Description

Process schematic

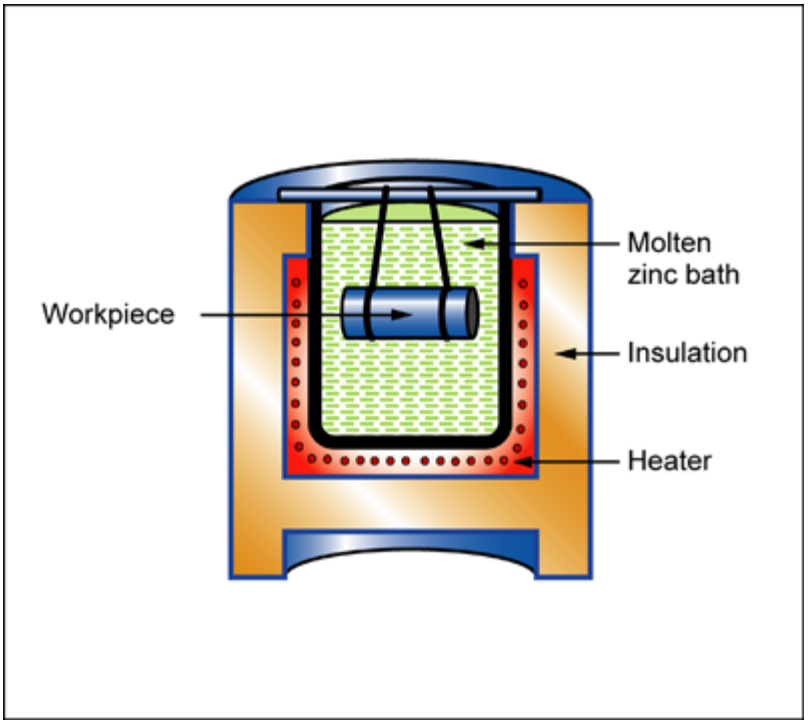

Figure caption

Galvanizing

The process

Hot dipping is a process for coating a metal, mainly ferrous metals, with low melting point metals usually zinc and its alloys. The component is first degreased in a caustic bath, then pickled (to remove rust and scale) in a sulfuric acid bath, immersed (dipped) in the liquid metal and, after lifting out, it is cooled in a cold air stream. The molten metal alloys with the surface of the component, forming a continuous thin coating. When the coating is zinc and the component is steel, the process is known as Galvanizing.
The process is very versatile and can be applied to components of any shape, and sizes up to 30 m x 2 m x 4 m. The cost is comparable with that of painting, but the protection offered by galvanizing is much greater, because if the coating is scratched it is the zinc not the underlying steel that corrodes ("galvanic protection"). Properly galvanized steel will survive outdoors for 30-40 years without further treatment.

Tradenames

Galvanizing

Material compatibility

Metals - ferrous	✓

Function of treatment

Corrosion protection (aqueous)	✓
Corrosion protection (gases)	✓
Wear resistance	✓
Thermal conduction	✓

Economic compatibility

Relative tooling cost	low
Relative equipment cost	medium
Labor intensity	low

Physical and quality attributes

Surface roughness (A=v. smooth)	B			
Curved surface coverage	Very good			
Coating thickness	85	-	170	µm
Surface hardness	10	-	12	Vickers
Processing temperature	325	-	500	°C

Process characteristics

Discrete	✓

Supporting information

Design guidelines

When properly selected, hot-dip metallic coatings provide excellent long-term corrosion protection. Because of the high temperature of the process, there can be some distortion of the workpiece. Galvanizing is preferred over painting because a metallurgical bond between the coating and underlying steel or iron. It can protect steel from corrosion for 30 years or more. Galvanizing is not always satisfactory for machined, threaded or mating parts because of the thick and uneven coating which has to be removed from the threads by retapping. The galvanizing process is limited by the batch size: specialized work can handle parts up to 30 m long and fabrications 18*2*5 m. Thickness control is poor, and the coating is less uniform than with electroplating.

Technical notes

The hot-dipping process is rapid (fraction of a minute for small objects to several minutes for structural parts). Postcoating treatment varies according to the needs of the coated component.
Hot dipping is principally applied to ferrous metals, commonly cast iron or steel. In specialized situations, materials such as high-strength low-alloy steel may be used.
Coatings are low melting point metals: aluminum, zinc, tin, lead, terne (lead alloy with 10 to 20 % tin). Zinc, aluminum and terne perform well in providing corrosion protection under atmospheric conditions, in soils and aqueous media. Lead and tin do not provide galvanic protection but may be resistant to soils that are highly aggressive to zinc coatings. Lead has good resistance to sulfuric and hydrochloric acids, brines, etc. However, owing to its tendency to coat unevenly and to pit, it is not used extensively as a coating for steel in the atmosphere or in most soils. Alloying lead with tin, antimony, cadmium, mercury, and arsenic produces coatings that have been used with success.

Typical uses

Aluminized steel or cast iron: refinery process piping and equipment, appliance parts, furnace heater tubes, brazing fixtures.
Galvanized steel: roofing and siding, nails, wire, tanks (water storage), boilers, pails, hardware for indoor and outdoor use, structurals, guard rails, lighting standards, pipes and fittings, fencing.
Lead on steel or copper; wire, pole-line hardware, bolts, washers, tanks, barrels, cans, air ducts.
Tin is a good base for paint.
Tin on steel, cast iron or copper: milk cans, food grinders, cooking pans, kitchen utensils and electronic parts.
Terne on steel or copper: roofing, lining cabinets used in chemical laboratories, gasoline tanks, oil filters.

The economics

Galvanizing is inexpensive, despite being energy intensive. Hot-dipped coatings can be applied on either a short-run or a mass-production basis. Galvanizing, particularly, is cost effective compared to other coating methods because it lasts longer and requires less maintenance: a hot dip galvanized coating has outstanding resistance to mechanical damage in transport, erection and service.

The environment

With tin, certain hazardous chemicals are used. The rate of immersion should be slow enough to prevent dangerous spluttering or explosions caused by trapped water or moisture being added to the molten tin.
Fumes are produced at nearly every stage of the tinning and galvanizing processes, requiring a efficient ventilating system.

Links

MaterialUniverse

Reference