

IMPROVING THE SURFACE PREPARATION OF CAST ZINC ALLOYS BEFORE ELECTROPLATING

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The application of galvanic protective and decorative coatings to zinc alloy parts usually does not cause any technological or technical problems. However, after short-term storage, swelling and peeling of the applied coating may appear on the surface of zinc alloy parts. This problem is often associated with the porosity of the zinc alloy. The surface of the cast parts has a relatively thin, porous casting crust, and pores form when the parts cool down after casting due to thermal shrinkage. Grinding the surface of zinc alloys can remove or reduce the thickness of the casting crust. On the contrary, galvanizing zinc alloy parts improves the structure of the surface layer by compacting the surface layer of the parts during impacts. A corrosive solution that enters the pores of a zinc alloy during chemical preparation of parts or during the coating process can cause corrosion with the simultaneous formation of hydrogen. It is the hydrogen pressure that causes the coatings to swell and peel off. Poor adhesion of the galvanic coating to the zinc substrate can be caused by a high concentration of sodium silicate in degreasing solutions. Sodium silicate is poorly washed off with water, and if you do not ensure thorough rinsing after degreasing, insoluble silicic acid can form on the surface during subsequent activation in an acidic solution. Therefore, despite the recommendation to use 20 – 30 g L⁻¹ of sodium silicate in degreasing solutions for zinc alloys [1], we believe it is necessary to reduce its content to 10 g L⁻¹ or less.

Zinc alloys are chemically active and have an electronegative potential, which causes difficulties with the application of galvanic coatings. The zinc base is unstable in both acidic and alkaline environments. Galvanic coating of a zinc alloy with a metal with a more electropositive potential leads to contact reduction of this metal by the zinc surface. This impairs the adhesion strength of the coating to the substrate. To improve the adhesion of the coating to the zinc alloy, pre-galvanizing is used. Given the amphoteric nature of zinc, it is better to use electrolytes that operate at close to neutral pH values for zinc coating. In our studies, the best result was achieved in the galvanizing electrolyte of the following composition: ZnCl₂ (30–60 g L⁻¹), NH₄Cl (150–180 g L⁻¹), H₃BO₃ (20–25 g L⁻¹). Optimal regime: pH = 5.5 – 6.0, t = 18 – 30 °C. Immediately before galvanizing, the parts should be kept in a solution of 60 – 80 g L⁻¹ NH₄Cl to activate the surface. The workpiece is loaded into the galvanizing bath under current. For the first 20–30 seconds, the cathodic current density is 10 A dm⁻², then it should be reduced to 2–2.5 A dm⁻². The thickness of the zinc coating should be 2–3 microns.

According to the literature [1], galvanic coating of zinc parts is best started with cyanide copper plating. However, the problem is the toxicity of cyanide, so in this case, a pyrophosphate electrolyte can also be used. Before copper plating, activation with 40 g L⁻¹ K₄P₂O₇ is mandatory. Copper plating electrolyte composition: CuSO₄·5H₂O (30–40 g L⁻¹), K₄P₂O₇ (200–250 g L⁻¹), sodium citrate (30–40 g L⁻¹). At T = 40–50 °C and intensive stirring, the current density j = 1,5 A dm⁻². After applying 6 microns of copper from the pyrophosphate electrolyte, other galvanic coatings can be applied.

References:

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