Abstract

Galvanic plating in engineering. Development of technological process of protective zinc coating on steel details.

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The diploma project has developed a technological process of applying protective zinc coating to steel parts. The steel bracket is operated in conditions of medium rigidity. The steel bracket is operated in conditions of moderate rigidity. To provide corrosion resistance, a zinc coating with a thickness of 9 microns with passivation is applied.

A pyrophosphate electrolyte is used which contains:

$ZnSO_4 \cdot 7H_2O$	93 g/l
$K_4P_2O_7 \cdot 3H_2O$	365 g/l
NH_4Cl	80 g/l
Dextrin	2 g/l.

Conditions of electrolysis:

1. temperature 40-50 ^oC;
2. density cathode current 5 $А/дм^2$;
3. pH 7,5-8,5;
4. mixing the electrolyte.

Cathodic efficiency is 93%.

The advantages of pyrophosphate electrolyte are high productivity, capacity dispersive (close to cyanide electrolytes), non-toxicity, stability. Ammonium chloride increases the electrical conductivity and capacity dispersive of the

electrolyte, dextrin increases the polarization of the cathode and the uniformity of the coating.

The coatings obtained from this electrolyte are characterized by high uniformity, strong adhesion to the base, the coating does not contain pores and is smooth.

To provide conditions for obtaining quality coverage, preliminary preparation of details is carried out:

1. Degreasing is designed to remove from the surface of the details of the layer of grease contaminants that were formed during the manufacture and storage of details. Conducted at a temperature of 40-60 ºC, for 5-20 min. The solution contains a complex of surfactants and organic amines Gardoclean 30-50 g/l.
2. Degreasing Electrochemical:
   The mode of electrochemical degreasing: t = 18-25 ◦C, and = 2-10 A/dm^2. Reversible current is used to prevent flooding of steel details. Processing time: 5-20 min.

NaOH GOST 2263-79	30-40 g/l
Na_3PO_4 GOST 201-76	15-20 g/l
Sodium silicate	20-25 г/л
GOST 13078-81	
Additive DHTI-NT (MNT)	2-3 г/л
ТУ 6-36-5800151-506-91	

3. Since the steel parts have a rust layer, it is necessary to carry out chemical etching of the parts. Conducted within 5-20 min. In solution containing:

HCl GOST 857-78	200-250 g/l
Inhibitor	0,5-1 g/l

4. Activation is intended for removal of thin layers of oxides from a surface.

Conducted within 0.5-1 min. In solution:

HCl GOST 857-78	50-100 g/l

Chemical brightening and passivation are selected as the final operations.

Chemical brightening is made in a solution of HNO_3 5 g/l. Processing time 0,25-0,5 min.

Passivation is the application to the surface of a dense layer of insoluble compounds to enhance corrosion resistance. In this diploma project, passivation is carried out in a chromatic solution of the composition:

CrO_3	10-15 g/l
HNO_3	3-7 g/l
Na_2SO_4	10-15 g/l

For the execution of an annual program of 10,000 m^2, a steel bath with a lining size of 1250x710x1000 mm is selected. The bath is equipped with on-board ventilation, electric heater, drain valve. The details are hung on a frame-type suspension. The amperage in the bath is 414,575 A, the voltage is 5,726 V. To maintain the thermal regime, there are 16 heaters of 2.2 kW each.

The quality of the coating received must meet the requirements of GOST 9.301-86.

Control of the appearance of the coating is made on 100% of the parts by inspection with the naked eye. The coating must be firmly glued to the main metal, without peeling, splitting, blinding and cracking.

The coupling strength is controlled by a heating method of 200 ° C and an elongation for 1 hour followed by a visual inspection of the surface of the coating. On the monitored surface, no swelling or flaking of the coating should be observed.

The thickness control of the coating is carried out by X-ray spectroscopy.

Control of thickness and strength of adhesion is carried out for 0,1-1% of products, but not less than 3.

To optimize the process of applying zinc coatings, reduce manual labor costs, and strictly adhere to the rules of the technological process, the bath is equipped with an automatic control and regulation system.

The main parameters associated with the debugging of the automatic line are:

- temperature;

- acidity of the electrolyte;

- the level of electrolyte in the bath;

- amperage and voltage in the bath.

Scheme of automation involves measurement, automatic control and registration of these parameters.

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In the economic-organizational calculations the department was calculated as an object of the economy: the optimal type of movement of labor objects, the number of employees and their schedule, the technical and economic indicators of production were calculated:

- the prime cost of coverage is 119 UAH/m^2;

- investment 1 287 392 UAH;

- profit is 418 200 UAH/year;

- profitability 34,5%;

- period of return of investments 3,078 years.

This project provides for the treatment of sewage, which is formed during application of galvanic coating. Wastewater contain acid-alkaline effluents. From the galvanic workshop, wastewater enters the reactor. Disposed wastewater from the reactor is sent to the expansion vessel, which serves as a function of the preliminary settling tank. From the diluent, neutralized water is fed into sediment bowls (or collections), located on the adjacent to the galvanic workshop area. Water from the first settling tank continuously goes into the sewage system, and the sludge passes into the second one. The sludge from the last settling tank comes by gravity into the tank receiver located in the vacuum compartment. Next, the sludge is fed into a vacuum filter, which provides pumping water or sludge, and a circular pump, which serves to discharge water into the sewer. The thick sludge (in the form of a crude powder) is automatically scrapered by a vacuum filter and is scraped into a sheet, from which it is then removed into a special container and exported from the factory.

Key words: galvanic coating, zinc, pyrophosphate electrolyte, anode, automation scheme, wastewater treatment, corrosion.