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TECHNOLOGIES OF RESTORATION AND STRENGTHENING OF CAMS OF THE CRANKSHAFT OF THE AUTOMOBILE ENGINE

The main factor in the restoration of the surface is the strength of the welded layer with the base material. The surfacing material must ensure reliable adhesion of the base material to the substrate, reduce the risk of chipping and concentrations of thermal stresses in the transition zones, have high physical and mechanical characteristics, the ability to strengthen treatments. OZSh-3 electrodes were used to restore the working surface of the steel 45 cams. In terms of carbon, manganese and silicon, the steel surfacing electrodes are close to the components of steel 45 and this guarantees a reliable adhesion of the surfacing layer to the base material. After application to the prepared surface of the surfacing layer, blade treatment was performed, followed by grinding to obtain the appropriate geometry and roughness. The removed layer of metal allows to remove welding defects (pores, micro cracks and other defects).

The aim of the work is to conduct microstructural, X-ray phase studies of the restored surfaces of the cams of the camshaft of the car, to determine the wear resistance and microhardness of the working surfaces. With the help of the proposed technologies of restoration and strengthening, the optimal modes of applying the recovery layer and the optimal modes of laser treatment (pumping energy 20 kJ without surface melting) with boron-containing coatings (thickness 2 mm) were selected. In the transition zone, residual austenite is transformed into ferrite with the formation of two phases: ferrite particles (dark cascades), and the phase "boron + carbon" - boron carbide (white spots).

The main transformation of the structure occurs in the surface and under the surface zones. The main lines observed on the X-ray diffraction pattern of the sample are α-Fe, which is more than 90% in intensity. Boride lines Fe_2B, FeB less intense (up to 4%) and also present in small quantities (up to 3%) iron carbide lines Fe_3C and compounds are observed $FeCr$. Researches of the restored and strengthened surfaces of cams by means of laser drilling are carried out. Reinforced surface layer has a complex structure and generally contains a martensitic base with thin layers of borides, carbides. The microhardness of the treatment zone increases by 3-4 times (H_μ 6500-7000 MPa).

References

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EVALUATION OF THE LIQUID STEEL DESULFURIZATION PROCESS IN A FURNACE

As part of modeling the process of deoxygenation of metal and powder during out-of-furnace treatment, an attempt was made to estimate the distribution coefficient of sulfur and its concentration in the alloy.

During the processing of steel in a ladle furnace, reducing silicon is produced, as a result of which the oxidation of both the alloy and the alloy is reduced, and the activity coefficient of sulfur is also increased. At the same time, the value of slag increases when lime is added to the ladle [1].

Analysis of the data on the composition of the slag, calculated by the mathematical model and obtained in experiments, allows us to conclude that the slag is more absorbent than sulfur.

The following simplifications were made in the calculations:

– mass transfer process under conditions of manganese limitation;

– at high mixing intensities, an equilibrium of the redox reaction is achieved [2].

The following reaction data were used to study the interaction between the liquid oxide alloy and the metal and to estimate the depth othe desulfurization reaction:

$$[S]+(CaO)=(CaS)+[O], \tag{1}$$

$$K_1=\frac{a_{CaO}\cdot a_O}{a_{CaO}\cdot a_s}=\frac{X_{CaO}\cdot\gamma_{CaO}\cdot[O]\cdot f_O}{X_{CaO}\cdot\gamma_{CaO}\cdot[S]\cdot f_S}, \tag{2}$$

It is clear that an increase in the distribution coefficient of sulfur between metal and slag, which ensures more complete desulfurization, is facilitated by the high activity of CaO in the slag, the high activity of sulfur in the metal, and the low oxidation of the metal [3].

Indicate the concentration of gray matter in the slag through XCaO:

$$X_{CaO}=\frac{(\%S)}{32\sum n}, \tag{3}$$

where 32 is the atomic mass of sulfur, g/mol;

$\sum n$ – 100g is the total amount of components in the slag.

From (2) and (3) we obtain an expression for the equilibrium distribution coefficient of sulfur $L_S=(S)/[S]$:

$$L_S=32K_1\frac{X_{CaO}\cdot\lambda_{CaO}\sum n}{\lambda_{CaO}}+\lg\frac{f_S}{[O]\cdot f_o} \tag{4}$$

After logarithmic (4) we get:

$$\lg L_S=\lg 32\cdot K_1\cdot\frac{X_{CaO}\cdot\lambda_{CaO}\cdot\sum n}{\lambda_{CaO}}+\lg\frac{f_S}{[O]\cdot f_o}, \tag{5}$$

When refining liquid iron and $f_O \approx 1$ və $fs \approx 1$. Then

$$\lg L_S^{Fe}=-2{,}78+0{,}86\cdot\frac{(\%CaO)+0{,}05(\%MgO)}{(\%SiO_2)+0{,}6\cdot(Al_2O_3)}-\lg[O]_{Fe}, \tag{6}$$

Thus, we obtain an empirical equation for the distribution coefficient, L_S^{Fe} which has the same structure as equation (6)

$$\lg L_S^{Fe}=-2{,}78+0{,}86\cdot\frac{(\%CaO)+0{,}05(\%MgO)}{(\%SiO_2)+0{,}6\cdot(Al_2O_3)}-\lg[O]_{Fe}, \tag{7}$$

With the help of a mathematical model, the optimal conditions for desulfurization of steel during processing in a furnace are determined.

As a result of the calculations, it was found that in order to ensure desulfurization during out-of-furnace metal processing, the optimal composition of slag oxide should be used, i.e. the composition of the slag, which ensures the reduction of the metal.

Thus, during the processing in the furnace, optimal conditions are created for the desulfurization of steel. Calculations show that at least 10% of sulfur in liquid steel can be isolated without additional measures.

References

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