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INCREASING WEAR RESISTANCE OF THE SUPERFICIAL MICROALLOYING LAYERS

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Abstract: *Structuralchanges occurring in the superficial layers of samples processed through electrical sparking method has major influences for increasing the wear resistance. The paper shows some theoretical and experimental aspects with respect to superficial hardening of the grey cast irons and carbon steels. The used process for the superficial hardening allows obtaining very high hardness (1100HV) on the treatment surfaces, without the change of the bulk structure. The microalloying and deposition with vibrator electrode give the superficial hardening.*
Keywords: *Deposition, layer, discharges, hardness, wear*

1. INTRODUCTION

The efficient and rational use of metallic materials is a problem of actual interest in most factories. The superior capitalization of metallic materials into products is obtained by application of the most efficient bulk ï and / or surface ï thermal treatments.

In most cases, the pieces are made by carbon steel, low-alloy steel or rich-alloy steel and in some cases by irons. In order to increase the wear resistance and the hardness, major properties of pieces, these are subjected to superficial hardening treatments: thermal (superficial chilling), thermochemical treatments.

This paper presents a theoretical and experimental evaluation, with respect to the superficial hardening of the grey cast irons and carbon steels. The experiments on some parts, were done for a superficial hardening in order to obtain a very high hardness (1100HV) on the treated surfaces, without the change of the structure, being necessary to use different processes. These research is limited to the materials used for the experiment, the dimension of the supporting pin-shoe assembly and can be applicable in specific conditions.

For the same purpose of increasing the endurance of pieces (machines organs, tools) intensely subjected to wear, in the last time a series of unconventional superficial treatments were imposed. One can remember the thermal treatments with laser beam, thermal treatments with electron beams and, last but not the least, the PVD and CVD. All these methods confer very high hardness to superficial layers, yielding to a considerable enhancement to the treated piece lifetime [3].

In important disadvantage of these treatments is the high-price since expensive installations and devices are needed. Recently, in the field of surface engineering a new kind of superficial thermal treatment of microalloying and spark deposition was imposed. Spark microalloying method is based on the material transfer effect from electrode to the surface of the treated piece during the electrical discharge in the gaseous environment between electrode and piece. The basic requirement is the electrical conductivity of the piece and electrode [3].

After being subjected to such a treatment, the piece surface will be covered with a layer made by electrode material, named white layer, under which is a diffusion zone formed by the basis material in which the electrode material has diffused.

The processes, which take place in the piece superficial layer during the treatment, are:

- the acquiring of a possible layer of white cast iron on the grey cast iron pieces, on which the deposition with hard carbides is achieved;
- the microalloying by combining the electrode elements with melted metal and basic material.

The currently obtained layer thickness are up to 50 εm with a layer consistence up to 100% and roughness R_a = 3.2 ï 14.8εm.

The electric spark of method basic requirement is the electrical conductivity of the piece and electrode. This fact determines the use of metals, metallic alloys, metalloceramic materials and fireproof compounds as electrodes and pieces.

The electric spark processing begins by bringing the electrode (anode) near the piece electrode (cathode), and when the distance becomes smaller than the percolation threshold, an impulse electric discharge forms which ends when the electrodes touch.

The last phase of the process begins when the pressure (given by removing the vibrating electrode) between the electrodes decreases, and ends when the electric circuit breaks off, at a distance greater than the percolation threshold (which is equal to the amplitude of vibration). Using the RC impulse generator, when the electrodes separate, an electric spark may or may not appear. Even if an electric spark appears, it will produce a negligible electrode erosion effect.

During the spark (10^{-6} ï 10^{-3} s), at the electrodes surface, localized centers of melt and evaporation develop, leading to electrodes erosion. Due to polar effect, the predominant transfer of eroded anode material to the cathode provides the forming of the superficial layers of diffusion (alloying) and deposition (white) with well-determined properties.

After discharge, at a certain time, the anode electrode is removed from the cathode piece, switching off the electric circuit; then the process is resumed, finally

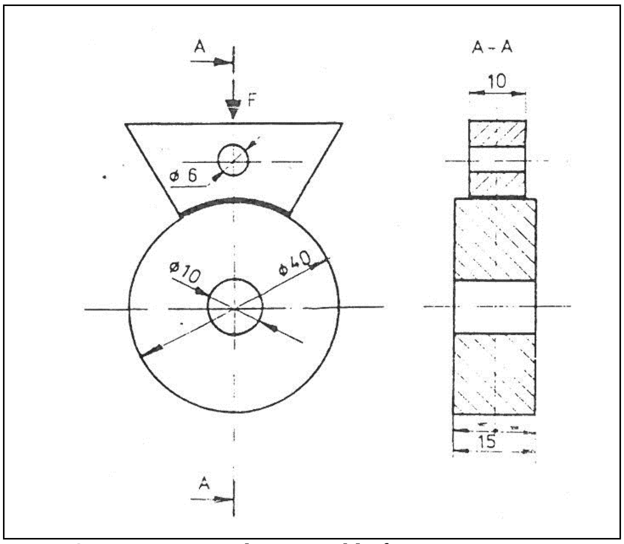

Fig. 2. Supporting pin - shoe assembly for wear test

The wear behavior of the hardened and unhardened coupons is listed in Table 6.

S[m]	▪Δm	
	A	B
125	110	-
250	150	-
500	200	30
1000	360	36
2000	580	45
4000	810	58
6000	1080	70
8000	1390	98

Tab. 6. Mass loss(φm) dependence on the abrasion length (S) after abrasion testing. Obs. A ï sample untreated superficially B ï sample treated by electric spark

4. CONCLUSION

The method used is simple and not expensive. The method is based on the material transfer effect from electrode to the surface of the treated piece during the electrical discharge in the gaseous environment between electrode and piece.

Using of optimal working regimes will lead to achieving some very good quality coatings

The type of coating depends on the electrode speed over the surface of the sample a well.

Superficial processing using electrical sparking is a typical discharging through multiple impulses and during a very short time. In essence, during the time of discharging a cathode erosion is produced and there is a material transfer on the processed surface.

A bigger distance between the electrodes leads to a high quantity of energy in the discharging channel, and to a decrease of the energy transmitted to electrodes. As a consequence, there is a decrease of erosion, so the material transfer between the electrodes is decreased.

Microhardness on layer is greater than on basic structure and enhanced values are obtained using the tungsten carbide electrodes.

Sparking with WCo8 electrode lead to hardness values in layer higher than with electrode Ti15Co6.

The thickness of the deposited layer can be as high as 100 εm.

The wear behavior of the layers is very good.

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