UDC 539.62

THE COPPER AND LEAD FUSIONS INFLUENCE ON PHYSICAL MECHANIC PROPERTIES OF HIGH-DURABLE STAINLESS STEELS

O. V. Shyrokov, V. V. Shyrokov, Ya. O. Shakhbazov, O. I. Datsyi

*Ukrainian Academy of Printing,
19, Pidholosko St., Lviv, 79020, Ukraine
vvshyrokov@gmail.com*

**Research methodology.** Modeling of the influence of the temperature factors and adsorption of active metals (copper and lead) on the mechanical properties of stainless steels has been conducted by means of the metallographic, electron and X-ray analyses of the structure (surface fracture). Mechanical tests of the definition of the characteristics of strength and ductility, fatigue trial on minicycle (pure bending) in the temperature range of 293 K ... 1350 without and in contact with air and spectral pure argon; magnetometric analysis have been also done.

**Results.** Based on the analysis of experimental data and calculations it has been found that this class of steels in the temperature range 500 ... 800 K inherent dynamic strain aging caused by dynamic blocking dislocation atoms of carbon and oxygen and less nitrogen.

There has been discovered the mixed impact of δ-ferrite content in embrittlement ability to melt. The minimum and maximum content of δ-ferrite (1 and 12 vol.%) has been defined. Embrittlement occurs at slightly lower temperatures than at intermediate concentrations of — 4 ... 6 vol.%. In the first case δ-ferrite structure is virtually nonexistent, except for certain substances in the martensitic colonies; and in the latter it is present in the form of individual grains. For intermediate concentrations of δ-ferrite the fines edge border martensitic or austenitic grain colonies and restricts access to melt them.

It has been found that the optimal content of δ-ferrite, which provides VTRMO minimizing the consequences must be between 4 ... 6 vol.%. Welded steel samples at embrittlement copper soldering have been destroyed in the heat-affected zone. The temperature range or degree of embrittlement does not depend on the method of soldering in this area. Embrittlement of welded samples in all cases occurs at temperatures of steel plasticity reducing (without soldering).

**Novelty.** For the first time the experiment has been conducted in a wide temperature range (293 ... .1350 K). The VNS55 steels have been tested for the deformation resistance and the effects of doping ratio of Cr/Ni on their high-temperature mechanical properties. For the first time it has been found that the VNS55 chromium-nickel steel gets embrittlement at temperature above 1173K by the influence of the copper and lead fusions resulting in a constant rate of deformation and tension during fatigue tests on minicycle (MTSV).

**The practical significance.** Based on the experimental results they have defined the temperature ranges of embrittlement by the copper and lead fusions for the VNS55 steels in the temperature range of 293 K ... .1350 with setting of the corresponding numerical values of the characteristics of strength, ductility and durability of steels in contact. The optimal structural phase and chemical composition of steels in terms of minimizing of the embrittlement action of copper have been found, being the basis for making recommendations for soldered-welded three-layer constructions with a metal collar filler.

The results are of practical importance in the design and calculation of critical fasteners, valves, choice of materials and other elements of the cellular structures that use or intended use of chromium-nickel steel, brazed or soldered them-welded joints.