Treatment Of Rusted Surfaces

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It is generally accepted that, for maximum protection, paints must be applied to surfaces which are entirely free from rust and other contamination. This is especially true of modern high performance coatings such as epoxies, inorganic zinc silicates, etc where abrasive blasting to a high standard is usually mandatory. There are, however, situations where it is not possible to completely remove all rust from the surface for design, economic, safety or other reasons. There has therefore been much research into treatments for rusted surfaces to avoid the need for such critical surface preparation. A large number of products have appeared on the market for such purposes although it is generally agreed that the protection achieved is nowhere near that attained if a rust-free surface is used. However, there is certainly a market for such products, especially in the consumer, or DIY market.

These can be arbitrarily divided into five categories:

1. Some of the products simply bind the rust particles together and to the steel surface, forming a barrier between the metal surface and the environment. There is no reaction between the rust or the metal substrate and the coating. Examples of this are penetrating primers such as PENETROL (OWATROL in other countries), ISOTROL and fish oils. Most of these are penetrating drying coatings (linseed oils or alkyds) and they may be overcoated for appearance or additional protection.

2. A second type, such as CORROLESS primers, contain a pigment which is claimed to convert rust into a more stable chemical compound (magnetite). These compounds also contain a conventional paint resin. They are usually overcoated with a top coat.

3. A third type are aqueous solutions of phosphoric or tannic acid or other tannin product, often in conjunction with wetting agents, surfactants, catalysts, etc. They are usually, but not always, water-based. Treatments are usually followed by a conventional primer and top coat. Some brand names which have appeared or are currently on the market include FERTAN RUST CONVERTER, GALMET IRONIZE and KILLRUST RUST-EETER.

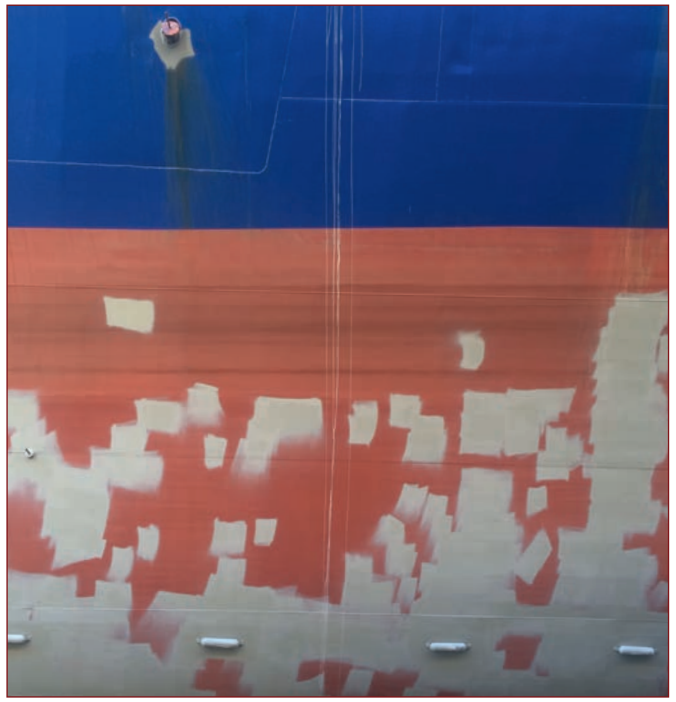
4. A fourth kind is similar to type 3 in that it is based on the tannin products but also incorporates a latex emulsion compatible with the acidic tannin product. As well as providing the same form of protection as type 3 above, the presence of a binder means that a polymeric film is also formed so that these products act as a rust pretreatment and a primer. Examples of this type are CORROSEAL, NEUTRA RUST 661 and FERONITE RUSTY METAL PRIMER.

5. Industry will usually use a high solids epoxy coatings, generally called surface tolerant epoxies or epoxy mastics, such as AMERLOCK, JOTAMASTIC 87, Dulux DUREBILD STE and the International INTERPLUS and INTERSEAL range. These are epoxy coatings which have very good wetting and penetrating properties but can also be built up to quite high thicknesses, 300 microns or more. The epoxy resin provides excellent adhesion so they bind the rust particles together and bond it to the substrate. Furthermore, the thick film provides excellent barrier protection.

There are two problems with coatings applied to rusted surfaces. Firstly, the rust particles are not strongly bonded to one another, nor the substrate, so that any coating applied to loose, flaky rust will have poor adherence to the substrate. When moisture penetrates through the coating, the coating will lift and disbond from the surface. All products recommend removal of as much flaky, non-adherent rust as possible to minimise this problem, but those with the best penetrating ability and strongest adherence will perform the best. The second problem is the salts such as chlorides, sulphates, etc., that are contained in the rust. The rust itself, hydrated iron oxides, is generally fairly innocuous chemically, and tends to grow due to the presence of new ferrous ions forming as a result of these salts reacting with moisture and oxygen. The salts aggregate at the bottom of the rust pits, so are generally not removed when the loose rust is removed. They remain under the coating and draw moisture through by osmosis, leading to blistering and coating failure.

Strait Shipping Strait Feronia (Jotamastic).

Roof refurbishment in Auckland (Jotamastic).



Tasport's Korimul Tug refurbishment over spot blasted surface with UHWJ.

The significant variations in rust, both in its adhesion and salt content, make it very difficult to scientifically evaluate the various rust treatments. It is impossible to compare results of one researcher to another because these two factors cannot be standardised. These will influence rates of breakdown far more than the small differences between the products. A poor quality product applied to a surface with almost all rust removed and no salts will show better performance than a better quality product applied to a surface with rust containing significant salts. A further problem arises because accelerated testing using salt spray is usually carried out. A salt spray solution on the surface of a coating placed over rust containing salts actually provides a *lower* osmotic pressure, therefore a slower rate of breakdown, than fresh water. Coatings over rusty surfaces should never be evaluated by salt spray or similar accelerated testing. Such tests may, in fact give results that are inversely proportional to life in actual exposure.

When all the above variables are considered it can be seen that it is very difficult to assess such products and the claims from manufacturers. As a result, while significant research has been carried out into their mechanism of protection, little work has been published on actual protection achieved by such products. DesLauriers (*Materials Performance*, Nov 1987, p35) did compare some tannin-based products and found poor performance. Generally speaking, those products based on soluble materials such as phosphoric and tannic acid (Types 2, 3 and 4 above) appear to provide least protection, probably because they are adding to the soluble content of the coating, leading to osmotic blistering. The inert materials (Type 1) probably provide superior protection to these, but the limited film build means that oxygen and moisture will penetrate fairly quickly, leading to eventual breakdown. The most successful treatments are the epoxy mastic type materials (Type 5) which have superior penetrating ability, adhesion and good film builds to minimise moisture and oxygen penetration. These are the usual treatments recommended in AS/NZS 2312.1 for poorly prepared surfaces.

According to AS/NZS 2312.1:2014, 75 microns of epoxy mastic (system EPM2) should provide 2 to 5 years to first maintenance in a moderate ISO C3 environments, while 200 microns of the same product (system EPM3) would provide 10 to 15 years in same environment and 2 to 5 years in a severe ISO C5 environment. The Standard also has a number of epoxy mastic primer systems, with a decorative topcoat for maintenance where blasting cannot be carried out. As mentioned above, the amount and salt content of the rust are significant factors in determining the life of such coatings and these figures must be considered as only a very rough guide. Any other rust treatment would be expected to provide significantly lower lives than these figures.

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