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Corrosion-resistant coating protects carbon steel structures for decades

A recent application of EonCoat® by the San Diego Water Authority is expected to significantly reduce maintenance costs due to corrosion.

A wet, high-humidity environment can wreak havoc on many aspects of water treatment operations, including the facility and the infrastructure required to collect and distribute water from sources such as aqueducts, reservoirs, lakes, and rivers. It can also negatively impact steel structures and appurtenances such as pumps, piping, pipe supports, and other critical equipment.

Since corrosion can cause leaks or premature failure of equipment, maintenance personnel are often tasked with monitoring, repairing, or re-coating carbon steel items as needed. However, these temporary solutions last a few years at best, and sending maintenance staff out regularly is both impractical and expensive, especially when equipment is scattered in various locations over hundreds of miles.

Fortunately, a new type of coating promises to deliver a more permanent solution for water treatment operations. Unlike traditional coatings, the product bonds best with corroded surfaces to create an alloy barrier that can prevent corrosion for decades. Since it is so effective in bonding corroded surfaces, flash rust is often intentionally allowed to form prior to application. The coating is safe for use with water, according to the National Sanitation Foundation (NSF), but can be applied to rusted equipment while it is in service and is safe for application in underground vaults or other enclosed structures.

Controlling corrosion

According to the NACE International report, "Corrosion Costs and Preventive Strategies in the United States," the total annual direct cost of corrosion for drinking water and sewer systems is US$36 billion, including the costs of replacing aging infrastructure, lost water from unaccounted-for leaks, corrosion inhibitors, internal mortar linings, external coatings, and cathodic protection. An authority on corrosion control solutions, NACE is a nonprofit, international association based in Houston, Texas, United States (US).

In the US, the San Diego County Water Authority, an independent public agency that provides water supply to 24 member agencies serving the San Diego, California, region's 3.3 million residents, sought to improve its anti-corrosion maintenance program. The agency owns and operates extensive infrastructure including nearly 500 kilometers of pipeline and 3,000 mechanical units that move the water through the pipeline system.

Much of the Water Authority's aqueduct system relies on the use of carbon steel appurtenances in underground vaults, which are often subjected to high levels of moisture and, at times, submersion in standing water. The agency spends significant resources each year attempting to prevent these steel assets from corroding. To address these issues, the Water Authority turned to EonCoat®, a spray-applied inorganic primer from the Raleigh, North Carolina-based company of the same name. The primer is a Chemically Bonded Phosphate Ceramic (CBPC), one of the first of a new category of coatings designed to stop corrosion, ease application, and reduce downtime.

In contrast to traditional polymer and zinc coatings that sit on top of the steel substrate, the corrosion-resistant CBPC primer bonds through a chemical reaction with the substrate, and slight surface oxidation actually improves the reaction. When applied to carbon steel, an alloy of stable oxides is formed that will no longer react with the environment and will protect the steel from corrosion. This corrosion barrier is covered by a ceramic layer that resists corrosion, water, abrasion, impact, chemicals, fire, and temperatures up to approximately 200°C. The double layer of protection – the alloy layer and the ceramic layer - makes it impossible for corrosion promoters such as oxygen and humidity to get beneath the coating.

The spray-applied inorganic primer, EonCoat®, is a Chemically Bonded Phosphate Ceramic (CBPC), a new category of coatings designed to stop corrosion.

"We pride ourselves on being ahead of the curve for all types of technology…includ[ing] the ever-changing coating industry," says Daryl Akioka, the Water Authority's project manager for the coating application. "Although most of our assets are underground, it has been a challenge to get proper protection for our above-ground appurtenances too. We are hopeful that EonCoat can supply a solution to aggressive maintenance schedules and annual recoating of problematic appurtenances.

In the Water Authority project, the agency used a planned outage on part of its aqueduct system to apply the CBPC primer to seven carbon steel mechanical appurtenances, including a blow off of approximately 305 millimeters (mm), a 914-mm turnout pipe elbow, two 203-mm pump wells, and three 254-mm air release valve assemblies. The appurtenances were removed from their below-grade vaults and transported to a blasting and coatings facility, where they were degreased and blasted to a NACE 3 / SSPC-SP 6 level and allowed to flash rust. With traditional industrial coatings, a more labor-intensive, time-consuming, near-white metal blast cleaning (NACE 2 / SSPC-SP 10) is typically required to prepare the surface.

EonCoat, which previously achieved NSF certification and won the NACE 2015 Corrosion Innovation of the Year Award in the coatings and linings corrosion control category, was then spray-applied at a coating thickness of 20 to 25 mm. Typically, a topcoat can be applied within 1 hour of applying the CBPC primer due to its rapid drying and curing time. Because it rained during several days of the project, resulting in high humidity in the spray area, the primer was allowed to cure for twice the time – 2 hours – before the topcoat was applied. In contrast, the cure time can be days between coats for standard three-part coating systems, depending on the product. The equipment was then transported back to the underground vault, reinstalled nd successfully returned to service by the Water Authority.

Application of the CBPC primer is now being considered for a number of carbon steel in-service structures by various water authorities around the country. Since the CBPC primer is inorganic and non-toxic, there are no volatile organic compounds (VOCs), no hazardous air pollutants (HAPs), and no odor involved. In effect, the water soluble, non-flammable primer can be safely applied in vaults and other confined spaces. Although CBPC coatings are relatively new in municipal water applications, their use will only grow as word spreads about how they can inhibit carbon steel corrosion for decades as well as reduce premature maintenance and appurtenance replacement.