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CYCLIC DURABILITY DIE-METAL

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We used a comprehensive methodology for conducting experiments. It included mechanical tests under static and cyclic loading, the study of the initial microstructure and its changes on the surface of samples for fatigue using optical and electron microscopes to study the kinetics of the fracture process, measuring the deflection of the current samples, the samples exposed fractographic analysis and other methods.

Metals and alloys of different classes in different structural states used in automotive, mechanical engineering and aerospace industries and processed at the request were investigated. Cylindrical specimens pre-deformed at room temperature by stretch, and flat samples by precipitation at different rates to different degrees, mainly in the range of uniform strain at a rate of $2 \cdot 10^{-3}$ to 10^{2} s^{-1}. Fatigue flat samples were tested on a specially designed two-stage set [1], and cylindrical ones were tested on drive МИП-8 converted for cargo loading and equipped with fazosinhronizator and an optical microscope with stroboscopic illumination [2]. For testing in a corrosive environment of cylindrical samples the camera was designed [3]. Accessories for fatigue and corrosion-fatigue tests on a two-stage sample set were specially designed and manufactured [4].

According to the results of static stretching it is found that the tensile strength and yield strength increase and the values of indicators ductility decreases with increasing degree of deformation, especially at low stacking fault energy (e.d.u.) material, which is related to changes in the structural state of it in the process deformation. It was found that pre-mixed hardening effects on the cyclic corrosion and cyclic durability of materials [5,6].

Corrosion durability of structural materials undeformed is lower (up to 2.0 times) life in the air and also is determined by the amplitude of the applied voltage, the lower the amplitude, the stronger the effect of the medium. In this case, plastic deformation tends to raise (up to 3 times) corrosion-resistance to fatigue failure of the studied materials in comparison to their undeformed state [5,7,8].

Analysis of the structural failure rate during fatigue of heat-treated and deformed structural materials in air and in a corrosive environment showed that the process of destruction of metallic materials under cyclic loading has three main stages: nucleation macrocracks, their growth and rapid dolomite, essentially related to the composition material and structure, depending on the thermal pre-treatment or plastic, and the test conditions.

Prestrain samples hinders the development of the process of fatigue and increases durability, which is due to increase in the period of crack initiation and decrease the speed of its spread. Corrosive environments causes multifocal nature of the occurrence and development of corrosion-fatigue failure giving rise to various types of corrosion damage. However, changing the current deflection curves of samples under cyclic loading in a 3% aqueous solution of NaCl has qualitatively the same character as in testing the air despite the significant features of the process. This is so that the determining factor of quality data about the current state of materials during cyclic loading of the parameter changes to the current trough is reducing the effective cross section of the sample along with the mechanisms of hardening-softening.

Thus, the analysis of experimental data indicates that the curves changing the current trough, coupled with metallographic, fractographic and other methods of studying the kinetics of fatigue failure, a very important integral characteristic of the processes occurring during fatigue and corrosion-fatigue loading of structural materials.

Theoretical study of the issue showed [13] that the sensitivity of the deformed structural materials for cyclic durability in corrosive environments, all other things being equal, can be evaluated with the value of the exponent A hardening under static loading: $\sigma_i = \sigma_0 \cdot \varepsilon_i^n$, where σ_i - actual current flow stress of the material, MПa; ε_i - true current strain; σ_o - a constant equal to the flow stress at $\varepsilon_i = 1$, MПa; n - exponent of strain hardening. At the same time lowering the exponent A must comply with the growing resistance of corrosion-fatigue failure as a result of technological uniform prior deformation of the material in stamping.

Experimental data support this conclusion. This relationship allows to predict the feasibility of introducing a process of manufacturing parts of plastic deformation in order to improve their corrosion durability, which is enough to monitor its impact on the amount of strain hardening exponent under static loading.

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