THE EFFECT OF JET ELECTRIC DISCHARGE ON THE STRENGTH CHARACTERISTICS OF THE SURFACE

M F Akhatov¹, R R Kayumov¹, R R Mardanov¹, I M Loginova²

¹Kazan National Research Technical University named after A. N. Tupolev - KAI, Kazan, Russia
²Kazan State Agrarian University, Kazan, Russia

ahatov.81@yandex.ru

Abstract. In this paper, the results of measuring the density of the skin of metallic tissues using an installation for assessing the strength of damaged layers (sclerometer) MV-11m, a study of the treatment of tissues with an electrolytic discharge, are revealed.

1. Introduction.
The development of technology poses to physics the task of studying processes with high concentrations of energy, high pressures and temperatures. An electric discharge in a liquid is one of these processes. As a result of the rapid release of capacitor energy, high temperature and pressure occur in the discharge channel. Presumably, the electron temperature is higher than the temperature of heavy particles. These qualities of electrical discharges in liquids are widely used in the development of new technological processes for processing various materials and in the creation of new means of energy conversion. The prospects of using such discharges for a number of technological processes, such as obtaining oxide powder, cleaning and polishing the surface of metals [1], for heating metals [2], as well as for initiating chemical reactions in electrolytes, have been established.

2. The main part
Measurements of the surface strength of metal products were carried out using the MV-11m installation for assessing the strength of surface layers (sclerometer) [3]. In particular, the installation provides automatic registration of scratching diagrams with a diamond indenter of surface layers of materials and coatings with determination of the fracture characteristic - hardness during scratching.

The measurement procedure is following: the test sample is placed on a lifting table and clamped to the lower surface of the beam. By rotating the screw, the indenter is buried by a predetermined amount. After the installation is turned on, appropriate measurements are carried out during the operation of the sclerometer, and a graph of the dependence of the force applied to the indenter on its movement is plotted in real time [4]. The figures show the results of the study, graphs of the dependence of the force applied to the indenter on its movement before and after processing for copper (Fig.1) and steel (Fig.2). In all cases, the diamond cone of the indenter was buried to a depth of 20mkm.
As can be seen from the figure, when examining untreated copper, the movement of the indenter begins already with an effort of less than 1 kg or less than 10N. The second graph shows that the movement of the diamond indenter begins at a force of 3.5 kg or approximately at a load of 35N. According to this it can be concluded that when the surface of copper is treated with an electrolytic discharge, the surface hardening of the product is performed [5].

2.1. Figure 2 shows the results of the study of the surface of the steel plate before and after processing. Here you can see that the movement of the indenter begins with a force of 7 kg or 70N. After processing a steel product with a discharge, its strength characteristics have noticeably improved, the movement of
the diamond indenter along the plate begins only with a force of more than 10 kg or already with a load of more than 100N.

3. Conclusion

As a result, measurements of the hardening the samples with various surface pretreatment show an increase in its strength characteristics several times. Thus, electrolytic discharge treatment affects the strength of the processed product, which is another advantage of this discharge.

The research was supported by a grant from the Russian Science Foundation (project No. 22-29-00021).

References

[1] Kayumov R.R. Experimental study of the effect of electric discharge on carbon fiber/Zakirov Zh.U., Kayumov R.R., Khazeev K.I.// Journal of Physics: Conference Series This link is disabled, 2021, 1870(1), 012007
[2] Akhatov M.F. Glycerin as an electrolytic electrode / Sh. Akhatov, G., Kayumov R.R., Valeeva R.R., Akhatov M.F.// Physical journal: conf. Series. 2019.V. 1328 Is.1,01200410
[3] Bagautdinova L.N. Low-power electric discharges with metal, dielectric and electrolytic electrodes at low frequencies and atmospheric pressure / Gaisin A.F., Sadriev R.S., Bagautdinova L.N., Nasibullin R.T., Gaisin F.M., Mastyukov S.S. // High temperature, 2020, 58(6), pp. 777-780
[4] Galimova R.K. Calculation of portable properties of some real gas mixtures at high temperatures / Taxeitov R.R., Galimova R.K., Yakupov Z.Ya. // Physical Journal: Conference Series, 2020, 1588(1), 012065
[5] Fakhrutdinova, I.T. Features of the development of an electric discharge between a jet anode and a liquid cathode / Galimyanov I.I., Gaisin A.F., Fakhrutdinova I.T., Shakirova E.F., Akhatov M.F., Kayumov R.R. // High temperature, 2018, 56(2), pp. 296-298
[6] Tsareva, A.M. Determination of natural frequencies and vibration modes of a disk of constant thickness with a central mount / Makaeva, R.Kh., Tsareva A.M., Karimov, A.Kh. // Russian Aeronautics, 2008, 51(1), pp. 53-59
[7] Gaisin A.F. Special features of a multichannel discharge in a porous solid cathode/Loginov N.A, Son E.E., Gaisin A.F., Gaisin F.M. //High Temperature. 2009. T. 47. № 4. C. 603-605. A subsection