

46 - WHITE RUST PREVENTION AND TREATMENT

INTRODUCTION

One of the commonly encountered problems with galvanized coatings of all kinds is 'white rust' or 'white storage stain'. It is manifested as a bulky, white, powdery deposit that forms rapidly on the surface of the galvanized coating under certain specific conditions.

White rust can cause considerable damage to the coating and is always detrimental to the galvanized coating's appearance.

The surface of galvanized coatings is almost 100% zinc. It is the durability of the zinc that provides the outstanding anti-corrosion performance for steel, yet zinc is a relatively 'reactive' metal. It is the stable oxides that form on the zinc's surface that determine its durability, and these oxides are formed progressively as the zinc is exposed to the atmosphere. Carbon dioxide in particular is a contributor to the formation of these stable oxides.

With newly galvanized steelwork, the zinc's surface has been subjected to little oxidation and is at its most vulnerable. For this reason, galvanizers use a chromate passivation process in conjunction with their galvanizing operations to provide protection to the galvanized coating during the 'youth' period of the coating. This passivation coating provides short-term protection to the zinc to give the stable oxides time to form on the surface.

WHITE RUST FORMATION

Pure water (H₂O) contains no dissolved salts or minerals and zinc will react quickly with pure water to form zinc hydroxide, a bulky white and relatively unstable oxide of zinc. Where freshly galvanized steel is exposed to pure water (rain, dew or condensation), in an oxygen deficient environment, the water will continue to react with the zinc and progressively consume the coating. The most common condition in which white rust occurs is with galvanized products that are nested together, tightly packed, or when water can penetrate between the items and remain for extended periods.

AVOIDING WHITE RUST FORMATION

There are a number of simple steps that can greatly reduce or eliminate the formation of white rust. These are:

1. Keep the packed work dry
2. Pack the items to permit air circulation between the surfaces
3. Stack the packed items to allow water to drain out
4. Treat the surface with proprietary water repellent or barrier coatings to prevent moisture contact with galvanized surface.

TREATING GALVANIZED SURFACES AFFECTED BY WHITE RUST

Once the galvanized surface has been attacked and the zinc hydroxide compounds have formed, it is desirable to remove the oxide products from the surface because:

- a. their presence inhibits the formation of stable carbonate based oxides
- b. they are unsightly

The effect on the galvanized coating can range from very minor to extremely severe and various levels of remedial treatment are available to deal with white rust problems at the levels at which they are likely to occur.

The following treatments are recommended to deal with white rust on galvanized products.

1. Light white rusting.

This is characterised by the formation of a light film of white powdery residue and frequently occurs

on freshly galvanized products during periods of heavy rain. It is particularly evident on areas that have been buffed or filed during quality assurance operations. These treatments remove the passivated surface from the galvanizing and expose unoxidised zinc to attack from rainwater. Provided the items are well ventilated and well drained, white rust rarely progresses past this superficial stage. It can be brushed off if required but will generally wash off in service with normal weathering. No remedial treatment is generally required at this level.

2. Moderate white rusting.

This is characterised by a noticeable darkening and apparent etching of the galvanized coating under the affected area, with the white rust formation appearing bulky. The galvanized coating thickness should be checked to determine the extent of attack on the coating. In the majority of cases, less than 5% of the galvanized coating will have been removed and thus no remedial work should be required, as long as the appearance of the affected area is not detrimental to the use of the product and the zinc hydroxide residues are removed by wire brushing. If appearance is unacceptable, the white rust affected area can be treated as follows:

- a. Wire brush the affected area to remove all white corrosion products
- b. Using a cloth pad wet with aluminium paint, rub the surface with the pad to apply a thin film of aluminium paint to the affected area to blend it with the adjacent unaffected galvanized surfaces.

3. Severe white rusting.

This is characterised by very heavy oxide deposits. Items may be stuck together. Areas under the oxidised area may be almost black or show signs of red rust. A coating thickness check will determine the extent to which the galvanized coating has been damaged. Remedial treatment to reinstate the coating should be undertaken as follows:

- a. Wire brush or buff the affected area to remove all oxidation products and rust if any.
- b. Apply one or two coats of approved epoxy zinc-rich paint to achieve required dry film thickness of 100 microns minimum.

CHEMICAL REMOVAL OF WHITE RUST

Zinc hydroxide dissolves readily in weak acidic solutions. A research project was undertaken by the American Galvanizers Association in 2007 to evaluate white rust removal methods. A number of commercially available cleaning products were evaluated, along with generic solutions. Because the tests were done in the USA, a number of these products may not be available locally.

Of the generic products that can be used to successfully remove white rust deposits from galvanized steel, white vinegar was found to be very effective and environmentally benign. Application can be done with a nylon brush (a dishwashing brush can be used) and any residues can be rinsed off with clean water after treatment.

A commercial product that is also available in Australia, that was also found to be effective, is CLR Clear, which has been widely advertised as a scale and stain removal product. Its application is similar to that of white vinegar, although the manufacturer's safety recommendations should be adhered to in the use and disposal of the products.

RE-PASSIVATING THE GALVANIZED SURFACE

Where white rusting has occurred and the item may be subject to continuing exposure that may propagate similar corrosion, re-passivating of the surface can be done by treating the surface with a

solution of 5% sodium dichromate, 0.1% sulfuric acid, brushing with a stiff wire brush for 30 seconds before thorough rinsing of the surface.

CONCLUSION

White rust is a post-galvanizing phenomenon. Responsibility for its prevention lies in the manner it is packed, handled and stored prior to the galvanized product's installation and use. The presence of white rust is not a reflection on the galvanized coating's performance, but rather the responsibility of all those involved in the supply chain to ensure that the causes of white rust are recognised and the risks of its occurrence minimised on newly galvanized steel.



Light white rust formed inside large diameter galvanized pipes caused by prolonged period of wetness after galvanizing and slow drying of the shaded sections of the pipes.



Severe white rust on a galvanized section of guard rail as a result of rails being tightly nested and stored in wet conditions





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01 - SPECIFIERS MANUAL – THIRD EDITION

Industrial Galvanizers Australian Galvanizing Division (IGAG) operates nine galvanizing plants around Australia, ranging in size from large structural galvanizing facilities to specialised small plants designed to process small parts.

The Australian Galvanizing Division has galvanized in excess of 2 million tonnes of steel products in Australia since its first plant was commissioned in 1965 and is recognized for its ability to handle complex and difficult projects, as well as routine contracts.

This experience has been collated in the Specifiers Design Manual, to assist those involved in the design of steel products and projects to better understanding the galvanizing process and allow the most durable and cost-effective solutions to be delivered to these products and projects. All sections of this Third Edition have been completely updated and additional sections have been included to provide additional technical information related to the use of hot dip galvanized steel.

In addition to its Australian Galvanizing operations, Industrial Galvanizers Corporation has a network of manufacturing operations in Australia, as well as galvanizing and manufacturing businesses throughout Asia and in the USA.

The company's staff in all these locations will be pleased to assist with advice on design and performance of hot dip galvanized coatings and products. Contact details for each of these locations are located elsewhere in this manual.

This edition of the Industrial Galvanizers Specifiers Manual has been produced in both html and .pdf formats for ease of access and distribution and all documents in the Manual are in .pdf format and can be printed if paper documents are required.

The Specifiers Manual is also accessible in its entirety on the company's web site at www.ingal.com.au.

Additional copies of the Specifiers Manual are available on CD on request.

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