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MATHEMATICAL SIMULATION STRUCTURE AND PROPERTIES OF WELDED DEPOSIT LAYERS

Alloys with high initial hardness generally have high wear resistance, but the exception to this general rule are alloys, in the structure of which a significant amount of retained austenite is formed. In the process of wear of such steels with a metastable austenitic structure under the influence of the energy of abrasive grains on the friction surface, deformation martensite may form.

This process is closely related to the redistribution of energy costs, that is, its dissipation, which triggers mechanisms that strengthen the working surface of the parts. The sensitivity to the adaptation of steels and alloys to external mechano-energetic influences, leading to the martensitic ($\gamma \rightarrow \alpha$) transformation, depends on the temperature of the martensite point, which is largely determined by the content of carbon and alloying elements in the solid solution. The formation of deformation martensite is accompanied by a complex shear in the crystal lattice of metastable austenite. With an external force during wear, the metal of the working surface receives the energy necessary for the ($\gamma \rightarrow \alpha$) transformation [2, 3]. Analysis of the dependence of the mass fraction of martensite on the magnitude of the deformation stresses showed that an increase in the mass fraction of martensite is observed in proportion to the deformation stresses of the material.

It is very important for the study of this topic the construction of a multicriteria mathematical model of the tribosystem based on an active experiment. Planning a multiobjective equation should have a clear algorithm. The first stage includes the analysis of each of the systems: metallurgical, tribotechnical, technological, operational, economic. After that, they are differentiated and the main criteria are selected, which to the greatest extent determine the process of metal destruction in this particular case of the operation of parts. After checking the factors for compatibility and correlation, they are encoded and the variation intervals are selected. The model can be of several types: differential, fractional rational, trigonometric, or polynomial. The design matrix of the experiment can be full factorial or fractional factorial, which takes into account the number of interactions between factors.

Next, it is necessary to find out the deviation of the results from the arithmetic mean, that is, the total variance of the reproducibility of the experiment. It characterizes the dispersion of the results of experiments at a certain combination of factor levels. If the comparative number of variances is more than two and one variance significantly exceeds the others, then Cochran's test can be used to determine their homogeneity. If this criterion is not met, it is necessary to increase or decrease the number of parallel experiments. After calculating the matrix, it is necessary to check the adequacy of the model according to Fisher's criterion and to assess the significance of the coefficients of the equation. Compliance with all criteria allows you to build a linear equation. An insignificant coefficient at a factor means that this factor does not affect, or does not significantly affect the optimization parameter. However, the value of the regression coefficient is influenced not only by the role of this factor, but also by the selected interval of variation. This means that with very narrow limits, the change in the optimization parameter can indeed be very small. However, this alone cannot yet conclude that the factor is insignificant. Therefore, the statistical signal of the factor should be verified, if possible, or at least analyzed from a technological point of view. That is, before the full factorial experiment, star or null points are added, followed by a central compositional orthogonal or rotatable second order planning. At the end, a quadratic equation is obtained. With the further insignificance of the coefficients, the degree of the equation is increased to the third order plan, and so on.

An attempt was made to reproduce the mathematical equation of the dependence of wear resistance, hardness and the amount of the hardening phase on external conditions. The regression equations were made with a certain tolerance, because we used the data of standard materials such as Cr12 and Cr12V (these steels are already studied) with certain assumptions, so that we can identify the effect of the chemical composition on the parameters we have chosen.

The task of adapting materials to external wear conditions is to predict the effect of external load conditions in combination with $\gamma \rightarrow \alpha$ transformation processes, at which the maximum production of deformation martensite in the working metal layer will be achieved. Analysis of the data, when comparing the initial and final amounts of retained austenite, shows that it is decreasing. At the same time, the degree of this hardening under the most favorable conditions, when the volume of transformations of unstable austenite is maximum, still does not provide a sufficiently high microhardness. However, the use of an unstable austenitic structure in combination with martensite and a hardening solid phase is the optimal solution. Therefore, it is very important to control the structure and development of martensitic transformations in alloys, because this will significantly improve their technological properties. But the process of scientific research and proof of these phenomena requires a deeper study.