

TECHNICAL PAPER WHITE RUST

White rust on galvanised steel

Prevention

It is easier to prevent white rust than to cure it! Reasonable precautions to protect steel during both transport and storage can considerably reduce the risk of white rust. Storage should be indoors if possible, preferably in a clean, dry area away from any source of chemical pollution. Since rapid changes in temperature may cause condensation

leading to white rust, storage should, as far as possible, be at an even temperature above the dew point. In particular, storage of coil or sheet on site can be improved by a few simple precautions, viz:

- Always stack the packs on metal or wooden skids to keep them from direct contact with the ground.
- Where possible, do not leave uncovered coil or sheet stacks lying in the open. Store them under cover and away from open doorways.

However, if it is absolutely necessary to store material out-of-doors, then the following simple precautions are essential:

- If stacks or coils cannot be kept under cover, erect a simple scaffolding around them and cover it with a waterproof sheet, tarpaulin or polythene. Leave space between the cover and the stacks or coils to allow air to circulate.
- Store off the ground and on a slope so that any rain penetrating the cover will drain away.
- Inspect the storage site regularly to ensure that, despite these precautions, the steel has not become wet. Be aware that sheets in the stack, not only the top but also in-between, get wet due to condensation at night and that the condense water connate evaporate.
- The period of outdoor storage should be kept as short as possible. Particularly during the summer period, higher temperatures speeds up the rust process very much.



A Tata Steel Enterprise

What is white rust?

How is it caused?

White rust is a complex, hydrated zinc carbonate/zinc hydroxide. It is a corrosion product of zinc formed under certain specific conditions of exposure.

The most common causes of white rust are:

1. Ingress of water, due to rainwater, between the adjacent surfaces in a stack of galvanised or per-painted steel or sheets or components or within windings in a galvanised coil during transport or storage.
2. Condensation within a coil, a stack of sheets or components caused by rapid changes in temperature.
3. Condensation from the drying out of new buildings or the laying and drying out of wet concrete screed.
4. The combined effect of weather and site dust on the components of a building frame before the application of the weather skin.
5. The combined effects of weather and site dust on roof decking before the application of insulation and weather proofing. It is important to note that white rust, since it can be transparent when wet, may not always be visible until the steel dries.

Is white rust harmful?

What action is required?

Because of the large volume of white rust often apparent, it frequently gives the misleading impression of extensive corrosion. However, in most cases, white rust does not indicate serious degradation of the zinc coating nor does it necessarily imply any likely reduction in the expected life of the product. Unless the sheets or components are to be over-painted later, superficial white rusting can be safely ignored. In most cases, when exposed to natural, acceptable environmental conditions, superficial deposits of white rust will gradually 'tone-in' and eventually disappear. However, heavy deposits, especially when combined with other corrosion phenomena should be regarded with caution.

The advice applies particularly to continuously galvanised steel, but in many respects relates also to products galvanised after manufacture. However, in the latter case, specific advice should be sought from the supplier involved. Figures A1, A2, B1, B2, and C each show an area of galvanised steel affected by products of corrosion.

Note

Where subsequent over-painting is required, white rust deposits must always be removed, otherwise they will impair paint adhesion (see note 3, page 4). The remedial actions recommended assume that the galvanised steel is not to be painted or otherwise coated.

Light white rust



Visible effect: thin, white, powdery deposit (fig. A1 and A2)

Cause

Caused by moisture trapped between sheets or components during transport or storage, or by condensation.

Remedial action

None required. The protective properties of zinc are not impaired by the presence of superficial white rust. Existing white rust deposits will slowly convert to protective basic zinc carbonate.

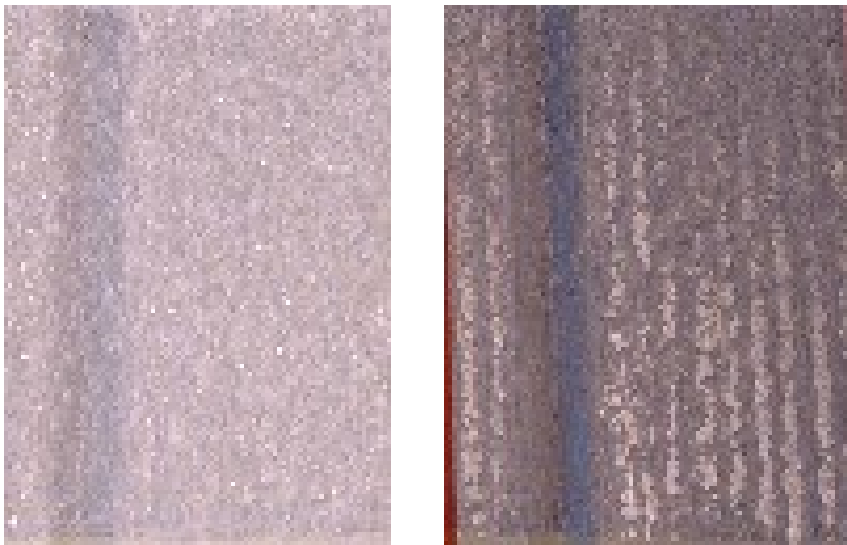
Removal

Where it is essential to remove white rust deposits, this can be achieved by using special proprietary cleaners or simple chemical solutions which can be made up on site. A suitable solution could be:

1 % solution of trisodium phosphate (Na_3PO_4) or 1 % solution of potassium or sodium dichromate slightly acidified with sulphuric acid (PH not less than 6). This solution may leave a stained surface.

N.B. In all cases, affected sheets should be thoroughly washed and allowed to dry after treatment.

Heavy white rust



Visible effect: thick, crusty deposit (fig. B1 and B2)

Cause

Prolonged, adverse storage or inadequate protection during transport allowing considerable water ingress between stacked sheets or components. In buildings, this can also occur where normal cycles of wetting and drying are combined with a corrosive atmosphere, before completion of the weather skin.

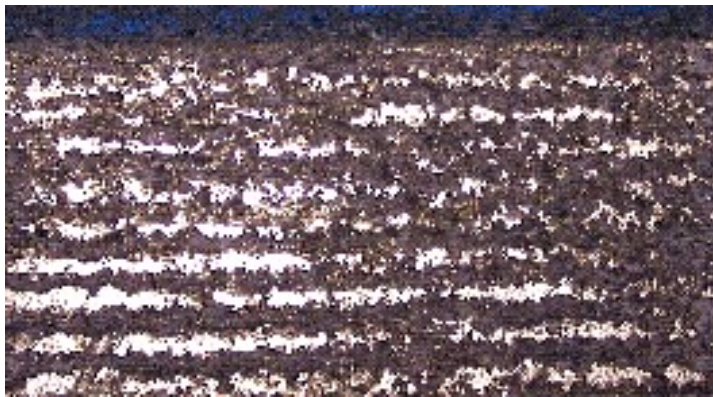
Remedial action

Remove small area of white rust by brushing with a stiff-bristled brush (not a wire brush). Check residual zinc coating thickness with magnetic gauge (note 1). An average of at least 3-point determinations should be taken in each case. If within specification (note 2), and if the sheet or component is to be used in reasonably dry or freely exposed conditions, no action is required. However, if the sheet or component is to be exposed to excessive condensate or to conditions where moisture can be retained, the deposits must be removed. If below specification, clean the area (note 3) and treat with an inorganic zinc-rich paint to a minimum dry film thickness of 25µm (note 4).

Notes

1. Simple hand-held magnetic thickness gauges suitable for the on-site or factory floor measurement of residual zinc coating thickness are available from several companies.
2. Coating weight should correspond to the relevant specification according to EN 10346, Continuously hot-dip zinc coated structural steel strip and sheet.
3. Small areas of white rust can be removed by abrading with a stiff-bristled brush. Large areas can be treated with a proprietary product or with simple chemical solutions which can be prepared on site.
4. Where wet conditions are likely to persist, over-painting with a suitable paint system should be considered as an added protection.

Red rust



Visible effect: thick, red rust (fig. C)

Cause

Corrosion of steel substrate where zinc coating has broken down completely. Should not be confused with superficial rust staining caused, for example, by small amounts of drilling swarf on the zinc surface or by wash from adjacent mild steel fixings.

Remedial action

In general, sheets or components showing this defect should not be used. In circumstances where there is no alternative but to use the defective material, a repair procedure may be undertaken if the purchaser agrees. Expert advice should be sought first.

White rust on pre-painted steel

Prevention

For pre-painted material the same precautions count as for galvanized steel, stated on page one. Storage should be indoors if possible, preferably in a clean, dry area away from any source of chemical pollution. Pre-painted material is also sensitive for rapid changes in temperature which may cause condensation leading to white rust.

Storage should, as far as possible, be at an even temperature above the dew point. In particular, storage of coil or sheet on site can be improved by a few simple precautions, viz:

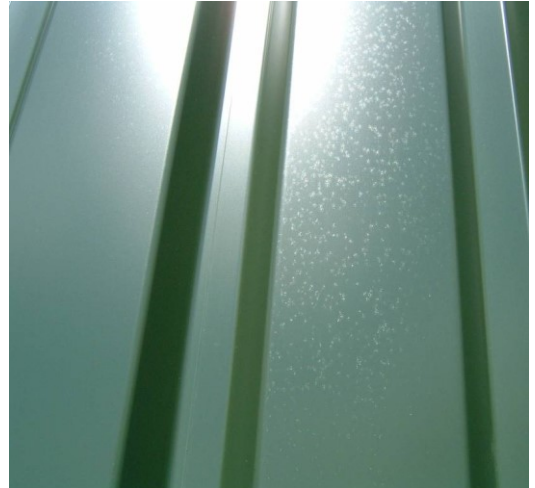
- Always stack the packs on metal or wooden skids to keep them from direct contact with the ground.
- Where possible, do not leave uncovered coil or sheet stacks lying in the open. Store them under cover and away from open doorways.

However, if it is absolutely necessary to store material out-of-doors, then the following simple precautions are essential:

- If stacks or coils cannot be kept under cover, erect a simple scaffolding around them and cover it with a waterproof sheet, tarpaulin or polythene. Leave space between the cover and the stacks or coils to allow air to circulate.
- Store off the ground and on a slope so that any rain penetrating the cover will drain away.
- Inspect the storage site regularly to ensure that, despite these precautions, the steel has not become wet. Be aware that sheets in the stack, not only the top but also in-between, get wet due to condensation at night and that the condense water connate evaporate.
- The period of outdoor storage should be kept as short as possible. Particularly during the summer period, higher temperatures speeds up the rust process very much.
- Strippable film applied on pre-painted steel does not diminish the risk. Sooner or later water will penetrate through the film.

Especially during summertime when rapid changes in temperature occur which may cause condensation within the stack of sheets or within the coil white rust could start within days when storage on site is not appropriate.

Light white rust



Visible effect: thin, white deposit (fig. D1 and D2)

Remedial action

Maybe not required for walls. The protective properties of zinc are not impaired by the presence of superficial white rust. Existing white rust deposits will slowly convert to protective basic zinc carbonate. However, for aesthetic reasons, light stains are in general easy to remove by cleaning with warm water and soap by means of a low-pressure spray or brush, max 60°C, max 60 Bar. Heavier stains may be cleaned with a basic solution which as well can be used to remove fungal growth, dirt and debris. A basic solution may be applied to a pre-washed surface by means of a low-pressure spray or brush containing:

- Household detergent - 0.5%
- Trisodium Phosphate - 3.0%
- 5% Sodium Hypochlorite solution - 25.0%
- Clean, fresh water - 71.5%

This should be rinsed thoroughly with clean water after treatment. Over spraying is possible by specialized firms. Regarding to roofs, remedial action will be required in most cases due to the more demanding conditions. Specific advice should always be sought for both the wall and roof utilization from the supplier involved.

Heavy white rust



Visible effect: thick, crusty deposit (fig. E)

Remedial action

In general, sheets or components showing this defect should not be used. In circumstances where there is no alternative but to use the defective material, a repair procedure may be undertaken if the purchaser agrees. Expert advice should be sought first.

IJsselstein, October 2019