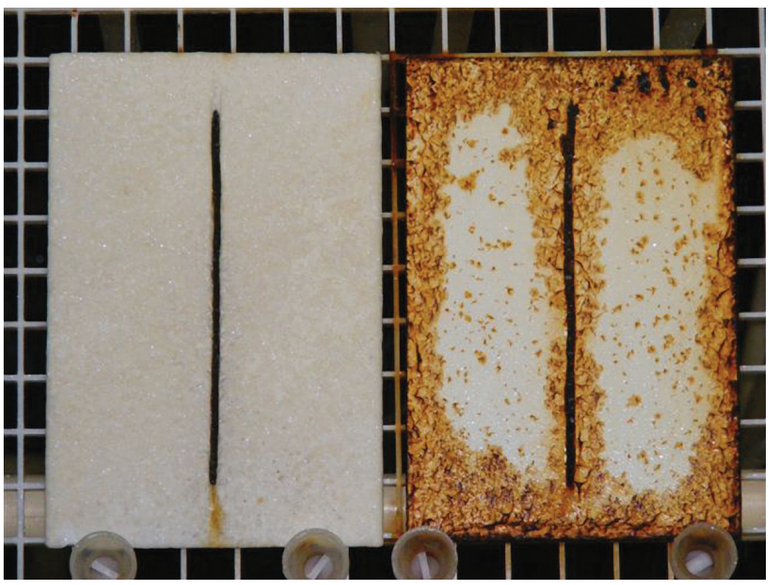
The best thing next to steel

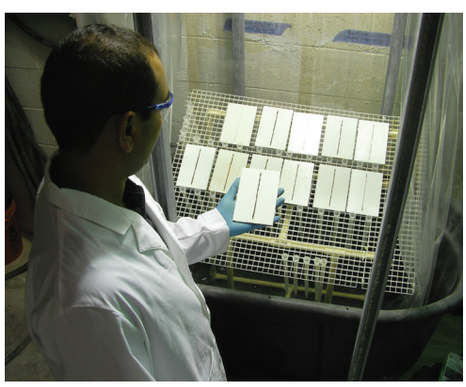


A CHEMICALLY BONDED PHOSPHATE CERAMIC CAN STOP HULL AND TANK CORROSION IN ITS TRACKS

The corrosion of steel, aluminum, and other structural metals erodes the safety and financial stability of a number of industries, perhaps none more so than the maritime industries.

But while traditional corrosion protection has relied mostly on short-lived physically-bonded coverings of substrate surfaces, a new category of chemically bonded phosphate ceramics (CBPCs) can create a longer lasting 'passivation' layer that stops corrosion. This is further protected by a tough ceramic outer layer.

For generations, polymer paints have acted as a physical barrier to keep corrosion promoters such as saltwater 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.



Above: Results from corrosion tests after 45 days

Right: Scientists checking the rate of corrosion

Placing sacrificial, reactive elements next to steel, such as zinc and galvanized coatings, is another strategy. But this only works until the sacrificial elements are used up and recoating must be done, usually after a few years. And while cathodic protection, whereby a negative voltage is imposed on steel, can limit corrosion, this can fail if it's not properly insulated and voltage 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.

Ideally, shipowners/managers 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 making this possible. According to the developed, these CBPCs 'essentially alloy the surface'.

Dr Arun Wagh, a former materials engineer at Argonne National Lab, and lead developer of the technologies underlying the EonCoat coating system's ceramics, explains 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.

'A hand-held thermometer indicates a 10-12°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 20mm thick. X-ray diffraction indicates this passivation layer is about 60% iron with components of phosphate, magnesium, silicon, hydrogen, and oxygen.

'History suggests that EonCoat's passivation layer may resist corrosion indefinitely, as demonstrated by the Iron Pillar of Delhi,' says Wagh.

The Iron Pillar, a 7m high, 6t artifact that has resisted corrosion for 1600 years with its original inscriptions still legible, has a virtually identical passivation layer to that of EonCoat.

In contrast to typical polymers used in 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, says the company, 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 dense ceramic outer shell. This is impermeable to water, and resists impact, abrasion, chemicals, and fire. It 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's dry to the touch in a minute, hard dry in 15 minutes, and can be returned to service in an hour.

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

Duplicating a NASA corrosion test, EonCoat was put to the test against 19 leading anti-corrosion coatings in a live corrosion test. Coated samples were scribed, then exposed to 12h of sea spray, followed by 12h of sunlight (or the UV light equivalent). After 45 days, every other high-performance coating tested failed. Except for the rust on its scribe line, the EonCoat sample looked the same as day one, claims the US-based manufacturer.

In the latest test, which has passed 120 days and includes brand names matched to numbers, 20 panels coated with a popular primer, topcoat, or EonCoat are sprayed daily with corrosive seawater. The product has now gone more than 10 000h with no corrosion in a salt spray ASTM B117 test, but the company believes that engineers, facility managers, and industrial contractors will see value in comparing its effectiveness with leading brands.

According to EonCoat CEO Tony Collins, CBPCs are a new approach to corrosion protection that should be looked into as aging plants, equipment, and infrastructure need to be safely maintained as long as possible.

He believes that the corrosion-preventing coating has immense potential in the merchant shipping industry and the company is now testing the coating on a 17 000ft²-capacity dry bulk carrying barge, on all internal and external surfaces, from the keel to the funnel. It's the next best thing that you can put next to steel, he says. SWaS

New Jotamastic for greater corrosion resistance

Jotun has improved its established Jotamastic range of anti-corrosion coatings wtih Jotamastic 90, a step change says the Norwegian coatings company in high-tech surface tolerant coating solutions.

Launched earlier this month in Rio de Janeiro, Brazil, the new generation Jotamastic 90 is being cited as 'one of the most technologically advanced surface tolerant repair and maintenance primers on the market.

The main features of this highly durable coating are its exceptional corrosion resistance, shorter overcoating intervals, wider top coat compatibility and increased colour flexibility using Jotun's Multi Colour Industry (MCI) tinting system.

'The new Jotamastic 90 utilises modern technology and materials providing excellent wetting properties, ensuring even better surface penetration and adhesion to the substrate and resulting in a durable solution,' says Lasse Isaksen, product manager, anti-corrosives.

Jotamastic 90 has good corrosion resistance and is suitable for the most severe environments. It has reduced drying time by up to 40% compared to existing products, thus reducing downtime and over-coating intervals. Compatible with most topcoats, including polysiloxanes and two-component acrylics, Jotamastic 90 is claimed to have improved wetting and penetrating abilities to provide a better inter-coat adhesion.

According to Isaksen the new range offers great potential for savings through lower surface preparation costs. 'It is one of the market's most durable solutions compared with other surface tolerant epoxies,' he says.

He adds: 'Investing in the right coating system today will yield future returns. The achievements will be lower maintenance costs, longer lifetime and better protection of your property'

Jotun's Jotamastic range was first launched in 1987 and has since protected more than 1.2 billion square metres of steel. SWaS

Europa II opts for cathodic protection

Hapag Lloyd Cruises and offshore specialist Polarcus have both opted to use Cathelco's hull corrosion protection system for vessels currently under construction in France and Norway. Both contracts were signed in August.

The UK-based cathodic protection systems supplier will supply equipment hull corrosion protection and marine pipework anti-fouling systems for two new Ulstein X-Bow vessels which are being built for Polarcus, the marine geophysical company, by Ulstein Verft AS of Norway.

This contract followed the successful installation of similar equipment to the *Polarcus Asima* and *Polarcus Alima* which were launched in 2010.

The 200 amp systems the company will supply will consist of four elliptical anodes mounted port and starboard and two reference electrodes connected to a control panel.

In operation, the reference electrodes measure the electrical potential at the hull/seawater interface and send a signal to the control panel which raises or lowers the anode output to provide the optimum level of corrosion protection at all times.

An artist's impression of *Europa II*

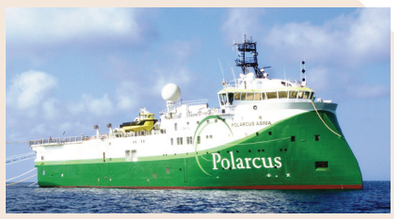
In addition, the vessels will be supplied with shaft earthing systems which protect against 'spark erosion' to the bearings and potential damage to the propellers.

Cathelco are also supplying marine pipework anti-fouling systems for the two new vessels which will protect four seachests on each against blockages caused by mussels and barnacles.

These will be fitted with copper and ferrous anodes which are wired to a control panel. In operation, the copper anodes produce ions which are carried through the seawater pipework system and create an environment where mussels and barnacles do not settle or breed. At the same time, the ferrous anodes produce ions which help to maintain a protective oxide layer on the internal surfaces of the cupro-nickel pipework to suppress corrosion.

A similar scope of supply will be delivered to the STX shipyard at St Nazaire, France, for installation to *Europa II*, the 225m long cruiseship Hapag Lloyd Cruise will take delivery of in 2013.

In total, a 350 amp system will be installed. The 150 amp system forward will consist of two 75 amp elliptical anodes and two reference electrodes connected to a control panel. The 200 amp aft system which will protect the stern of the ship and the more vulnerable area around the propellers will consist of two 100 amp anodes and two reference electrodes.



Polarcus has opted to use Cathelco's hull corrosion protection system for vessels under construction in Norway

In operation, the reference electrodes measure the electrical potential at the hull/seawater interface and send a reading to the thyristor control panel which automatically raises or lowers the output to the anodes. In this way, the hull receives the optimum level of corrosion protection at all times.

The cruiseship will also be equipped with seawater pipework anti-fouling systems to protect a total of six seachests. Two will be installed with three copper anodes and one aluminium anode wired to control panels. Four others with smaller flow rates are protected with pairs of copper and aluminium anodes.