nordic GALVANIZERS

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Wet-storage stain - why is it formed? How to avoid it?

Figure 1. Wet-storage stain on closely joined angle irons after outdoor storage.

Wet-storage stain, or white rust, is the term for the white, floury and loose corrosion products shown in Figure 1. White rust is preferably formed on newly galvanized surfaces.

White rust only forms if there is water on the galvanized surfaces, e.g. rain or condensation. If the galvanized steel are stacked tightly, the attack will primarily take place in gaps where ventilation is poor.

White rust is created due to a corrosion process, that is increased by the fact that there is relatively more oxygen at the edge of a water film or a drop of water, than in the middle. A so-called “oxygenation element” is formed because the oxygen-rich areas become nobler (cathodes) than the oxygen-poor (anodes). Such ”oxidation elements” can also cause corrosion on black steel, stainless steel and aluminum.

Since this white corrosion product is very bulky (about 500 times that of the zinc from which it was formed), it can appear to be serious. Though, the white rust is normally not harmful to other of the coating’s properties, and the standard for hot-dip galvanizing, EN ISO 1461: 2009, states that white rust is not cause for rejection providing the thickness of the zinc coating meets the specified minimum value.

If the original glossy appearance of the hot-dip galvanized products is to be preserved, storing in completely dry conditions is needed. The formation of condensation water, which can occur on the hot-dip galvanized objects due to varying temperatures during outdoor storage under tarpaulin or equivalent, should therefore also be avoided.

The white rust attack can be stopped by removing the moisture on the zinc surface. Failure to stop the attack can result in harmful attacks. The back of this leaflet gives advice on how to avoid white rust and how to remove it.

The corrosion process

1) Cathode process in oxygen-rich areas:

$$1/2\ O_2 + H_2O + 2e^- \rightarrow 20H^-$$

(2) Anode process in oxygen-rich areas:

$$Zn \rightarrow Zn^{++} + 2e^-$$

(1) + (2) Corrosion process:

$$Zn + 1/2\ O_2 + H_2O \rightarrow Zn\ (OH)_2$$

(zinc) (oxygen) (water) (white rust)

Before the damage has occurred

Thin zinc coatings applied by electro-galvanizing are usually post-treated by chromating. This provides some protection against white rust, depending on the nature of the chromating. Hot-dip galvanized items are usually not post-treated to protect against white rust, but with appropriate storage it is possible to reduce the risk of white rust attack. For outdoor storage, the hot-dip galvanized items should be stacked with wood, for example, so that there is good air ventilation around all surfaces. The items should also be stacked with a slope so that rainwater can run off all surfaces without accumulation of water on the items.

Outdoor storage items covered with tarpaulin should also be stacked with spacers so that condensate, formed due to changing temperature, can be removed by air ventilation. The tarpaulin should therefore only act as a roof that protects against rain and snow.

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The tarpaulin must not rest on the hot-dip galvanized steel and must allow air ventilation, for example through openings at the ends of the workpiece stack. Figure 2 provides suggestions for how hot-dip galvanized items can be stacked.

When the damage has occurred

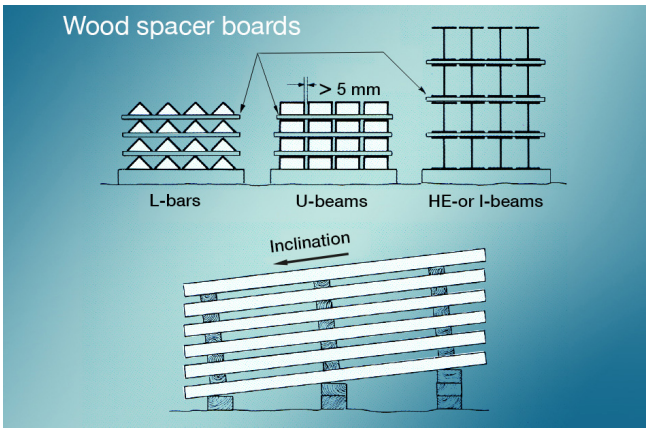
Items with white rust are dried, e.g. by appropriate storage. The white rust attack is hereby stopped and will in time be transformed into the normal layer of zinc corrosion products, which have a protective effect.

Newly formed white rust can often be removed by washing with a stiff nylon brush and water. Minor stains with stuck white rust can be cleaned with an abrasive sponge.

White rust that has been on the zinc surfaces for a long time becomes harder and harder to remove. Removal can here be done by gentle steel brushing. A stainless steel brush should be used to avoid the risk of iron contamination and rust discoloration.

Cleaning can also be done by brushing with dilute acetic acid, and after that proper rince with clean water.

A white rust attack that is stopped in time does not need any finishing. If the zinc surface is measurably damaged, the workpiece can be re-galvanized or the damaged areas can be repaired using one of the methods mentioned in Nordic Galvanizer's information sheet; Repair of damage to zinc coatings.



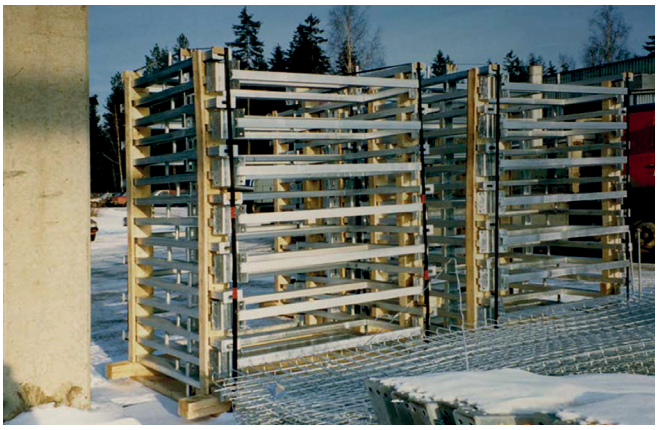


Figure 3. The galvanized steel should be stored with a slope and turned so that water accumulations are avoided. Spaces are placed so that no gaps occur and so that all surfaces are ventilated.

For further information contact:

nordic GALVANIZERS

Tlf. +46 (0)8 446 67 60,
info@nordicgalvanizers.com
www.nordicgalvanizers.com