Zinc & Post-Coatings: Facts to Consider

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Commercial zinc coatings are very effective for enhancing corrosion protection and thus extending service life of finished parts. Zinc is electroplated from acid, alkaline and cyanide plating baths. Zinc is also deposited in a cold tumbling process, by impacting zinc powder on to the substrate using glass beads (*as discussed elsewhere in this issue - Ed.*). This process is commonly referred to as mechanical plating. Zinc alloy baths, containing metals such as iron, nickel and tin, have a typical application for functional, high corrosion protection requirements. The focus here will be on traditional zinc coatings and post-top coats, to improve overall corrosion protection. Process baths and their performances are considered to be optimum.

The thickness of zinc deposited is most critical to achieving a desired corrosion protection. Most requirements specify at least 0.00025" thickness. The zinc coating may range up to 0.0005" depending on the specific need. Mechanical zinc thicknesses may reach 1 mil, because of the process' ability to build a relatively stress-free, non "dog-bone" deposit buildup. There are several methods used to determine the zinc deposit thickness. The procedures listed are briefly described.

X-ray. This is a popular, non destructive method. Many platers make direct measurements of sample parts while a load is being plated. It is a very accurate method, offering precise data in relatively small or discreet areas of the surface. X-rays are produced and emitted radiation is measured from the base metal and zinc coating.

Magnetic. The instrument works on the magnetic field system. It detects thickness by difference of the base metal substrate (steel or iron, which are magnetic), versus the zinc coating, which is non-magnetic.

Coulometric. This instrumental method is used in reverse plating, or de-plating applications. The zinc deposit is anodically dissolved. The ampere-minutes or coulombs required are determined and calculated as the initial deposit thickness.

Cross-section. This procedure requires some time and implementation by trained personnel. A section of the finished part is cut on a plane perpendicular to a significant surface. After it is mounted, the section is polished for contrast with the base metal. Thickness is determined microscopically.

Weight loss. The subject part is weighed. Afterwards, the zinc coating is chemically stripped while not etching the undercoat or base metal. The coating weight is determined by weight difference.

These are the most common thickness measurements. The x-ray method seems to be the most popular one in current use.

Chromate post plate dips provide excellent corrosion protection to zinc plated parts. The coating which forms with the zinc surface is a first line barrier to the effects of oxidation, while extending the intended service life of finished parts. Much attention has been focused on the development of trivalent chromates, based on stricter environmental regulations and the requirements of RoHS. Colored chromates in industrial use include clear (blue), yellow, and black. Typical salt spray hours for colored chromates over 0.0003" of deposited zinc, per ASTM B-117 are:

Chromate	Hours to White Corrosion
* Clear	10-25
Iridescent yellow	75-95
Black	75-95
Olive Drab	145-300

*Also referred to as blue

The above salt spray data pertain to a moderate exposure condition, which is usually dry and indoors with periodic wear and condensation. For direct exposure to condensation and periodic rain, the equivalent salt spray data would require a zinc coating thickness of 0.0005".

Additional corrosion tests of zinc plated and chromated parts include:

Cyclic corrosion test. It is a series of exposure tests that may comprise neutral salt spray or fog, followed by hot air blowing, followed by high humidity. This is usually a cycle, such as 8 hours of total for all three described exposures, in a proportional ratio.

Lead acetate. This is a destructive spot test, whereby a 5% solution drop of lead acetate is observed on a section of the finished part. The time required for the test solution to darken is compared to the time for an unchromated zinc surface to darken.

Sealers are used as a final dip after chromating. These baths provide an additional level of corrosion protection. Some of these post treatments also provide thermal shock resistance, improved surface friction and solderability. Sealers may also contain dyes, which are absorbed by the chromate, offering varying colors for aesthetic and industrial applications. Sealers include the following types:

Inorganic. These are based on silicon chemistry. They may be as silica or inorganic silicates. This type of sealer converts the chromate coating to a silicate passivate. Salt spray protection upwards of 300 hours to white corrosion and 500 hours to red rust can be achieved. It provides ideal protection for wire goods and fasteners.

Wax. The dip forms a mechanical barrier. It effectively seals off the previously exposed chromate film. Where required, the coefficient of friction is greatly reduced. Salt spray protection of 300 hours to white corrosion can be obtained.

Polymer. It also forms a mechanical barrier, sealing the previously exposed chromate film. The finish can be glossy or even colored, per dyes in the polymer film. Salt spray protection of 300 hours to white corrosion can be obtained.

Zinc facts

About 7.2 million metric tons of zinc are produced annually worldwide. Nearly half of the demand for zinc is used for plating and galvanizing of steel. The annual weight of steel that is coated with zinc is approximately 100 million tons. *P&SF*