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Technology of Ion-Plasma Nitriding of the Teeth of the Saws of the Saw Cylinder Node

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ABSTRACT: The technology of obtaining a deep-nitrated layer on a disc saw of a sawing cylinder for a short period of time (0.5-2 hours) and the subsequent standard heat treatment is considered. The results of resistant characteristics test of disc saw made of У8Г steel and processed according to the deep nitrating technology are presented.

KEYWORDS: Deep nitrating, circular saw, sawing cylinder, ion-plasma nitrating, heat treatment, resistance, У8Г steel.

I.INTRODUCTION

The saw cylinder volunatarily machines are designed to grip the teeth of saw blades fiberletuchek, separation of the seeds and removal through slotted gaps in the grate to vozduhotehnika apparatus. In addition, simultaneously with the separation of the fiber, the saw cylinder, coming into contact with the raw roller on the fiber capture arc into the working chamber, rotates it, which creates conditions for a constant supply of fresh bats to the saw blades.
The following technological requirements for the saw cylinder are established: it must have a high gripping ability to ensure a given performance and uninterrupted rotation of the raw roller; saw blades must be rigidly fixed to the shaft of the saw cylinder, do not change their position during operation. During rotation of the cylinder saw blades are exactly in the center plane of the gap between the grates [1].

According to the number of saw blades on the shaft of the saw cylinders are divided into 80, 90 and 130 - saw cylinders and cylinders with an even greater number of saws. The increase in the number of saws over 90 requires a change in the size of the fiber separation machine.

II. SIGNIFICANCE OF THE SYSTEM

The problem of increasing the efficiency of the circular saw unit of the saw cylinder fiber separating machine by increasing the durability of the tooth can be solved by the use of ion-plasma nitriding. This technology can significantly accelerate the process of saturation of the surface of the saw teeth with nitrogen, compared with traditional furnace nitriding. Thus, when nitriding a circular saw unit of the saw cylinder of a fiber-separating machine from carbon steel У8Г in a plasma of a two-stage vacuum arc discharge (DVDR), a layer with an effective thickness of up to 200 µm and a hardness of up to 0.05 kgs/mm^2 is formed within one hour. Vitality of the teeth of the saws, the last such treatment increased 1.5 times compared to easterbunny circular saw [2].

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III. LITERATURE SURVEY

Ion-plasma nitriding is a multifactorial process of chemical-thermal treatment. The structure, phase composition and characteristics of the diffusion layer formed under glow discharge conditions are determined by a number of technological factors. By controlling them, it is possible to adjust the thickness of the nitrided layer and its structural state, which determines the complex of necessary properties of the hardened parts, taking into account the conditions of their operation. In addition to the usual technological factors that affect the efficiency of ion nitriding (temperature and duration of saturation, the composition of the gas medium), it has additional, due to the specifics of processing in the glow discharge (working gas pressure, electrical characteristics, interelectrode distance; configuration of parts and their location in the cage). Most of these factors are in a complex and yet insufficiently studied relationship. Therefore, the currently used ion nitriding processes are based on empirical data and experimental selection of rational modes of surface hardening of certain alloys[3].

When ion nitriding of any conductive materials, there are practically no restrictions on the size and weight of the processed parts.

One of the disadvantages of the existing method of ion nitriding is the inability to accelerate the process by increasing the density of the ion current, as a result of overheating of parts reduces the surface hardness.

Studies have shown the prospects of using the method of ion nitriding in glow discharge to improve the properties of metal alloys.

Nitriding in the glow discharge is a fairly simple and reliable process, but as a result of ion bombardment significantly deteriorates the purity of the substrate surface, the process requires the presence of hydrogen, which makes certain difficulties.

IV. METHODOLOGY

The proposed technology compares favorably with other known methods of strengthening the circular saw in that a relatively deep diffusion layer with a high concentration of nitrogen is created in the steel. During the subsequent hardening of the circular saw, nitrogen diffuses deep into the product, increasing the hardness and heat resistance of the steel at a depth of 0.7—1 mm.

The method of ion-plasma nitriding by the method of DWDR allows due to the high emission ability of plasma to provide purification, heating and high rate of diffusion of nitrogen deep into the metal [4]. Thanks to this solution, a high concentration of nitrogen can be achieved in a short time (0.5—2 hours) in a thin (up to 200 μm) surface layer.

Implementation of deep ion-plasma nitriding technology was carried out at the STANKIN-APP-1 unit (Fig. 1). The object of the study was a circular saw made of steel У8Г and samples of the same steel witnesses for the subsequent measurement of microhardness and phase analysis. In order to avoid deformation of the circular saw, a tool was developed, since the thickness of the circular saw is 0.95 mm (Fig.2).

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Fig.1. Vacuum installation "STANKIN-APP-1".

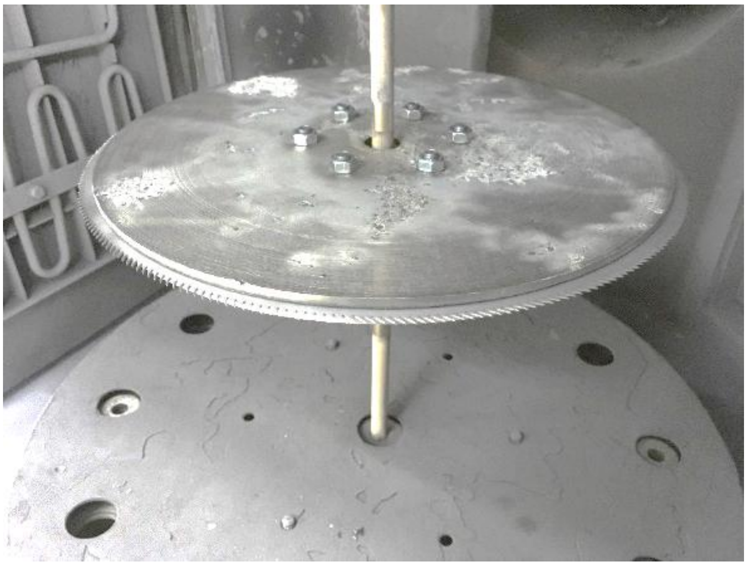

Fig.2. Circular saw with tooling, placed in the vacuum chamber of the "STANKIN-APP-1".

Disk saw and samples, after mechanical treatment of annealed steel billets were placed in a vacuum chamber of the "STANKIN-APP-1". Then, heating was carried out to 650 °C in argon medium at a pressure of 0.4 MPa with simultaneous ion cleaning of the surface. Ion-plasma nitriding was carried out at 650 °C in a pure nitrogen medium for 1 hour at an arc current of I_d = 80 A and an additional anode current of I_{da} = 75 A, while the offset voltage U =700 b was applied to the table with the part. After nitriding, the disk saw and the samples are slowly cooled in the chamber to room temperature[5].

To measure the microhardness and the establishment of the phase composition were made of the micro-sections on equipment of the company "Struers" (Denmark).

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Microhardness was measured using the prefix "Micro-duromat 4000" to the microscope "Polyvar-Met" (Austria) at a load of 0.294 N and a test time of 10 seconds. Prints on the surface of the microplate were applied in the form of a "track" from the edge to the center in steps from 10 to 500 microns (depending on the hardness and distance from the surface of the sample). At the same time, the number of prints at each depth varied from three to eight, depending on the magnitude of the spread of values. The relative error of the average microhardness with a probability of 0.95 did not exceed 4%.

X-ray phase analysis was performed using PANalytical Empyrean (Holland) diffractometer using sica radiation. The survey was carried out under conditions of symmetrical Bragg-Brentano focusing, using a beta filter.

V. EXPERIMENTAL RESULTS

The results of measurement of microhardness after ion-plasma nitriding are shown in Fig. 3 and give an idea of the high concentration of nitrogen in the thin surface layer.

This is evidenced by the high microhardness of the surface layer: at a depth of 200 microns, the microhardness ranges from 600 to 700 HV. The high hardness is due to the presence of complex iron nitrides and alloying components of the me4n type in the steel structure, which contain up to 6% nitrogen by weight, while the nitrogen content in the ferrite is significantly lower (at 590°C not more than 0.12%) [6, 7]. The created high concentration of nitrogen in the thin near-surface layer is necessary for further diffusion of nitrogen deep into the steel in the process of subsequent hardening.

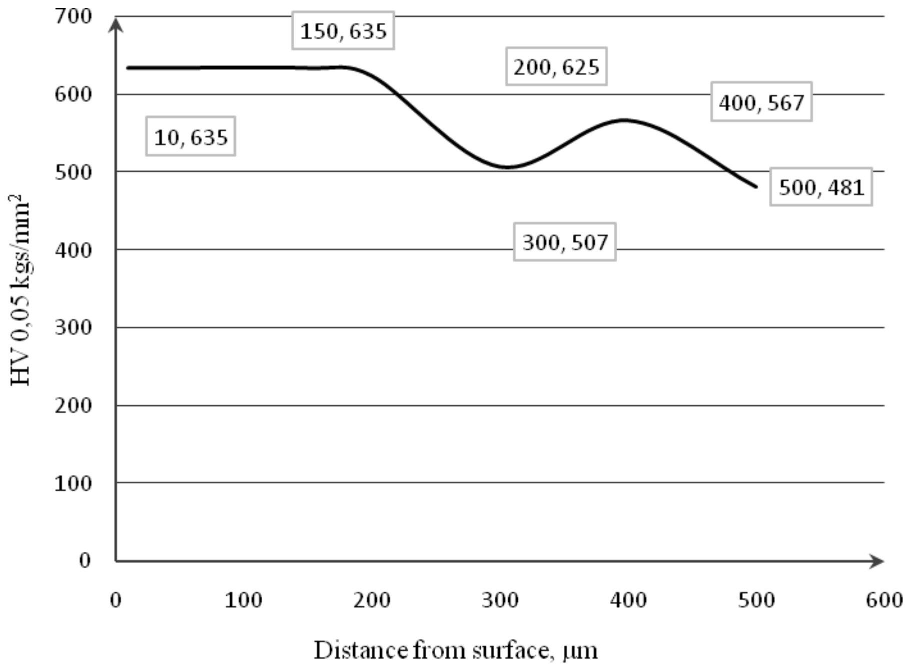

Fig. 3. Distribution of microhardness in depth in steel У8, after ion-plasma nitriding at 650°C with a shutter speed of 1 hour.

High hardness and heat resistance of steel U8G after processing, as well as a large depth of the hardened layer cause increased resistance of the teeth of the circular saw (Fig.4). For example, the resistance of teeth after deep nitriding is 1.5 times higher compared to non-nitrided ones.

Fig. 4. Circular saw after nitriding.

VI.CONCLUSION

1.Chosen a more appropriate technology of advanced ion-plasma nitriding and by its practical implementation for circular saw blades of steel У8Г.
2. Deep nitriding technology allows to obtain the depth of the diffusion layer of more than 1 mm with increased hardness and heat resistance, while the process of nitrogen saturation does not exceed 1 hour.
3. The results of endurance tests show the feasibility of using this technology for circular saws. The total resistance of the teeth of the circular saw steel У8Г increased by 2 times compared to the circular saw without nitriding.

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