THE PROCESS OF HOT DIP GALVANIZING

Unlike organic plaint systems, a hot dip galvanized coating is produced by a metallurgical reaction between iron and the coating material, that is, molten zinc. A series of hard abrasion resistant iron/zinc alloys are formed, and these are overcoated with relatively pure zinc as the product is withdrawn from the galvanizing bath. The various layers all play a significant role in the provision of corrosion protection. For the coating to from, the steel surface is required to be totally free from all contaminants such as mill scale, rust, grease and oil.

As the name implies, the hot dip galvanizing process entails dipping or immersion into a series of cleaning and pre-treatment chemicals prior to immersion in the molten zinc. The advantage of this method is that all product surfaces are wetted uniformly, including areas which would be inaccessible for cleaning and coating by other methods.

Galvanizing entails the following operations:

1. **INSPECTION PRIOR TO GALVANIZING**

This important prerequisite to processing is to ensure that the design of structures, welding and fabricating standards, as well as the surface condition of material, is acceptable for galvanizing to the relevant specification. Slag from stick welding (as opposed to shielded arc welding) is not readily removed by the cleaning chemicals, while the presence of some paints, for example, alkyd enamel, are also difficult to remove except by abrasive blasting, grinding or the use of a paint remover. Water-borne paints should always be used to identification or marking during fabrication of products which are to be galvanized. Inspection prior to galvanizing is also necessary to ensure that products can be galvanized without the danger of an explosion. Sealed cavities where vent holes are not provided can result in the formation of superheated steam which may cause injury to personnel and damage to the product.

2. **DEGEASING**

Components which are appropriately suspended from materials handling devices are immersed in a degreasing chemical. This is to ensure that steel surfaces are not masked from the subsequent and most important acid pickling process. If an alkaline caustic soda-based degreaser is used, subsequent rinsing in water is essential in order to avoid a neutralizing effect on acid during pickling. Acid degreasers normally contain hydrochloric acid, but phosphoric acid-based degreasers are also effective.

3. **ACID CLEANING**

Either hydrochloric or sulphuric acid is used to prepare steel for galvanizing. Hydrochloric acid is used unheated at a concentration of about 15 percent. Sulphuric acid is heated to a temperature of about 70 degrees C with a concentration of 10 percent. In conventional plants, material is rinsed in water prior to being transferred to a flux solution. In some plants where hydrochloric acid is used, rinsing is dispensed with. The acid carried over is converted into either ammonium chloride by additions of ammonium hydroxide, or zinc chloride by adding zinc dust. Other contaminates are filtered out.

4. **FLUX**

After pickling in acid, material is transferred to a flux solution which consists of ammonium chloride and zinc chloride. This solution is normally heated to a temperature of 70 degrees C. The flux plays an important role in that it provides barrier protection to prevent flash rusting during the period between acid pickling and immersion in the zinc. It also has a final cleansing effect on steel surfaces as they enter the zinc. The flux also facilitates the formation of a uniform coating which is free from discontinuities.

5. GALVANIZING

After fluxing and further drying (ideally in a drying oven to avoid excessive splashing of zinc due to the presence of moisture), the products are dipped into the molten zinc which is heated to a temperature of about 450 degrees C. This is more or less 21 degrees C above the zinc melting temperature. The steel is immersed at a fairly rapid speed and once the coating has formed, withdrawal is at a slow speed (ideally <1m per minute) to ensure uniform drainage and a smooth finish. In automatic or semi-automatic plants, where products such as small bore tubing are galvanized, withdrawal speeds are much faster with the ultimate coating thickness and finish controlled by external air wiping and steam jet blasting of the internal bore.

In most plants, the zinc contains small quantities of aluminium (typically 0.005 percent). Apart from enhancing the initial appearance of the coating, the aluminium provides added benefits which include a slight reduction in coating thickness on excessively reactive steels, and a lower degree of wasteful zinc oxide formation on the molten zinc surface in the bath.

6. QUENCHING

This process solidifies the zinc coating to ensure easy handling. It also arrests the alloying reaction in the case of reactive steels, which continues well below the melting temperature of zinc.

The quench water normally contains a passivating chemical which retards the formation of white rust (wet storage stain) until such time as the freshly applied reactive zinc surface has developed a stable and protective basic zinc carbonate film.

Products which may be prone to distortion are air-cooled and not quenched in order to avoid the effects of thermal shock.

7. QUALITY CONTROL AND FINAL INSPECTION

In order to achieve the required coating standards, routine analyses of the various chemicals used in the process are essential. Failure to do this results not only in substandard coatings but also additional processing costs for the galvanizer. Final inspection of hot dip galvanized coatings is relatively simple. Visual examination ensures that no coating discontinuities are present and the coating is uniform. Unlike other coatings, hot dip galvanizing will not coat contaminated steel surfaces. A suitable calibrated coating thickness measurement instrument is used to ensure that coating thick-nesses conform to the requirements of the relevant specification.