

Galvanized steel and galvanic corrosion

Hot dip galvanizing is a well known method to protect steel against corrosion and a powerful way to increase the life time of the product when used in very corrosive environments.

During galvanizing the steel is dipped in molten zinc, and a reaction between steel and zinc occur. Thus, the zinc coating is not painted to the steel surface, it is chemically bounded. Since it is a chemical reaction the appearance of the zinc coating may differ, depending on the type of steel used in the product.

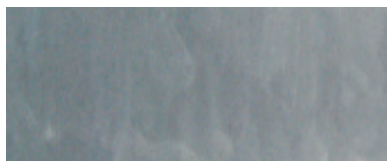
Zinc is a base metal with large tendency to corrode. The reason for the low corrosion rate in most environments is that stable corrosion products are built on the zinc surface, which protects it and slow down the corrosion rate to very low values.

The protective coating is created in the following way:

- * When a newly galvanized product is exposed to air, zinc oxide is created on the surface.
- * The zinc oxide reacts with water and carbon dioxide from the environment.
- * Through this reaction basic zinc carbonates are built up on the surface.
- * The zinc carbonates are very stable and protects the surface from further corrosion.



Newly galvanized steel could be very bright.



After a while in use the surface may be more dull.



Differences in colour may exist, but do not influence on the quality of the corrosion protection. The reason for the differences is that the reaction between steel and iron varies depending on type of steel and cooling speed after galvanizing.

Quality control of galvanized steel

In the galvanizing standard EN ISO 1461 it is specified how samples for coating thickness control of galvanized products shall be collected.

Thickness measurements and visual control of the surfaces takes place before the products leave the galvanizing plant.



Thickness measurements.

Galvanic corrosion

If two different metals are connected to each other and an electrolyte (liquid, manure or moisture bedding material) is present a galvanic cell is created, which leads to corrosion of the less noble metal. The corrosion attack is located to the area where the electrolyte exists, even though the contact point between the metals is located to a totally different area.

When low alloyed rebar steel is casted into concrete it becomes passivated, which means that it gets a corrosion potential corresponding to the potential of stainless steel. If hot dip galvanized steel from the stable equipment get in contact with the rebars in the concrete, a galvanic cell will be created. Very high corrosion rate of the zinc have been noted in some cases after such connections. The corrosion attacks are located to galvanized steel exposed to urine and manure, or close to the animals water cups.

How is the contact created?

Contact between rebar and galvanized equipment usually occurs in one of the following ways:

* During installation of the equipment, the pole by mistake get in contact with the rebar when screwed into the stable floor. This could be avoided by using screws which is shorter than the deep on which the rebar is located. If there is uncertainty about if contact has been created, it is possible to perform contact measurements, see below.

* By intentional connection for potential equalizing with so called PUS (potential equalizer) in the distribution box of the building.

When will accelerated corrosion occur?

A galvanic cell may lead to accelerated corrosion, which harm the zinc coating. How fast the corrosion proceeds depends on several different factors. The relation between dry- and wet time for the exposed surfaces, type of bedding material, the behavior of the animals and type of stable. Generally, bedding material with high absorbency usually leads to drier environment and decrease the risk for accelerated corrosion.

Depending on type of animals, stables can be a very corrosive environment. Even though, zinc is resistant to corrosion if galvanic contact not is present. As an example it could be mentioned that studies performed by Swerea KIMAB¹ have shown that the corrosion rate of zinc was 0.8 µm/year in a pig stable. After galvanic contact between galvanized equipment and stainless steel (same corrosion potential as rebar in concrete) the corrosion rate was 41 µm/year.

Problems with galvanic corrosion could also occur in road environments. When galvanized road poles by mistake was connected to bridge rebar, corrosion rates of more than 100 µm/year was noted in areas with electrolyte. When the contact was broken the corrosion rate decrease to normal values.

Studies of several hot dip galvanized stable equipments made both in Nordic countries and in other countries, have shown that galvanic corrosion is not related to the company that have galvanized the steel. The galvanizer has no influence on how the galvanized equipment is installed and used, and can because of that not take any guarantee responsibility in cases when galvanic corrosion occur.



Nordic Galvanizers

Do you want to know more about hot dip galvanizing or galvanic corrosion, please contact Nordic Galvanizers, the branch organization for galvanizing companies in Nordic countries.

nordic
GALVANIZERS 

Nordic Galvanizers
+ 46 (0)8 446 67 60
www.nordicgalvanizers.com
info@nordicgalvanizers.com

¹ The Swerea institutes provide advanced services within the sectors of materials, process, product, and production technology. These services include research and development, testing, pilot production, training, standardization, and consulting.