

ZINC MATTERS

APRIL 2020

ZINC COATINGS EXPLAINED

Why use Zinc coatings?

Zinc based materials have been used for decades as corrosion protective coatings to improve the resistance of steel to aqueous & atmospheric corrosion. Zinc based coatings function effectively by at least three protective mechanisms:

- **barrier protection**
- **galvanic protection**
- **the formation of inhibiting corrosion product**

As a barrier protection, the zinc based coating serves to isolate the underlying metal from corrosive environments and will be the first to corrode. A barrier coating is only effective as long as the coating is completely intact.

In the galvanic mechanism, the zinc based coating is less noble than the underlying steel substrate, so it corrodes preferentially and provides sacrificial protection to the steel substrate that may be exposed to the environment at pores, cut edges, or scratches in the coating.

Under the inhibition mechanism, corrosion products such as zinc carbonate and zinc hydroxide from the sacrificial zinc coating act as an inhibitor to further corrosion.

Galvanizing

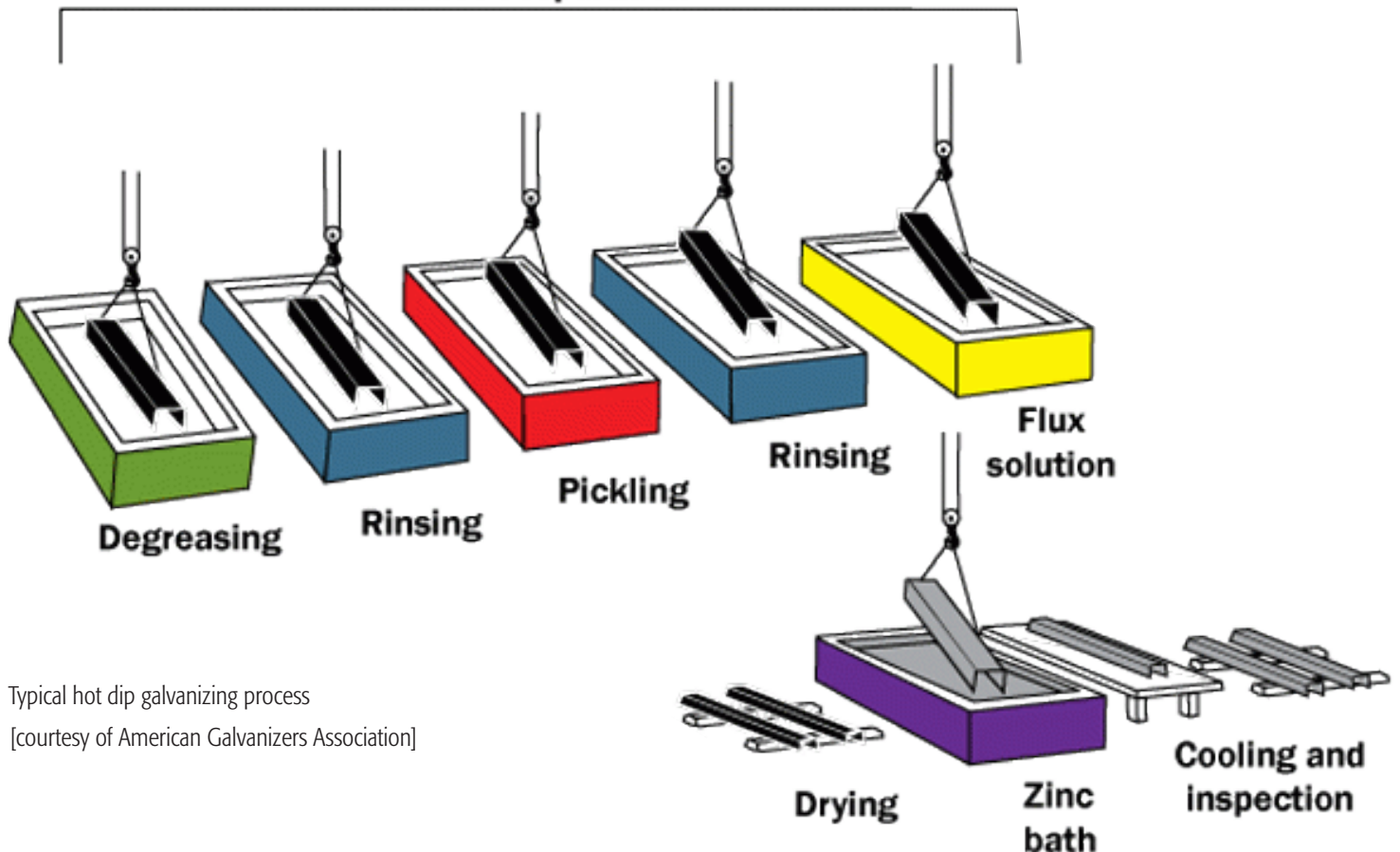
For this coating, the steel to be coated is pretreated by first degreasing, then rinsing, acid pickling to remove mill scale and rust followed by a rinse before fluxing with ammonium chloride. The steel items are then ready to be dipped in hot molten zinc at around 435 – 455° C which coats the entire surface. After removal from the zinc bath the zinc coated items are quenched in water, zinc dichromate or other proprietary solutions. Aluminium and other alloys are often added to the galvanizing bath to increase initial brightness.

Hot dip galvanizing of steel is affected by the phosphorous and silicon content of the steel so engineers need to note this fact when purchasing steel for galvanizing.

Hot dip galvanized zinc coatings are highly effective anti-corrosion coatings and offer a long trouble free and maintenance free life for steel structural elements, bridges, masts and for reinforced concrete steel bar. Hot dip galvanized steel can even offer aesthetic appeal depending on the architectural design. Hot dip galvanized zinc coated steel can also be surface prepared and then coated with an effective organic barrier system to form a duplex coating system, which, besides providing enhanced corrosion protection, will provide colour to steel structures.

It is important for specifiers and engineers to realise that continuous hot dip galvanized steel sheet is not the same as batch hot dip galvanized steel material. The continuous coated sheet may have 15 – 20 microns of zinc coating on each face, whereas the batch coated item will have a minimum of 55 microns zinc coating. Galvanized steel items corrode in a linear fashion and coating thickness determines the life of the item. Construction bolts are often electroplated, with a very short life in corrosive environments before rusting and thus to achieve long life for bolts they should be hot dip galvanized.

Surface Preparation



Typical hot dip galvanizing process

[courtesy of American Galvanizers Association]



Corroded zincalume fence showing white zinc and aluminium corrosion product

Galvalume

In this material the steel substrate is coated with a material that consists of 55 % Aluminium, 43,5 % zinc and 1,5 % silicon. Galvalume coated material is supplied in sheet form and can be rolled into fence pieces and multiple profiles for roofing and building applications.

The method of corrosion protection is different to that of a pure zinc galvanized coating. In Galvalume type coatings the zinc rich areas are attacked first and the aluminium area are largely unaffected, however once the zinc is consumed the aluminium starts to form a protective barrier with its oxidation by products before the underlying steel can start to be attacked.

The zinc acts in a galvanic protection role while the aluminium fulfils a barrier protection role. Care must be taken in selecting this form of material as both the corrosivity of the location and the thickness of the coating must be taken into consideration. If powder coated, a powder coat system with excellent UV stability and resistance to moisture penetration must be applied to the Galvalume.

In South Africa the trade names Zinalume, Aluzinc and Zinal refer to products manufactured from this type of material.

Galfan

A zinc coating largely unknown to engineers and specifiers but nonetheless very useful for very corrosive marine environments. Galfan corresponds to the zinc aluminium eutectic with 5 wt % aluminium plus the addition of up to 0.05 wt % mischmetal namely lanthanum or cerium to aid wetting and fluidity when coated onto wire.

One of the objectives for producing Galfan coatings was to develop a zinc-rich coating without intermetallics at the coating-to-steel interface for improved formability.

The Galfan coating has a two phase microstructure and corrodes with time in a parabolic manner unlike galvanized zinc coatings which corrode in a linear fashion. Galfan is used to coat wires which are subsequently formed into strands and then formed into wire rope where the Galfan offers nearly double the operational life when compared to galvanized wire. Galfan is coated to tube, wire, and sheet and in batch processes.



Galfan coated wire rope in a coastal environment

Tips for specifiers of galvanized steel

Hot dip galvanized steel can be coated but engineers and architects need to ask themselves why they would want to duplex coat a surface that already offers outstanding long term corrosion protection.

It must be remembered that organic coatings are permeable and that electrolyte from the environment can permeate through an inferior coating and selective attack can occur at the underlying zinc surface. Corrosion products produced under the organic coating could result in the delamination of the organic coating.

If aesthetic appeal is critical and extra weathering protection is being sought, make sure the galvanized surface is first gently sweep blasted, then apply a good primer compatible with galvanized surfaces and finally a resilient top coat with the final colour chosen.

Uncoated hot dip galvanized zinc surfaces will initially be bright silver – however after 12 months the surface will acquire a matt grey colour as protective zinc carbonate forms on the surface. This final surface will be corrosion resistant for an extended period dependent on the galvanized coating thickness and the classification according to Standards ISO9223 / 14713:1, which defines the zinc loss rate per annum.



International
Zinc Association

Zinc...essential for modern life

Tel: 021 788 9980 • Cell: 082 831 2924 • zinc@iafrica.com

IZA AFRICA DESK

www.zinc.org