**THOUGHT LEADERSHIP ARTICLE**

Hot dip galvanizing versus zinc-rich paint

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**30 August 2021:** Engineering and technical staff often get confused over the various terms bandied about in South African industry such as ‘galvanized’ or ‘cold galvanizing’ or ‘zinc-rich paints’. So, what’s the difference?

It is metallic zinc in hot dip galvanizing that affords cathodic protection and barrier protection to galvanized steel. The extent of protection offered is directly proportional to the zinc coating thickness.

This is not so for zinc-rich paint, which consists of fine zinc powder dispersed in a dry film of paint resins. A further factor to be considered is the environment to which these coatings would be exposed. Paint coatings are notorious for having pinholes that allow the external environment to penetrate the coating, something hot dip galvanizing avoids.

The key difference is that hot dip galvanizing results in the zinc coating forming a metallurgical bond with the underlying steel, whereas zinc-rich paints (cold galvanizing) merely adhere to the steel surface. Each has its place in corrosion-protection applications.

Care should therefore be taken when selecting zinc-based coating systems for chemically-aggressive environments. Zinc, being an amphoteric metal, is attacked by both acids and alkalis. Zinc coatings should only be used in the pH range of 6 to 12. Zinc phosphate and zinc chromate containing paints do not provide cathodic protection as they are corrosion inhibitors rather than sacrificial coatings and provide protection by a totally different mechanism.

When considering zinc-rich paints, only those that contain sufficient quantities of metallic zinc dust provide cathodic protection. There must obviously be sufficient zinc particles present to ensure that they are in electrical contact with each other in order to provide a common anode. Individual isolated zinc particles dispersed in the paint binder or resin will not provide protection, as they would essentially be insulated from the steel substrate and each other.

On the other hand, if too much zinc dust is added to the paint, there may be insufficient binder available to glue these particles together, giving a weak coating with poor adhesion and cohesion. In accordance with ISO 12944, all zinc-rich paints should contain a minimum of 80% zinc in the dry film in order to function as sacrificial primers. From the point of view of zinc content, hot dip galvanizing is the ultimate zinc-rich primer. However, there are occasions where a zinc-rich paint is the answer.

Duplex coating systems (galvanized steel plus coating) provide synergy by virtue of the fact that the durability of the combined hot dip galvanized and organic coating system is greater than the sum of the separate durability of the hot dip galvanizing and the coating layer. In some circumstances, such as with design restrictions, size of component, geographical location of the fabricator in relation to the galvanizer, or where hot dip galvanizing is physically impractical or impossible, it may have to be substituted by either inorganic or organic (epoxy) zinc-rich paint.

Looking at the pros and cons of hot dip galvanizing versus zinc-rich paints, one of the considerations is cost. The essential difference is that hot dip galvanizing costs are calculated by the mass of the steel that is hot dip galvanized, while painting costs are based on the area painted. Tables are available for most steel sections giving surface area by mass. As a rule of thumb, the following can be used:

* Extra light steel: More than 40m2/ton
* Light steel: 30 to 40 m2/ton
* Medium steel: 20 to 30 m2/ton
* Heavy steel: Less than 20 m2/ton

In the case of hot dip galvanizing, steel is subjected to a specific cleaning process, including degreasing, acid pickling and fluxing, with intermediate water rinsing, thereby creating a thoroughly clean surface, which is essential for hot dip galvanizing to take place.

The resultant coating thickness is dependent on several factors, including chemical composition of the steel, steel thickness and surface roughness. In steel of thickness equal to or greater than 3 mm but less than 6 mm, the mean coating thickness is required to be at least 70 microns by SANS 121. However, on steel thickness greater than 6 mm, the coating must be 85 microns.

In the case of zinc-rich paint, the painter will abrasively blast clean the steel and then apply a suitable 75 micron thick (inorganic or organic) zinc-rich primer coat for a protective coating system at a cost based on the total area of steel painted.

It can be argued that the hot dip galvanized coating contains more zinc and will therefore last longer than the 75 micron paint (with 80% zinc in the dry film). On the other hand, the hot dip galvanizing requires thorough cleaning before the primer or intermediate coat can be applied.

However, both methods of providing the required metallic zinc primer can be cost-effective, depending upon circumstances. It is for this reason that in recent years both options have been given in protective coating specifications, leaving the final decision whether to hot dip galvanize or paint up to market forces. Clearly, hot dip galvanized coatings and paint coatings complement each other in the protective coatings industry.

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**About the International Zinc Association**

The IZA is the only global industry association dedicated exclusively to the interests of zinc and its users. Operating internationally and locally through its regional affiliates, the IZA helps sustain the long-term global demand for zinc and its markets by promoting such key end uses as corrosion protection for steel and zinc as being essential in human health and crop nutrition. IZA’s main programmes are Sustainability & Environment, Technology & Market Development and Communications.

In South Africa, the IZA plays a vital role in establishing the basis for the successful revitalisation of the zinc industry by increasing awareness of zinc and its applications and benefits in key sectors and markets, which will ultimately translate into the increased uptake of zinc.

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