A Brief History of Cathodic Protection for Ships

As long ago as 1824 Sir Humphry Davy was consulted by the British Admiralty who were concerned about "the rapid decay of the copper sheeting of His Majesty, ships of war and the uncertainty of the time of its duration". Davy proposed the attachment of a small piece of zinc to nullify electrochemical action on the copper sheathing, while he also investigated an impressed current system, but reliable batteries had not then been developed. It was not until 1956 that the United States Navy seriously began to experiment with platinum-clad titanium anodes for the protection of their ships and submarines. A great deal of development work had to be undertaken by those concerned in the design and construction of cathodic protection systems, and in more recent years niobium has replaced titanium as the substrate metal, but today this invaluable means of avoiding corrosion is an established technique on many types of ships and steel structures, including off-shore oil rigs - themselves undreamt of thirty years ago.

Paint That Stops Rust - Completely

Traditionally, paint has provided the most economical method for protecting steel against corrosion. However, paint cannot prevent a car from rusting indefinitely. Eventually, flaws develop in the paint that allow the ravages of rusting to take place.

The situation may soon change. Chemists have developed a paint called Rustmaster Pro that worked so well to prevent rusting in its initial tests that the scientists did not believe their results. Steel coated with the new paint showed no signs of rusting after an astonishing 10,000 hours of exposure in a salt spray chamber at 38°C.

Rustmaster is a water-based polymer formulation that prevents corrosion in two different ways. First, the polymer layer that cures in air forms a barrier to both oxygen and water vapour. Second, the chemicals in the coating react with the steel surface to produce an interlayer between the metal and the polymer coating. This interlayer is a complex mineral called pyroaurite that contains ions of the form \([\text{M}_1\text{Z}_x(\text{OH})_2]^{x+}\), where M is a 2+ ion (Mg\(^{2+}\), Fe\(^{2+}\), Zn\(^{2+}\), Co\(^{2+}\), or Ni\(^{2+}\)), Z is a 3+ ion (Al\(^{3+}\), Fe\(^{3+}\), Mn\(^{3+}\), Co\(^{3+}\) or Ni\(^{3+}\)) and x is a number between 0 and 1. The anions in pyroaurite are typically CO\(_3^{2-}\), Cl\(^-\) and/or SO\(_4^{2-}\).

This pyroaurite interlayer is the real secret of the paint’s effectiveness. Because the corrosion of steel has an electrochemical mechanism, motion of ions must be possible between the cathodic and anodic areas on the surface of the steel for rusting to occur. However, the pyroaurite interlayer grows into the neighbouring polymer layer, thus preventing this crucial movement of ions. In effect, this layer prevents corrosion in the same way that removing the salt bridge prevents current from flowing in a galvanic cell.

In addition to having an extraordinary corrosion-fighting ability, Rustmaster yields an unusually small quantity of volatile solvents as it dries. A typical paint can produce from 1 to 5 kg of volatiles per gallon; Rustmaster produces only 0.05 kg. This paint may signal a new era in corrosion prevention.