## ABSTRACT

Galvanic platings in Mechanical engineering. Technology development of Ni-Co alloy plating on the steel parts.

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TechnologyforNi-Coalloyplatingofpressform (foringectionmouldingof commode doors) 100 thick was developed.It’s aimed to impart detail’s a lage hardness and stability to hight temperatures and pressures. Thepart dimensions are 500*300 mm, withplatedareaof 0,2031$m^2$.

A large adhesion to the plated part is one of the basic requirements to the electrolytic plating. So, it is necessary to clean substrate surface from thin lipid layers in depth, for avoiding bad adhesion of plating.

The best hardness, strength and specific resistance values are observed with Co content in Ni-Co alloy in a range from 20 to 40%. It is important to notice that with cathode current density, increasing internal pressures are rising and hardness is decreases.

In project, sulfamic electrolyte was chosen for Ni-Co alloy plating. Electrolyte composition:

Nickel sulfamate 450-500 g/l

Cobalt sulfamate 25-30 g/l

Nickel chloride 10-12 g/l

Sodiumdodecylsulfate 0,01-0,1 g/l

Boricacid 25-30 g/l

Saccharin 0,05 g/l

Electrolysis regime:

pH 3,5-4,5 , temperature 45 $^oC$,

cathode current density 8,5 A/$dm^2$ ,

Electrolyteismixingby Gasbubbler

Cathode current yield is 98%

The plating's obtained from this electrolyte has a great hardness and flexibility with a high current yield of the process. It gives an opportunity to get an even-thickness plating with big efficiency.

Technology uses НПА1Nickel anodes.Due to the low content of cobalt in the anode alloy, cobalt content in the electrolyte is monitored. It is cheaper than using of separate nickel and cobalt anodes.

Primary preparation of the parts is carried out to provide conditions for obtaining qualitative platings:

Degreasing parts in the organic solvent

Dehydration in an organic solvent is carried out to remove the main amount of mineral oil. Detail is wiped cloth moistened with perchlorethylene. Process time is about 8 minutes.

Electrochemical degreasing mainly is used for the final removal of lipid layers left after chemical degreasing. Degreasing is carried out on a cathode for 5 minutes, and then on an anode for 1 min.This method reduces the flooding of the metal. Conducted in stock solution:

| | |
|---|---|
| NaOH tech. | 20-30 g/l |
| $Na_2CO_3$ | 20-30 g/l |
| $Na_3PO_4$ tech. | 50-70 g/l |

Electrochemical degreasing regime:

temperature 60-80◦C,

current density 5 $A/dm^2$,

process time 6 minutes.

Chemical etching. Steel parts with exact size and a thin layer of scale are etched in the solution of the following composition:

1. Hydrochloric acid – 100 − 150 g/l;
2. Potassium iodide – 0,5–1 g/l;
3. Hexamethylenetetramine – 9 – 10 g/l

Etching regime:

process time 2-5 min,

tempretature 18 – 25°C.

**Externa lvisualcontrol of plating** is per for medfor 100% of parts by externalinspection. On the monitored surface, no swelling or flaking of the coating should be observed.

**Adhesion** is checked with an electronic adhesionmeter.For adhesion control of plating to the substrate surface was chosen adhesionmeter PosiTest AT-A. For the preheating of the adhesion of the plating, the following algorithm is used.The edges of the detector are sticked to the part.Connected device is working when pressing the "measure" button.Acceptable adhesion values from 0,8 to 1 MPa.

**Platingthicknesscontrol**is carry out with X-ray fluorescence thickener Fischer XAN®500, used for electroplating plattings. During measurements the device is pressed to the surface, after setting the value raise, the sensor will be the last value.The next measurement can be carried out after the value of the sensor will take the usual form. Permissible values of the thickness of the coating from 97 to 103 microns.

**Hardness control**is carried out with the help of a portable hardness monitor TPU-3. Hardness is defined as the ability of the plating to resist external mechanical action. The principle of operation of a hardness meter is based on the determination of the ratio of the impact velocity and rebound of the drummer, which then makes the recalculation of the scales by Lib, Vikers, Rockwell, Brinell. Allowable hardness values of 43-49 HRC on Rockwell.

The main parameters with which the automatic line is connected is:

- Temperature (45–50 $^{o}$C);
- acidity of the electrolyte (pH 3,5–4,5);
- electrolyte level in the bath (0,6 m).

Thus, the galvanic baths in the automatic line are equipped with sensors and devices for monitoring and controling the values of the parameters mentioned above.

Stationary baths can also be provided with similar sensors and devices.

Having analyzed the technical and economic indicators of this enterprise, we can say that it is cost-effective. Calculated economic values indicate that the project is competitive in the market of services and has prospects for development in this

area.Return on investment for 3.92 years is normal for the enterprisewithout the possibility of its bankruptcy.It was calculated the covering cost of 352.32 UAH/$m^2$ with the production of 11110 $m^2$/year. The profitability of the projected enterprise is 41.92%

The obtained results of calculations indicate the expediency of creating a production unit for the enterprise. Since the products developed by the developed enterprise can meet the needs of customers and increase competitiveness, expand the market and ensure the stable work of the entire enterprise.

As a modern complex method of neutralizing ions of various metals and acids, their precipitation with a solution of sodium hydroxide is used.

Since the heavy metals, acids and alkalis are used during the coating process, it is not necessary to clean the waste water. To reduce the flow of water, it is desiccated and returned to production.

The consumption of these reagents is determined based on the permissible concentrations of metal ions or acids in sewage in accordance with sanitary norms.

At the advanced plants, the galvanic workshops are located on the second floor, and the neutralization station is on the first. At the same time, the reception and treatment of technological sewage without the use of additional collectors and pumps is greatly facilitated. Mostly, acidic and alkaline waste water from a galvanic workshop is driven by gravity into a storage tank, where partially neutralizing.Nickel and cobalt containing waste water fall into another tank. The drive is a reinforced concrete container lined inside a diabetic tile or rubber. From the reservoir, the waste water enters the reactor, designed to operate under pressure. The reactor is made of steel and lined with polyvinyl chloride.

The neutralization process in the reactor lasts 7-15 minutes (taking into account the time for loading and unloading) and is controlled by the pH value. The higher the pH of sewage (acid and alkaline), entering the neutralization, means the less time that is required for their treatment.The moment of completion of neutralization of nickel-containing waters is determined by chemical analysis.

Disposed waste water from the reactor is sent to the previous tank. It is a steel bath lined with a vinyl plastic or rubber. The sediment from the bath is usually chosen

1 time in 3 months. Further, the neutralized water by gravity comes to the tank, located on the adjacent to the galvanic workshop area.

A sedimentation tank is supplied with a polyacrylamide, as a flocculant, to precipitate more rapidly. The sedimentation tank is made of reinforced concrete. The sludge from the settling tank comes by gravity into the tank receiver, located in a vacuum compartment located in the basement. Further, the sludge is fed to a vacuum filter, equipped with a vacuum pump, which provides suction of water or sludge, and a ring pump, which serves to discharge water into the reservoir.

The sludge (in the form of raw powder) is automatically scraped off by a vacuum filter and fed into a sedimentation tank. It is fed into a special storage device, from which the sludge is exported from the factory for recycling.Exhausted electrolytes (sour or alkaline) are neutralized as well as wastewater, only for this purpose use more concentrated solutions and in greater quantity Typically, spent electrolytes at the neutralization station are received periodically.Neutralization of sewage and electrolyte follows the reaction:

$$H^+ + OH^- = H_2O$$

Neutralized heavy metals ionsare converted into precipitating hardly soluble hydroxides:

$$Me^{2+} + 2OH^- = Me(OH)_2$$

Lighted water from past operations is fed to a complex of mechanical filters, where the finishing water purification from the residual content of disperse substances takes place.From the mechanical filters, the purified water, under residual pressure, enters the activated carbon filter, where the finishing water purification from the residual content of soluble organic compounds occurs.

The purified water, which meets the requirements for supplying the industrial reverse osmosis plant, comes under the pressure of a column of liquid for the installation of reverse osmosis to desalinate, from which it is returned to production.

During the implementation of this project, nickel-cobalt, which occurs in the shop for application of galvanic coatings in the process of application of the alloy, uses

harmful, chemically aggressive, fire and explosive substances and materials; The use of mechanical, electrical, thermal energy and compressed air energy is foreseen.

As vehicles in this project, it is foreseen the use of dummy TK (electric cars, electric forklifts), as well as conveyor and pipeline transport. The project is designed taking into account the requirements for occupational safety and fire safety.

Based on the analysis of harmful and dangerous factors, measures have been developed to create healthy and safe working conditions.

At the pollinating station, the following devices provide a systematic monitoring of the microclimate: alcohol thermometers (for measuring the temperature), psychrometers (for measuring the humidity), and anemometers (for determining the speed of air (once every three months) The project provides for the use of natural and artificial ventilation systems to effectively stabilize the working area of the air. In the premises of the workshop the project provides for common mechanical ventilation, as well as control of the maximum permissible concentration (MPC) of dangerous substances in the air. Natural ventilation is also providedIn summer, the bottom row of windows opens, starting at a height of 1.2 m from the floor level. Airborne devices should be at a height of 3 m from the ground. For removal of harmful emissions from the places of their formation, mechanical ventilation and local exhaust systems are used.

In industrial premises, natural, artificial, combined lighting is applied. In the fixtures of local lighting, fluorescent lamps of the type LB-40 are used.

In emergency lighting, the minimum illumination is 5% of normalized, but not less than 2 lux. For evacuation of people it is planned to illuminate on the floor of the main passages and on the stairs not less than 0,5 lux, in open areas - not less than 0,2 lux, lamps are connected to an independent power source, serviceability is checked once a quarter.

The noise reduction is achieved by the following methods:

– isolation of noise sources by means of sound insulation and sound absorption (partitions and enclosures, preventing the propagation of noise); use of silencers installed on air ducts;

– acoustic furnish of premises, and in particular, the room of sound absorbing porous materials;

– reduction of noise in the source of their formation - minimum tolerances, thorough balancing, damping of vibration of colliding parts;

– using personal protective equipment (ear plugs, ultraviolet tampons, headphones, helmets, helmets);

– with architectural and planning solution. The distance from the wall to the equipment from the working side of the line is 1.5 m, from the non-working 1.2 ... 1.5 m. The area of production premises for one working not less than 4,5 $m^2$.The minimum height of the room is 5 m, with the area occupied by the line of application of the alloy, does not exceed 25% of the total area of the galvanic workshop.

The following technical methods and means of protection are provided to ensure the electrical safety: electric equipment breaking, protective shutdown of installations, equalization of potentials, dielectric rubber gloves, isolation of current-carrying parts, rubber insulating supports, blocking devices, blocking, warning posters. The safety of operation in the normal mode of electrical installations will be followed by the following factors: isolation of current-carrying parts (isolation resistance not less than 0,5 Ohm), inaccessibility of current-carrying parts, small voltages (on portable fixtures).

Also, during operation, equipment with grounding of the I class is used, ie grounding occurs automatically when the plug is plugged into the socket.

The project provides for effective methods and means for protecting workers from injury in hazardous areas. These include guarding devices that prevent the passage of a person into a dangerous zone (to distribution devices of electrical equipment, electric motor cases, traumatic areas). Devices that signal and provide information on the operation of the process equipment, changes during the process, warn about the dangers and report, the location of their location and, if necessary, automatically disable emergency areas. The speed of vehicles (caravans, electric locomotives) in the shop is not more than 5 km / h; all load-lifting mechanisms will be subject to periodic inspections and technical inspection.Throughout the workshop

there are warning posters for informing the workers about possible hazards and first aid in obtaining various kinds of injuries.

For extinguishing a fire a stationary fire extinguishing system with air-mechanical foam is provided, as well as a water supply network, equipped in the form of a system of risers, on which fire cocks are installed.Fire cocks are located at a distance of 20 m and at an elevation of 1.35 m. According to the SNiP 20102-85, the water consumption for fire extinguishing inside the building is assumed to be based on two jets with a productivity of 2.5 m / s each.

A security and fire alarm system of an autonomous type is installed. High voltage cables are made in armored shells. Before starting electrolysis, the pipelines (supply and discharge of the electrolyte) need to be blown off by air and check the results of the purge.To protect the electrical equipment from ignition, the following methods are used: regular maintenance, painting of electrical equipment with non-combustible materials.The building is protected from a direct lightning strike by a lightning rod of a rod type.