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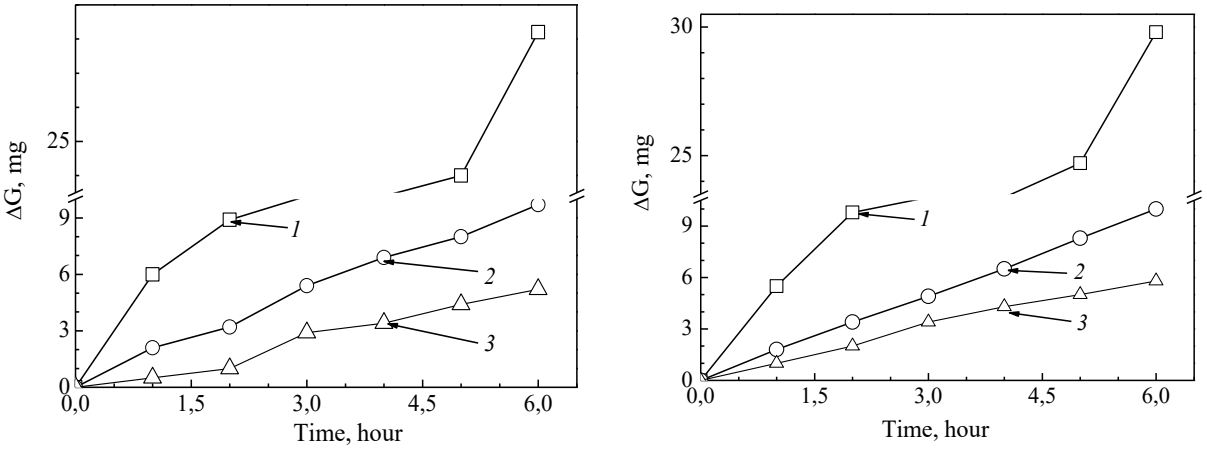
THE EFFECT OF NANOCRYSTALLIZED SURFACE ON THE TRIBOLOGICAL BEHAVIOR OF PEARLITIC STEEL

A significant part of equipment and machines used in various industries (military industry, oil and gas industry, metallurgy, agriculture, etc.), as well as military equipment are operated under the combined action of mechanical loading and abrasive wear. Surface treatment methods are used for improvement of their performance characteristics. A promising surface treatment of pearlitic steels is formation of surface nanostructured layer, which characterised by a unique complex of physical and mechanical properties. For this purpose, severe plastic deformation is widely used. The method of mechanical pulse treatment (MPT) of steels used in the study enables formation of nanocrystallized surface with 12–60 nm crystallite size [1]. The aim of this work is to improve the tribological properties of alloyed steel 40X using MPT. The steel had pearlitic microstructure in the as-received state. Wear resistance of the nanocrystallized surface of 40X steel formed by MPT in different technological fluids (oil and aqueous) under wear of friction pair 40X steel (ring) – ШХ15 steel (liner) was estimated and compared with that of 40X steel after quenching and tempering at temperature 200 °C. Studies were performed in oil with 0.1% abrasive at P = 4 MPa and V = 0.9 m/s. Quantitative analysis was carried out to determinate material loss (Figure).



a) b)

Fig. 1 – Weight loss ΔG of rings (a) and liners (b) of friction pair 40X steel (ring) – ШХ15 steel (liner) with different treatments of steel 40X: 1 – heat treatment; 2, 3 – MPT in aqueous and oil technological fluids, respectively.

It was revealed that the weight loss after 6 h of wear of 40X steel with the nanocrystallized surface layer formed by MPT in oil was the smallest among the studied treated steels. The friction coefficient of the pair with 40X steel with the nanocrystallized surface formed in oil was decreased in almost 4 times compared to that of the friction pair with the heat-treated steel.

References

1. Mechanical fabrication methods of nanostructured surfaces / H. Nykyforchyn, V. Kyryliv, O. Maksymiv, O. Zvirko // Handbook of modern coating technologies. Fabrication methods and functional properties. – Amsterdam: Elsevier, 2021. – P. 25–67.