ABSTRACT

«Electroplating in machine building. The development of technology of three-nickel coating on a steel parts»

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In 21 century humanity standing in front of space colonization. However space is not so friendly, it holds many dangers. Radiation, extreme temperature changes, toxic atmospheres and grounds that is small fraction of what the pioneers will face. But before people will stand a new ground, machines need to be used. These machines must explore new planets, carry out the necessary studies and send them back to earth, but in addition they are required to withstand enormous loads, not to be corroded To solve these problems scientists produce new invations, upgrade old one and try to do everything they can. And one of this invation is galvanic coatings.

The application of galvanic coatings is one of the effective methods of protecting metals from corrosion, increasing wear resistance and, consequently, service life, reliability of parts of machines and mechanisms, devices and electronic equipment, improving the electrochemical characteristics of numerous conductive materials. Galvanic coatings considerably improve the processing of various metal structures and products, giving them an aesthetic look. The requirements for corrosion resistance of the material may vary significantly, depending on the intended use of the product and the intended lifetime.

Nickel coatings are used in various industries. The widespread use of nickel in electroplating is due to its physical, mechanical and chemical properties.

Nickel - a silvery-white metal with a strong luster. Has an atomic mass of 58.71. Nickel density 8900 kg / m3, melting temperature 1452 ºC, heat capacity 0,48 · 103 J / (kg · K), resistance 9,068 · 10-6 Ω · m. Nickel has a variable valence (II, III); its elec-

trochemical equivalent in reactions is 1.095 g / (A · h), the standard potential E0Ni2 + / Ni = -0.25 V.

In relation to water and air at normal temperature, nickel is stable. Nickel readily dissolves in dilute HNO3. Concentrated HNO3 passivate it. In alkaline solutions, nickel is stable at all concentrations and temperatures. It is corrosion-resistant in solutions of some organic acids and mineral salts. The disadvantage of nickel is that its coating is porous and capable of absorbing a large amount of gases, which worsens its mechanical properties, to solve this problem industry used alternate deposition of several layers of metal. In such multilayer coatings, the pores of each layer usually do not coincide.

Combined nickel coatings include bi-nickel, three-nickel and sil-nickel. These coatings have higher protective properties due to the electrochemical interaction of individual nickel layers included in the composite coating.

The mechanical protection of the base metal is due to different structures of the nickel layers.

Three-nickel - a three layer nickel coating. Such a method of nickel-coating - one of the most advanced and effective methods of applying nickel coatings. These coatings are characterized by high corrosion resistance, due to the difference in potentials between the middle high sulfur layer and the adjacent lower and outer layers of nickel. The method consists in the fact that between a sparkling and shiny layer of nickel a layer of nickel is deposited in the thickness of 0,75-1,0 microns, which contains 0,12-0,2% sulfur. This layer is a more active anode compared to the upper shiny layer, and because of this, corrosion develops along the edge of the sparkling and shiny layers. Due to this delay the penetration of the corrosion process through a sparkling layer to the base metal.

The strong grip with the surface of the covered part is one of the main requirements for electrolytic coatings. For this, the surface of the products must be cleaned of corrosion products and grease films, which impair the grip. The coating should be stable in solutions of many organic acids, mineral salts and alkalis at all temperatures and concentrations.

Before the coating is applied, all parts are machined. The parts made of hot rolled metal should have a clean surface (no pickling sludge, scale, rust and other contaminants).

The reason for deflection of the parts may be: heterogeneity of rolled, rolled scale, sinks, cracks, pores, bundles, manifested after etching, if, under the control of a clean, these defects deduce the parts for the marginal deviations.

The surface of the parts supplied to nickel, after machining, should be without visible layer of lubrication or emulsion, metal chips, gauze, dust and products of corrosion.

Chemical degreasing. This type of degreasing of the metal surface is grounded in the application of solutions of alkalis, alkali metal salts and a number of special cleaning agents and compositions based on organic and inorganic surfactants and solvents.

Degreasing in alkaline solutions reduces to the saponification of animal and rose linen fats (chemical interaction with alkali to the formation of water soluble compounds) and the emulsification of mineral oils (not chemically decomposed with alkalis, but they can form emulsions with them and, due to this relatively easy to separate from the surface metal)

Electrochemical degreasing. This degreasing significantly accelerates and improves the removal of fatty contaminants. Mainly used for the final removal of minor fatty contaminants remaining after chemical degreasing, traces of hand-captured parts when mounted on suspensions, etc.

In the process of electrochemical degreasing fats are emulsified with bubbles of hydrogen or oxygen. Intense gas release contributes to the rupture of fatty film and droplet formation under the action of forces of surface tension. Oil drops are separated from the surface and captured by gas vials are applied to the surface of the electrolyte. There is a process of flooding - the hydrogen released on the cathode partially diffuses into the metal, which causes a change in the physical properties of the metal. The process takes place in a bath of electrochemical degreasing.

In practice to get nickel coating industry use acidic electrolytes of brilliant nickel, which are divided into sulfuric acid, chloride, sulfamic acid (sulfamate), silicon fluoride, hydrofluorophosphate, and others.

Alkaline electrolytes, which are used in practice, are divided into citrate, ethylene diamines.

Sulfuric electrolytes are widely used in many industries, have a diverse composition and operating modes of baths to obtain coatings with different specified properties. These electrolytes are quite sensitive to deviations from the accepted operating mode of the bath and to the presence of foreign impurities in the electrolyte.

Hydrofluorocarbon and silicon-fluorocarbon electrolytes are used for high-speed deposition of Ni. The resulting sediments are light and elastic.

Watts electrotytes are used to obtain matte coatings. With all of their diversity, they differ in their composition from the standard

Sulfamine electrolytes are used to produce brilliant coatings. Obtained from these electrolytes, sediments are plastic, with small internal stresses.

Quality control is subject to both the coating and the base metal, because the quality of the coating depends largely on the quality of the metal base. Before coating, control the quality of the base metal and determine the surface roughness, determine whether there are defects in it. High-quality metallic coatings must meet the requirements for appearance, thickness, porosity and bond strength with the base metal.

Control of the appearance of the coating. Control is carried out on 100% of the parts with the eye in a well-lit room at a distance of 25 cm from the monitored surface. By appearance:

- the coating obtained from the electrolyte has a shiny, silvery color with a yellowish tinge;

- As a consequence of deviations allowed on the surface of the covered parts, the surface of the base metal may include: traces of machining, rolling and other deviations allowed by standards or technical conditions on the base metal, stains and dark stripes in hard-to-reach for clearing openings;

- the surface of the part covered with the necessary coating is not considered to be defective in the presence of the following features: unevenness of color, traces of water strokes and solutions of chrome and phosphate salts, "illumination" formed during the control of measuring instruments and devices;

- on the surface of a part covered with several types of coatings or with the use of insulation, the following characteristics are not considered to be defective: separate sharpening of one covering to another; a displacement of the boundary of the coating to 2 mm downwards or the other side; darkening of the metal in the transition zone of one coating to another.

Control of the thickness of the coating. For control of the thickness of the coating from each batch, we select from 0.1 to 10% of the parts, but not less than 3 parts from the loading of the stationary bath. For details on the cover it is allowed to set a sample of not less than 0.1% of the parts.

The method by which control of nickel coating is carried out, is called jet-drip.

Before controlling the thickness of the coating, the parts will be kept to room temperature.

Depending on the size of the surface and the shape of the parts distinguish the test areas. The quality control is done on the outer surface of the parts, in accessible areas, not rolling, without edges, angles, carvings, openings, places of contact with the mounting device, soldered and welded joints.

In large details, the thickness of the coating is recommended to be determined using a magnetic thickness gauge.

In the case of impossibility of controlling the thickness of the coating on the parts it is allowed to make control of the coating on samples of witnesses or quality is guaranteed by the correctness of the implementation of the process When controlling the thickness of the coating is allowed:

- reduction of coating thickness up to 50% in openings, on internal surfaces, non-concave parts of complex configuration and places of connection of integral assembly units;

- in the holes with a diameter of up to 12 mm at depths of more than one diameter, the thickness of the coating is not controlled. In such cases, the absence of coverage is allowed;

- the thickness of the coating is not controlled through through holes with a diameter of up to 6mm at a depth of more than one diameter;

- slight increase in the maximum thickness of the coating on individual parts of the parts provided that the assembly and normal operation of the parts are assured.

Control of coupling strength. To determine the grip strength, select from 0.1 to 1% of the parts, but not less than three, from each batch. Apply the following methods for controlling the strength of the clutch:

- method of cutting;

- method of drawing a grid of scratches;

- method of hydrophobicity.

For this project, we choose the method of cutting, since it is simple and visual.

The method of cutting. Use steel or brass brushes (for soft coverings) with a wire diameter of 0.1 ... 0.3 mm with a rotation speed of 1500 ... 2800 rpm, which grind the surface of the coating for at least 15 minutes. After that on a controlled surface there should not be bloating and detachment of the coating.

Automation. A lot of attention in the chemical industry is given to automation, since automated lines provide higher performance of equipment, and also allow:

1) to reduce the cost of manual labor, which is an important factor in working in aggressive and toxic environments;

2) following to the strict rules of the technological process necessary for obtaining a qualitative electroplating coating;

3) to reduce the cost of electricity, non-ferrous and precious metals**.**

Ecological safety of production. Galvanic production is one of the most dangerous sources of environmental pollution. Pollution occurs due to the formation of a large volume of sewage containing harmful impurities of heavy metals, inorganic acids and alkalis, surfactants and other highly toxic compounds. In addition, waste water contains a large amount of solid waste, which is formed after a reagent method

of disposing of waste water containing heavy metals in a low soluble form. This is mainly reflected in the state of surface and underground reservoirs.

Compounds of metals, which are deposited by sewage of galvanic production, have a fairly harmful effect on the ecosystem of the type "water body - soil - plant - animal world - man". For example, cadmium compounds, even at low concentrations, have a pronounced toxic effect on fish and other aquatic organisms. Compounds of hexavalent chromium with a concentration in water of more than 0.01 mg / L cause toxic effects on the microflora of reservoirs. Thus, many chemicals that enter the environment, and thus in the reservoirs and through drinking water in the human body, in addition to the toxic effects of causing the carcinogenic (causing malignant formations), mutagenic (causing changes in heredity) and teratogenic effects (capable of causing injuries to children who are born). For example, arsenic, selenium, zinc and palladium carcinogenic effect on warm-blooded animals when they enter the body with drinking water, and chrome, beryllium, lead, mercury, cobalt, nickel, silver, and platinum when they enter the body in other ways. Under experimental conditions, cadmium, lead, arsenic, cobalt, aluminum and lithium cause teratogenic effects on animals. Some inorganic compounds cause allergic reactions in humans, for example, chromium compounds (IV). Many inorganic compounds, even at very low concentrations, affect fish and their nutritional resources. Most aquatic organisms, other than humans and warm-blooded animals, are more susceptible to the action of toxic substances. The accumulation of harmful inorganic compounds by fish tissues poses a threat to the poisoning of people who eat such food. Mercury can be accumulated by microorganisms, fish and their nutritional resources to high concentrations.

Based on the phase state of the substance in the solution, all pollution can be divided into four groups:

- suspensions in the form of fine dispersed suspensions and emulsions;
- colloids and macromolecular compounds;
- organic substances dissolved in water;
- salts, acids, bases, dissolved in water.

For each of the pollution groups there are their cleaning methods. By the mechanism of the processes methods of wastewater treatment are divided into four groups:

• mechanical (settling, filtration, centrifugation), these methods do not change neither the chemical nor the phase state of substances and are used to disperse impurities;

• chemical (or reagent), lead to a change in the chemical composition of the house-shock due to reactions that are deposition and crystallization of impurities, neutralization, oxidation-reducing or catalytic treatment of solutions;

• Physico-chemical (sorption, electrochemical, membrane and temperature-based methods), with the allocation of impurities by physico-chemical methods possible, but not obligatory, changes in both the chemical composition and the phase state of the house-shock;

• biological, based on the purposeful use of microorganisms of the animal and plant world for the disposal of undesirable impurities in water

Hazardous substances in large cities and industrial centers come into the reservoirs in the form of various compounds and mixtures. They have a common, or so-called combined effect on the human body, warm-blooded animals, flora and fauna of reservoirs, on the microflora of sewage treatment facilities.

Some inorganic compounds can cause detrimental effects on microorganisms of treatment facilities, stop or slow down the processes of biological wastewater treatment and fermentation of sediments in methane tanks. Toxic metals in reservoirs are detrimental to flora and fauna and inhibit the processes of self-purification of reservoirs, in addition, they can not be self-purifying. Their concentration in reservoirs can be reduced due to breeding, deposition at the bottom and partly assimilation of flora and fauna. By reducing the flow rate of the fluid, the amount of substances that fall in the sediment increases.

When using water contaminated water for irrigation, non-ferrous metals are applied to the fields and concentrated in the upper most fertile humus layer of soil. Which leads to a decrease in the nitrogen fixing ability of the soil and the yield of

crops, the accumulation of metals above allowable concentrations in feeds and other products.

The modern complex method of neutralizing ions of various metals and acids is their precipitation with a solution of cyanide ferrate and sodium sulfide. The latter are non-toxic and well soluble in water, but practically insoluble in acid solutions. This solution provides a more complete deposition, in comparison, for example, with lime. The consumption of these reagents is determined in accordance with sanitary norms, based on the permissible concentrations of metal ions or acids in sewage.

At the advanced plants, galvanic workshops are located on the second floor, and the neutralization station - on the first. This greatly facilitates the receipt and treatment of technological sewage without the use of additional collectors and pumps. In most cases, the waste water from the galvanic workshop is driven by gravity in the drive. It is a reinforced concrete container lined inside a diabetic tile or rubber. And from the storage tank, the waste water enters the reactor - a monzueus, which is designed to work 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). The control is carried out at the pH value: the higher the pH of the sewage (acid and alkaline), the lower the time for their treatment. The moment of completion of neutralization of nickel-containing waters is determined by chemical analysis.

From monzius disposed of waste water is sent to the dilator. It is a steel, lined with a vinyl plastic or rubber bath, which serves as a preliminary settling tank. Bathing is usually selected once a quarter. From the diluent, neutralized water by gravity flow into the sediment bowls (or collections), which are located on the adjacent to the galvanic workshop area.

The work of settlers is based on the principle of connected vessels. Thus, water from the first settling tank continuously goes into the reservoir, and the sludge passes into the second one. The sediments are made of reinforced concrete. The sludge from the last 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 vacuum filter automatically scrape pasty slime (in the form of raw powder) into a sheet, from which it is then removed into a special container and exported from the factory.

Used electrolytes (sour or alkaline), as well as waste water, also neutralized.

Results

The purpose of this project was to obtain a three-nickel coating, for which a technology of galvanic coating of nickel coating on steel parts in an automatic galvanic line with a productivity of 8000 m2 / year was developed. Conducted calculation of the technological process. For implementation of the annual production program, balance sheets of current, voltage, energy, heat calculation were made, calculated the charges of the anodes, chemical reagents and water. In order to minimize the harmful effects on the environment, the proposed reagent method of wastewater treatment, which is simple, high degree of purification and economical.

Labor protection measures were developed that are based on the analysis of harmful and dangerous factors of the projected production, which are in accordance with applicable norms and standards, and relate to the normalization of industrial lighting, working area air, noise protection, vibration and electric shock, and fire safety. Also, individual protection measures are selected for workers.

In the economic part of the diploma project, the technical and economic indicators of the enterprise are calculated.

Also in the project a scheme of automation of the process of coating the three-nickel is proposed.

Key words: galvanic coatings, nickel coating, galvanic bath, three-nickel, space, protection, control, electrolysis, wastewater.