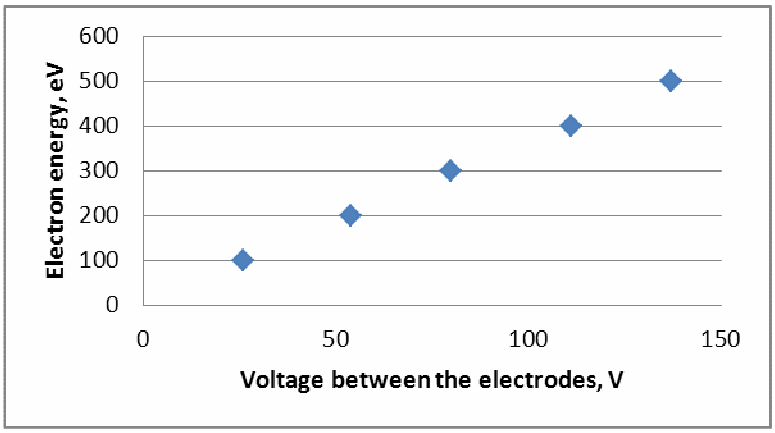

Fig. 4. The dependence of the electron energy on electrodes potential difference for selection in the aperture of Faraday cup

Computer simulation IBSimu package is a powerful and available tool for solving problems of electrophysics, connected with transportation of charged particle beams. In this research the simulation of electrostatic analyzer with two different electrodes was carried out. The shape and position of the electrodes can be randomly chosen, so that the solution of this problem may be optimized depending on the real conditions available in the electron gun.

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UDC 658.264 = 111

THE METHODS OF FUNCTIONAL COATINGS APPLICATION ONTO FLAT SEALING SURFACES OF THE STOP VALVES PARTS

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The actuality and effectiveness of the stop valves worn-part reclamation are presented. The results of the comparative analysis of the known techniques of protective finishing onto the sealing surface for valves service properties restoration are given. The classification of anti-abrasion coating application methods are given depending on their properties and characteristics. Factors and conditions influencing the abrasion resistance of the coating material and its adhesion with the detail base material are defined. The usage of the freezing out coating process onto the flat sealing surfaces of the stop valves parts are shown.

In practice the service life of the stop valves parts is frequently less than the standard one, what is predetermined by many reasons, namely, by stiffening of operation conditions: the increase of temperature and working medium (water, steam, drilling and bore-hole fluids, natural gas, hydrocarbon oils), its corrosive power. Due to the high rate of the working medium vibro-impulsive loads, cavitation and flowing section elements erosion of valves emerge, against this background of high temperatures such damaging factors as abrasive erosion and mechanochemical wear intensify.

The current concern lies in the issue of increasing the durability of the stop valves used in pipeline transportation systems (oil-and-gas, heat-and-power), since their insufficient endurance capability can be the reason for the environment pollution, increases the scope of repair-and-renewal operations, parts repair stock.

Special importance is paid to the matter of pipeline valves parts service life improvement in the respect of the used materials and know-how. This can be exemplified by prefabrication of parts with sealing surfaces from

volume-alloyed materials with further heat treatment and application of electrochemical coating methods or surface impregnation. However the possibilities of the employed abrasion-resisting materials and the known technologies of their application to a considerable extent re used up, that's why the employment of more enabling technology to assure high durability of quickly wearing parts of the stop valves is a perspective trend.

Practically the low post-repair performance period of the repaired stopping-control valves due to intensive destruction of the restored coating on sealing surface takes place. The frequent reason for this is faulty adhesion of the protective coating with the material of the restored part, and in some cases insufficient coating hardness as well.

Thereupon the elaboration of new and the improvement of the applied restoration processes of pipeline valves parts worn-out surfaces, providing secure adhesiveness between the coating material and the part is of great practical consequence.

The solution of this task is connected with the necessity of carrying out of the system comparative analysis proceeding from requirements to functional coatings.

Parts subject to wear out fall under two groups: parts forming friction couples; parts destruction of which is called by the working medium (liquid, abrasive particle, gas etc.) [1].

The shutter parts are the most loaded elements of a valve, the probability of its failure depends on the sealing reliability [2].

The coating structure; geometrical and physical-mechanical condition of the coating facial layer; coating material compatibility with the counterbody in friction couple belong to the main factors defining the durability of the parts protective coatings [1].

The main requirement raised to the geometrical condition of the coating facial layer applied to the given groups of the valves parts is the quality of the working surfaces, for instance, the sealing surface roughness shall be not less than Ra = 0,16 μm [3].

The main performance requirement to the parts of stop valves is high abrasion resistance of the coating surface cover.

The biggest influence on it is given by the presence of carbides and borides in the microstructure of the coating.

Valves parts operation conditions contribute to working surfaces gripping leading to score marks resulting in intensive destruction of the sealing surfaces. One of the main ways to reduce contact surfaces gripping is the increasing of their hardness.

Thus the main criteria for choosing the method of restoration are the hardness of the protecting coating and its adhesion with the base material.

From many ways of increasing pipeline valve parts abrasion resistance by means of protective coating application [4] one should single out thermal spray coating and surfacing.

However for the sprayed coating the mechanical interlocking and a low level of cohesive resistance at the boundary "coating-base" are characteristic. Protective coating and base material cohesive resistance is increased by means of surface preparation for the coating with the help of "ragged" threading, abrasive flow treatment, etc.

To obtain sufficiently solid and anti-abrasion coating with good bond between coatings and a base surfacing and diffusion alloying are widely used. However the last strengthening method due to the low thickness of the obtained coatings is not suitable for application of functional coatings restoring geometry of the worn-out part.

The surfacing process has got wide application for parts restoration and quite sufficiently explored [5]. This method has a number of advantages [5], the following ones are important in the respect to stop valves parts restoration:

- possibility to apply coatings of a big thickness with high efficiency;
- absence of restrictions in sizes of the facing surfaces;
- possibility to apply a wide range of wear-proof coatings;
- possibility to combine with other restoration techniques.

While repairing the valves of heat-and-power and oil-and-gas equipment the protective coatings surfacing in the majority of cases is performed by means of arc method. Nevertheless the quality of the pad weld is not always assured high and stable due to the considerable depth of penetration, which leads to undesirable interfusion of the base and built-up metals.

Based on the usage of the highly concentrated sources of energy contemporary methods don't have this disadvantage. Laser, plasma and electron-beam techniques of surfacing provide inconsiderable depth of penetration and the width of the heat affected zone.

Plazma technique of protective coating application is the most widely used [6].

Nevertheless performing plazma surfacing of the wear-resistant coatings it is impossible to adjust the degree of the base metal penetration.

Comparative analysis of the methods of protective coatings application on the wearing sealing elements of the stop-control valves by means of the surfacing method shows that each of them has significant disadvantages to eliminate which certain conditions able to assure the formation of the superficial protective coatings with a set of necessary properties have to be provided.

Thus to obtain quality coatings applied by means of electron-beam and laser surfacing it is necessary to perform surfacing of the coatings with preheating and in some cases with concurrent heating of the base metal to reduce the residual tensions as well as to reduce the probability of cracks emergence in the built-up layer. Though the introduction of the preheat leads to the rise in price of the technique.

The important role in the formation of the protective coating is played by the processes of damping the surface of the solid metal by the molten and of temperature fields distribution in time during the whole process of surfacing. Under electron-beam, laser, arc and plazma surfacing the damping is of "dot" nature. At that regardless that the thermal energy source is approximated to the quick-acting in the process of protective coating application by the given methods, nevertheless it can be viewed as dot method with concentric distribution of temperature fields because of its immediate action.

As a base material for the fabrication of the shutter part with sealing surfaces usually chromium steel is used, that's why to prevent chrome burning-out the surfacing shall be performed quickly avoiding the breaks and reheating.

The disadvantage of the "dot" damping in the process of surfacing by the point source vividly emerges on the stage of the metal bond formation, when the physical contact and chemical interaction of both the part material and the coating take place.

Based on the outcome of the comparative analysis of the protective coating surfacing methods it is possible to note that to receive quality combination of the coating metal with the base metal and minimal content of the elements of the base metal in the surfacing metal while surfacing it is necessary to assure:

- minimal depth of penetration of the base or to exclude it completely;
- damping the surface of the solid metal by the molten all along the building-up surface;
- minimal duration of solid and liquid phase contact.

None of the considered surfacing methods assures the observance of the total set of the necessary conditions which allow obtaining the qualitative result – required service properties of the applied functional coatings under the high efficiency of the restorative process.

If to consider the pipeline valves from the point of view of shutter unit design, so, according [7], taking into account the quantity of the units used stop valves make up 80% of all the valves. Herewith taper-seat valves with flat sealing surfaces are used in the main. That's why one of the promising techniques of stop valves parts surfaces restoration is the method of freezing-out, which allows restoring their geometrical parameter in a single cycle with high efficiency [1].

Freezing-out method lies in dipping the flat fluxed surface of a detail for on definite time into fusion of the process alloy with bigger temperature. As a result of the ongoing thermal processes the coating is formed on the surface by means of crystallization of the alloy layer and a solid bond is assured when the emergence between the activated atoms of the base metal and process alloy.

Nevertheless the traditional method of freezing-out is characterized by low bond strength between the coating and the base related to insufficient deoxidation of the base surface.

To eliminate this disadvantage it is necessary to improve the method of coating by means of freezing-out with a degree of deoxidation of the base surface sufficient for a strong metallic bond formation.

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