen and oxygen.

In contrast to typical paint polymer coatings which sit on top of the substrate, EonCoat bonds through a chemical reaction with the substrate, so slight surface oxidation actually improves the reaction. This makes it virtually impossible for corrosion promoters like oxygen and humidity to get behind the coating the way they can with ordinary paints.

The corrosion-resistant passivation layer is further protected by a true ceramic outer shell. This dense ceramic outer shell is impermeable to water and resists impact, abrasion, chemicals and fire. The ceramic outer shell forms simultaneously with the passivation layer and chemically bonds with it, after acid and base materials mix in the spray gun nozzle then react with the substrate surface. The dual-layer ceramic coating can be used both as a primer and a topcoat, and can be applied in a single pass that is dry to the touch in a minute, hard dry in 15 minutes, and can be returned to service in an hour. With the new CBPC EonCoat, it is UV resistant and only requires a one step application.

For pipeline repairs, the manufacturer says joints can be handled easily as well as any places where the pipe has been damaged. Due to its highly abrasion-resistant nature, long runs over rough terrain in inclement weather are no longer a problem. EonCoat, in particular, is very tolerant of surface prep. Prepping long runs of pipe has been problematic in the past, particularly if the environment is humid or wet. These environmental issues no longer pose a problem.

It is important to note that EonCoat is unique in the CBPC world because it contains zero VOCs which means it has no toxic chemicals and is safe to apply in environmentally sensitive areas.

Though CBPCs such as EonCoat have proven themselves in the laboratory and in examples such as the Iron Pillar, Tony Collins of EonCoat knew the effectiveness of the new material had to be compared to that of traditional anti-corrosion coatings.

Corrosion Protection Comparison. Duplicating a NASA corrosion test, which has far reaching implications for any industry where corrosion is a major problem like pipelines, Collins immediately put EonCoat to the test against 19 leading anti-corrosion coatings in a live corrosion test, viewable to the public by webcam.

Coated samples were scribed, then exposed to 12 hours of sea spray, followed by 12 hours of sunlight (or the UV light equivalent). After 45 days, every other high-performance coating tested failed. Except for the rust on its scribe (gouge) line, the EonCoat sample looked the same as day one.

To monitor another ongoing corrosion test modeled on NASA's sea spray test, the public can view, zoom and control a live webcam at [www.eoncoat.com](#). In the latest test, which has passed 120 days and includes brand names matched to numbers, 20 Q panels coated with a popular primer, topcoat, or EonCoat are sprayed daily with corrosive seawater.

"There's nothing like seeing results with your own eyes," said Collins of the ongoing corrosion tests displayed by webcam. "The product has gone more than 10,000 hours with no corrosion in a salt spray ASTM B117 test, but we believe that engineers, facility managers, and industrial contractors will see value in comparing its effectiveness with leading brands. CBPCs like EonCoat are a new approach to corrosion protection that should be looked into as oil and natural gas pipelines need to be safely maintained as long as possible."

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