

How to Prevent White Rust on Zinc Coated Steel Products

What is White Rust?

White rust is a white powdery deposit formed from a natural corrosion process that can occur on any new zinc coated steel product.

It is damaging to the appearance of the steel, not to mention to the anti-corrosion layer of zinc that protects the body of the steel.

Zinc is a very durable coating for the purposes of providing sacrificial protection to the underlying steel substrate but, because it is reactive to water, great care must be taken in storing it correctly. That is why it is often referred to as “wet storage stain.”



Picture 1. Close-up photo of white rust

The white powder is actually zinc hydroxide— the substance formed when zinc reacts with water and air - and it gradually consumes the zinc coating; this process is most likely to happen in wet conditions with inadequate air circulation.

There is an interesting case study at the end of this report highlighting the problems that can occur.

Conditions Determining White Rust Formation

There are several key factors that determine the speed of the white rust formation process:

- Storage method
- Storage place
- Air circulation
- Climate

Storage Method

The white rust problem is often exacerbated when packs of tube and pipe are stored flat, one on top of the other or “nested”.

Storage Place

Storing the steel outdoors, exposed to moisture and the other elements will always increase the likelihood of white rust formation.

Air Circulation

If the packs of steel are strapped together, this restricts air flow around the product, reducing the chance for moisture to evaporate and increasing the chances of corrosion.

Climate

In areas of high rainfall, like tropical and many sub-tropical areas, moisture can get trapped between individual surfaces and wet storage stain can result.

Also, when zinc coated steel is exposed to the atmosphere with alternate wet and dry conditions, its surface will dull with time, as the “normal” corrosion mechanism of zinc produces a zinc carbonate layer.

Care and Storage Recommendations for Zinc-Coated Steel Product

To maintain the aesthetic appearance of zinc coated steel, barrier protection coatings such as paint or powder coating are required. This will help prevent the “normal” corrosion that can affect the product.

In terms of white rust specifically, end users need to take precautions when receiving the product and then when storing it, addressing each of the conditions that cause it, as outlined above.

Firstly, when it is delivered make sure any zinc-coated product is in a dry condition and free of white rust. Deliveries should be rejected if inspection reveals signs of wet storage stain or if packs are wet or moist with condensation.

When making arrangements for storage of your product consider the following factors:

- Packs of zinc coated steel should be stored undercover promptly, to ensure that they are not exposed to unnecessary moisture.
- They should be stored away from open doors, windows or louvres to avoid exposure to moisture-laden air, salt contamination and condensation.
- It is important to maintain cleanliness and control the pH, corrosion and bactericide inhibition levels in water-based cutting fluid systems used to cut packs of zinc coated steel tubulars. Residual fluids and swarf left inside the pack will result in accelerated corrosion.

If the packs are kept in a dry place then the zinc corrosion rate will be very slow; the best location is inside and away from the elements completely. If the product becomes wet, white rust may result from the reaction of zinc, moisture and oxygen.

If products are exposed to water, the easiest way to avoid corrosion is to ensure that they can dry out. Wet packs must therefore be separated as soon as possible into individual lengths, to allow all surfaces to dry out thoroughly.

If there is no alternative but to store packs outside, with minimal protection from the elements, then it is essential that the pack be broken open and individual lengths stacked with plastic dividers between each layer, as shown in the diagram below:

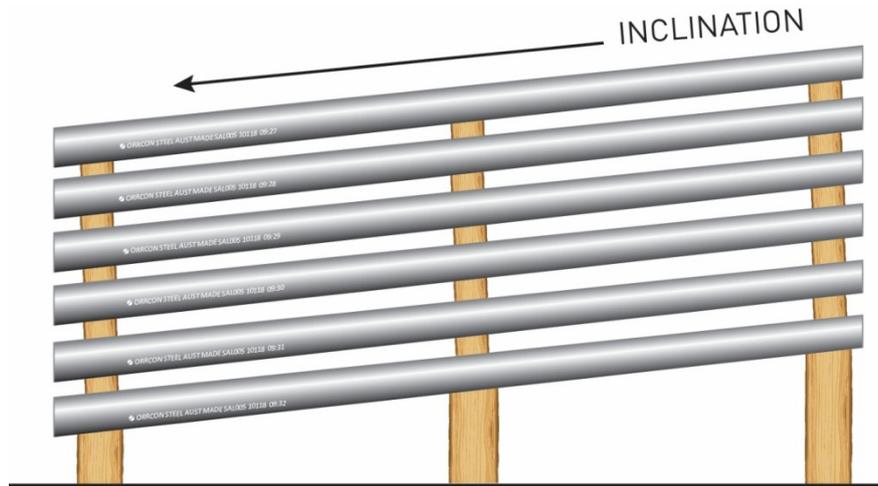


Figure 1. Recommended method for external storage of zinc coated product

To help prevent wet storage stain from occurring on zinc coated surfaces, the product should be stored at an incline of 5mm for every 1m length. This ensures that water drains freely from exposed surfaces. Straps should be cut and spacers inserted between each layer to eliminate entrapment of moisture between contacting surfaces.

The corrosion rate of zinc coated steel stored outside, as per the above diagram, will be marginally higher than if the tube was stored inside, but not as fast as if the product is stored in pack form and stacked in a pile outside.

Bear the following additional recommendations in mind when deciding how to store your products:

- Product stored outside should be provided with cover for protection from the rain; a low-cost under-roof shelter (i.e. roof and no walls) offers increased protection from moisture and increases the longevity of the zinc coating.
- Use of a tarpaulin is not advised as this will trap moisture and condensation and exacerbate the formation of the white storage stains.
- Surfaces can be treated with proprietary water repellent or barrier coatings which prevent contact with moisture on galvanised surfaces

Standard precautions apply for all zinc-coated steel; for details please refer to *Appendix E* of AS4750: *Electro-galvanised coatings on ferrous hollow and open sections*.

How to Repair White Rust

There are various methods to remove white rust and repair damage, depending on the severity of the oxide coating.

Two methods are shown: rubbing with a nylon scourer (scotch-brite) and vinegar; and mechanical buffing with a wire brush wheel. The effectiveness of each may be seen below.



Picture 2. White rust repair using Vinegar and nylon scourer



Picture 3. White rust repair using Wire brush wheel

After the white rust is removed, three coats of a zinc rich spray paint are applied, as per manufacturer's instructions (eg. Liquid ALLGAL[®] spray paint).



Picture 4. Zinc paint repaired (Vinegar/scourer)



Picture 5. Zinc paint repaired (wire brush wheel)

Both methods prove equally as effective, but the use of a mechanical wire buffing wheel (or a wire brush) is a lot faster and produces a cleaner surface for re-painting.

Case Study on White Rust

In 2010 a steel reseller near Brisbane supplied one of their rural customers with two truckloads of zinc coated cattle rail.

The customer stored the product on his property in a paddock under a tarp and, after a period of around six months, started to break the packs open to erect his fencing.

He was alarmed to see the presence of white rust. Samples were provided and the presence of white rust was variable throughout the pack, some lengths were severely affected by wet storage stain. A particularly bad sample confirmed the presence of white rust that progressed to red-rust corrosion where the zinc has been consumed as per the following pictures:



Picture 6. Photo of returned sample – “normal” sample



Picture 7: Photo of returned sample - showing white rust



Picture 8. Pack warning label

The back of the tags obtained from the product clearly stated the need to store the product under cover and to keep it dry.

Examination of the production history of the steel in question indicated no anomalies or process issues occurred during production of these products.

Also, delivery of product to the customer was accepted as dry and free of damage.

The white rust was determined not to have occurred during the manufacturing process or delivery of this product.

It was likely that the high amount of rainfall in the customer's region over the previous six months caused moisture to be trapped and this was the main reason for the white rust formations.

Storage conditions at the customer's site did not follow recommended practices and was deemed the likely cause.

Summary

Prevention is better than cure with white rust. Learning how to check delivery of product for any signs of moisture and storing it in the optimal conditions to prevent the onset of corrosion can save a lot of time, money and hassle.

Taking the right steps to provide a suitable storage area, preferably inside, with adequate air circulation and the minimum possible exposure to moisture will ensure your coated steel products live up to your expectations.

Further Guidelines

Guidelines for the expected durability of the various zinc coatings available on the market are published in various standards:

- *AS4792 Hot-dip galvanised coatings on ferrous hollow sections.*
- *AS4750 Electro-galvanized coatings on ferrous hollow and open sections.*
- *AS2312: Guide to the protection of structural steel against corrosion by the use of protective coatings*
- *ISO14713: Protection against corrosion of iron and steel in structures – zinc and aluminium coatings – Guidelines.*

About the Author

Orrcon Steel is a leading Australian distributor and manufacturer of steel, tube and pipe.

Their product range covers RHS, SHS & CHS structural tubular steel, hot rolled structural steel and a variety of fencing, roofing and building accessories.

They have a structural tubular mill in Brisbane and a precision tubing mill in Adelaide, distribution centres in five Australian states and a number of branches, stockists and resellers nation-wide.