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BOOK OF ABSTRACTS

Formation by vibratory-centrifugal hardening of a surface ultrafine grain structure with residual compressive stresses

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The formation of nanocrystalline (NCS) and ultrafine-grained structures (UFGS) after severe plastic deformation (SPD) using the method of vibration-centrifugal hardening (VCH) is one of the new technologies to improve the physical and mechanical properties of steels [1, 2]. In these works, it was shown that, at optimal parameters, forms on the 40Kh steel surface an ultrafine-grained ferritic structure with a grain size of 190 nm, dislocation density of $0{,}84\cdot10^{12}$ cm^{-2}, microhardness of 8.9 GPa. The microstructure at a depth of 1 mm is more fragmented, and the depth of hardening reaches 7 mm. In [1, 2] the dependence of the parameters of the hardened layer on the processing modes and on increasing its wearing qualities in oil environments is shown, as well as the improvement of its corrosion and electrochemical characteristics as together with cavitation erosion damage resistance. In the conducted study, the effect of 40Kh steel on the the nature and magnitude of residual stresses was measured. The results of the study show that VCH under favorable conditions generates residual compressive stresses of the first kind, which increase in size in the hardened layer with an increase in the processing time and the mass of the hardening tool. Such growth is caused by an increase in the fragmentation degree and imperfection of the surface layers structure, which leads to an improvement in of the physical and mechanical properties. The residual stresses in the hardened layer after VCH reach maximum values. The circumferential compressive stresses reach up to σ_{vib}^{max} = 1600 MPa, and radial compressive stresses – up to σ_r = 290 MPa.

1. *Kyryliv V., Kyryliv Y., Sas N. (2018) Formation of Surface Ultrafine Grain Structure and Their Physical and Mechanical Characteristics Using Vibration-Centrifugal Hardening. Adv Mater Sci Eng 2018, 3152170.*

2. *Aftanaziv I.S., Bassarab A.I., Kyryliv Ya.B. (2002) Mechanical and corrosion characteristics of 40Kh steel after vibration-centrifugal hardening treatment. Mater Sci 38(3):436–441*