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INFLUENCE OF THE DEFORMATION DEGREE ON THE CORROSION RESISTANCE OF AISI 304 AND AISI 316 STEELS IN VARIOUS ENVIRONMENTS

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Welded products made of corrosion-resistant steels often operate in a complex stress state, and deformations and stresses are characterized by different values, have different directions and gradients, therefore, almost all corrosion damage occurs in a stressed state. The analysis of the performance of the above-mentioned products made it possible to conclude that the stress state affects the corrosion behavior of the metal [1,2] due to the following phenomena:

a) imparting additional energy to the metal, which causes a decrease in its thermodynamic stability; a deformed metal has a lower work function, that is, the bond is weakened and, consequently, it is easier for the Me^+ ion to leave the lattice in comparison with an undeformed metal;

b) violation of the protective properties of surface films under the influence of deformation; the film formed on a stressed or deformed metal at the initial moment of the action of the electrolyte contains more cracks and a larger size than on an undeformed metal;

c) an increase in the degree of inhomogeneity associated with the appearance of crystal lattice defects and new anode phases under the action of deformation.

In connection with the above, the work investigated the effect of plastic deformation of AISI 304 and AISI 316 steels on their corrosion resistance in a 60% sodium chloride solution, since it is in this environment that the electrochemical corrosion of both steels proceeds most intensively.

Samples were pre-cut from the strip and installed into specially prepared grippers. After that, the samples were installed in a ZIM tensile testing machine of the UMM-5 type and stretched. The degree of deformation was 20 %, 40 %, 60 % and 80 %. In fig. 1 shows a graph of the change in mass loss of samples of the studied steels depending on the degree of deformation.

During the analysis of the research results, it was found that the effect of plastic deformation on the corrosion resistance of AISI 304 and AISI 316 steels is ambiguous.

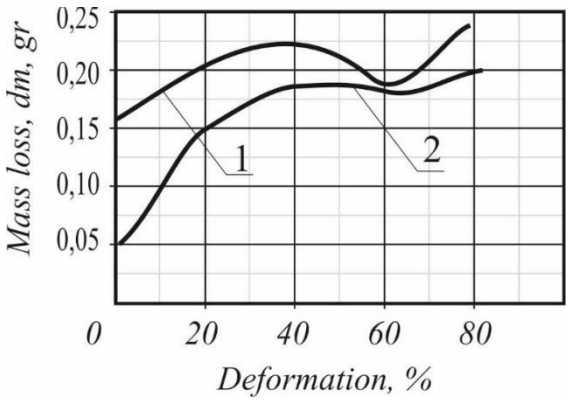

Fig.1. **The influence of the deformation degree of samples of steels AISI 304 (1) and AISI 316 (2) on their corrosion resistance**

At low and medium degrees of plastic deformation (20-40%), there is an increase in the initial anodicity of the boundaries due to the accumulation of deformation energy on them. As a result of local anodic dissolution in the zones of corrosive pathways existing in the metal even before the application of stresses or arising under the action of applied stresses, microspots are formed, which, as a result of the combined action of stresses and the corrosive medium, develop into microcracks. A further increase in the degree of deformation to 60% leads to energy deconcentration, which can lead to a slight increase in corrosion resistance. With an increase in the degree of deformation up to 80%, an increase in the weight loss of the samples of the studied steels is observed due to an increase in the density of dislocations and an increase in the concentration of stresses of the second kind, intensifying the development of corrosion processes.

Also, the effect of tempering at a temperature of 550 °C, carried out after stretching samples with various degrees of deformation, on their corrosion resistance in a solution of sodium chloride, was investigated. It was found that tempering at a temperature of 550 °C for all previously deformed samples of AISI 304 and AISI 316 steels leads to a decrease in the intensity of corrosion processes, which is associated with a decrease in the level of internal stresses in the metal.

Conclusions:

1. In a specific analysis of the effect of the stress state of welded structures made of steels AISI 304 and AISI 316, it is necessary to take into account the nature of the metal and medium, the deformation-force scheme, the degree and conditions of deformation.

2. According to the research results, it is recommended to carry out heat treatment of welded products in the form of tempering at a temperature of 550 °C.

References:

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