ANVIL® INTERNATIONAL, INC.

TECHNICAL BULLETIN

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New products and developments from Anvil International, Inc.

Zinc coatings provide corrosion protection

Zinc coatings are used extensively as a corrosion resistant coating for ferrous metals. The zinc provides electrochemical protection against corrosion of the underlying ferrous substrate. In the process of providing the corrosion protection the zinc is gradually consumed. When the zinc is consumed, corrosion of the base metal begins.

Some background on the nature of the corrosion process will aid in the understanding. Corrosion of steel parts is initiated by electrical potential differences between small areas of a steel surface. When these areas are electrically connected by an electrolyte, moisture condensing from the air is the most common one, a corrosion cell is formed. A small electrical current begins to flow. The iron ions formed at the anode combine with other ions present in the environment. As a result, loose flaky iron oxide, rust, is formed.

Notice that the environment is a major factor in initiating the corrosion. It also determines the rate of corrosion. Highly conductive electrolytes intensify the reaction and speed the corrosion. Environmental conditions also play an important role in determining the life of a zinc coating.

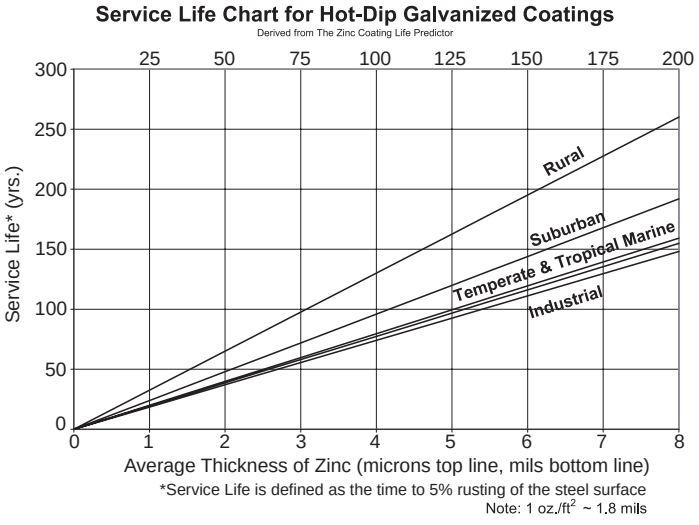
Zinc coatings provide corrosion protection in two ways. First by providing a barrier between the electrolyte and the ferrous surface. Secondly, the zinc coating is more anodic than the underlying ferrous surface. This means that even when the electrolyte is able to come into contact with the iron, the zinc, being more anodic than the iron, will preferential corrode and protect the iron. If environmental factors are equal, the duration of the corrosion protection provided by the zinc will be a function of the thickness of the zinc coating.

Hot dipped galvanizing is an acknowledged process for providing a premium zinc coating. The process begins by first cleaning the part in a hot alkaline solution. This step will remove surface dirt and oils. The part is then transferred to a pickling solution which uses hydrochloric or sulfuric acid to provide a chemically clean metal surface. Next the surface is fluxed by immersing the part in a flux solution that removes oxides and prevents further oxidation. The part is then immersed in a bath of molten zinc. The zinc is maintained at a temperature of 815F to 850F. The zinc metallurgically bonds with the ferrous part. A series of layers of zinc-iron alloy are created. On top of these layers is deposited a layer of pure zinc. The part is then removed from the bath and the excess zinc is removed.

The hot dipped galvanize process produces parts with a zinc coating that is from one to eight mils in thickness. Three mils is typical. A patina will gradually form on the zinc surface after one to two years. The patina is actually a thin film made up of zinc oxide, zinc hydroxide, and zinc carbonate. The patina is very tightly adhered to the surface and cannot be dissolved in water.

An alternate process is the zinc electroplating, or electrogalvanized, process. In this process, zinc is electrically deposited on the surface of a ferrous part. The coating is bonded to the ferrous part by interatomic bonding. There is no diffusion reaction like that which occurs in the hot-dip process. The electroplate process is used to apply thin zinc coatings. A typical thickness for the coating is approximately one-half mil or less.

The service life for the coating is determined by two factors, the environment and the coating thickness. Recent studies on the life of a galvanized coating show that a coating in an industrial environment will have 60% of the life of the same coating in a rural environment. The coating in an industrial environment will have nearly the same life expectancy as a zinc coating in a marine atmosphere. The same study also compared the service life for various thicknesses of zinc coatings. Using the industrial environment as the application, a half mil coating will provide a service life of about ten years, while the three mil zinc coating will have a useful life of approximately fifty-five years. More detailed analysis can be performed by referencing the "Service Life Chart for Hot-Dip Galvanized Coatings" chart. This chart was electronically published by the American Galvanizers Association. For a .pdf file, use www.galvanizeit.org/servicelife/servicelife.htm



In short, for a given application, the coating thickness is the determining factor for service life. The hot dipped galvanize coating provides a thick zinc coating that virtually guarantees a long life in any atmospheric environment. The additional thickness of a hot dipped galvanized coating provides service life assurance against the rigors of installation that can result in gouges and scrapes in the coating. Hot dipped galvanize is very impact resistant. Good impact resistance is an important trait to for a product to have during the erection of a piping system in order for it to provide the maximum service life.