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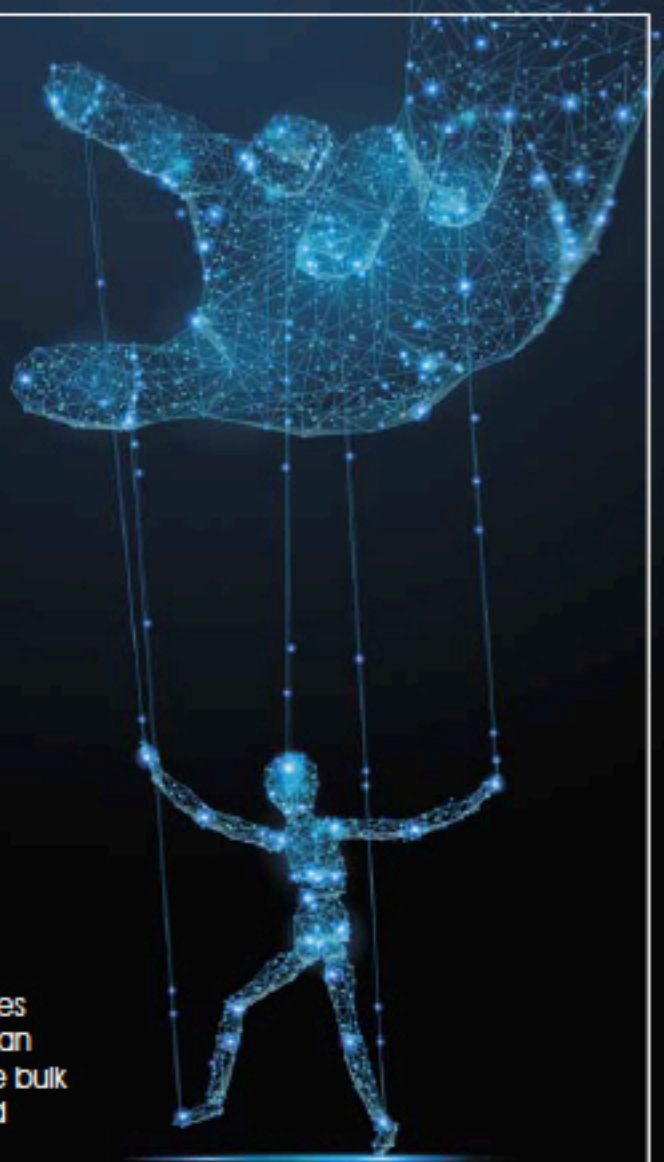
UNDER CONTROL



Del Williams, EonCoat, USA, outlines how a new anti-corrosion coating can help mines, quarries and aggregate bulk processing sites avoid corrosion and wear on their steel hoppers.

In mines, quarries and aggregate bulk processing, the large steel hoppers that are used to store and dispense vast volumes of ore, rock and gravel are often subject to abrasion, moisture and salt deposits, which can all accelerate corrosion.

Once corrosion starts, often through a breach in traditional barrier-type coatings (such as epoxies or polyurethanes), the coating acts like a greenhouse, trapping water, oxygen and other corrosion promoters. This allows the corrosion to spread quickly under the coating itself, which is difficult to inspect, and can lead to failure and costly, premature replacement. For these reasons, such coatings are typically reapplied at a sizeable cost in downtime, surface preparation and coating application.

Fortunately, there is a new type of coating that offers extended corrosion and abrasion protection, while providing rapid turnaround with minimal surface preparation. Unlike traditional coatings, the product bonds best with corroded surfaces – so much so that flash rust is often intentionally allowed to form before application – to create an alloy barrier that can prevent corrosion for decades. The coating can be applied to equipment with pitting and is safe for application in enclosed or confined areas.

Controlling corrosion and wear

One of the world's largest underground mines, located in Sweden, wanted to extend the life of one of its large iron ore process hoppers, where corrosion to its lower steel cone was noted during an inspection. The hopper is vital to the mine, since it stores and dispenses thousands of tonnes of processed iron ore granules every week.

The hopper corrosion resulted from a very corrosive, moist, salty service environment. The hopper stores and processes iron ore, accompanied by large amounts of natural salts, mined from deep underground. These salts act as a very effective electrolyte, a key ingredient in the corrosion of

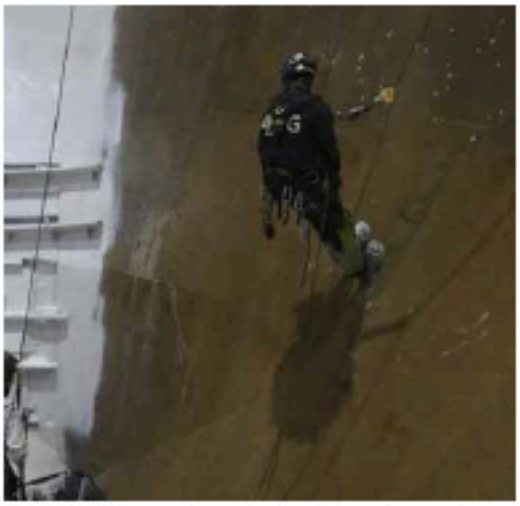


Figure 1. Innovative coating prevents corrosion of steel hoppers and other mining equipment.

steel. Condensation from varying temperatures throughout the year is also present, contributing to corrosion.

Meeting the challenge

To address these issues, the mine turned to SPI Performance Coatings, a European distributor, and EonCoat®, a spray applied to form an inorganic coating, from the North Carolina-based company of the same name. The coating is actually 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 coating bonds through a chemical reaction with the substrate. 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," said Merrick Alpert, President of EonCoat. "This corrosion barrier is covered by a ceramic layer that resists corrosion, abrasion, water, impact, chemicals, fire and temperatures up to 200˚F (93˚C) with a topcoat."

A high temperature version also provides protection up to 1022˚F (550˚C).

As a true ceramic coating, it is many times more abrasion resistant than traditional epoxy coatings. Like most ceramics, it provides a very hard surface that does not wear or scratch easily. Abrasion tests conducted on a Taber machine, using an abrasive wheel rotating against a coated panel show that the number of cycles to get 0.001 in. wear for most polymer paints is about 75 cycles, and for an ordinary epoxy it is about 125 - 250 cycles. To get the same amount of wear in EonCoat it takes >1200 cycles.

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.

In fact, there is actually a third form of corrosion protection provided as well.

"If the ceramic shell and alloy layer is ever breached, the ceramic shell acts as a reservoir of phosphate to continually realloy the steel," explained Alpert. "This 'self heals' the breach, depending on its size, and stops the corrosion if necessary. This capability, along with the coating's other properties, enables effective corrosion protection for the life of in-service structures with a single application."

Because of the dual layer of corrosion protection and unique self-healing capability of the alloy layer, the coating is expected to last a minimum of 30 years and carries a 30 year warranty.

The CBPC coating's approach to corrosion protection has undergone years of extensive third party laboratory and field testing in a range of demanding industries.

As proven by NASA's beachside corrosion test results, the EonCoat coating – on a standalone basis – has outperformed the paint industry's leading anti-corrosive systems, which used both primer and topcoat.

In other testing, the anti-corrosion coating remained unaffected after thousands of hours in a salt fog chamber. Cyclic polarisation test data also show that the primer's protection is consistent with that delivered by premium alloys, such as Hastelloy.

Tackling the corrosion

To protect the steel hopper from corrosion, however, before applying the CBPC coating, many years of iron ore deposits first had to be removed using mechanical hand tools, as some deposits were a few inches thick in places. This work had to be done far above the ground, hanging from ropes, adding complexity to the project.

Abrasive blasting was then done to remove the remaining ore and surface corrosion. Since the steel hopper had never been painted and there was no visible mill scale, a commercial surface preparation standard of (NACE 3 / SSPC-SP 6 / SA2) was acceptable.

One of the benefits of the CBPC coating, in fact, is a simplified surface preparation requirement, along with quick return to service that minimises facility downtime. The time saved on an anti-corrosion coating project with the ceramic coating comes from easier surface preparation and expedited curing time.

With a typical industrial coating, near white metal blast cleaning (NACE 2 / SSPC-SP 10 / SA2.5) is required to prepare the surface. But with the ceramic coating, only a commercial blast cleaning (NACE 3 / SSPC-SP 6 / SA2) is typically necessary.

A topcoat, if desired, can typically be applied within one hour of applying the CBPC primer due to its rapid drying and curing time. This rapid return to service with mining assets, such as ore process hoppers, saves thousands of dollars per day in production downtime.

In contrast, for corrosion protection projects using typical polymer paints, such as epoxies or polyurethanes, the cure time may be days or weeks before the next coat of traditional 'three part systems' can be applied, depending on the product and application conditions. The cure time is necessary to allow each coat to achieve its full properties, even though it may feel dry to the touch.

In the mining project, when blasting was complete on the hopper, the lower section was washed with potable water to

remove blasting debris deep within the surface profile. Since salt water accelerates corrosion, the high levels of salts present became apparent shortly after the washing process, as the steel hopper quickly began to flash rust minutes afterward.

In fact, heavy surface pitting of the steel due to corrosion was also noted, so much that a surface profile gauge was not able to take any accurate readings. In some areas, this was in excess of 5 mm.

However, unlike more conventional coating systems, none of this was a problem for the anti-corrosion application.

With traditional coatings, extensive surface preparation is required and carried out a little at a time to avoid surface oxidation, commonly known as 'flash rust', which can require re-blasting.

In contrast, with the CBPC coating there is no worry about surface prep. The entire surface can be blasted, then coated without concern over losing an acceptable blast. The coating can be applied when it is wet or humid, and surface oxidation assists in the formation of the alloy layer.

When the tank had dried sufficiently, EonCoat was applied directly to the steel surface without any further surface preparation.

The anti-corrosion coating was applied to the lower section of the steel hopper in a single coat at a thickness of 800 µm (0.8 mm) over an eight hour shift. The coating consists of two non-hazardous components that do not interact until applied by a standard industrial plural spray system, such as those commonly used to apply polyurethane foam or polyurea coatings.

The next morning the entire area was pressure washed (3500 psi) to determine whether the application was successful.

Unlike traditional coating systems that can hide future problems, the CBPC coating will simply wash off if it has not fully reacted with the substrate, allowing an applicator to touch up any problem areas before returning a steel structure to service.

Over the whole area applied (4090 ft^2/380 m^2), only three small areas (less than 3 ft^2/0.28 m^2 total) were recoated using a small cartridge gun.

Due to the success of the project under tight time restrictions, the anti-corrosion coating has been approved for further projects throughout the mine. Since the coating is inorganic and non-toxic, there are no volatile organic compounds, no hazardous air pollutants and no odour involved. This means the water soluble, non-flammable coating can be safely applied underground and in other confined spaces.

Although CBPC coatings are relatively new in mines, quarries, and aggregate processing applications, over time their use will grow as more users discover how the coatings can inhibit carbon steel asset corrosion and wear for decades, as well as reduce premature maintenance, downtime and replacement. GMR