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STUDY OF THE STRUCTURE AND PROPERTIES OF THE METAL OF 10Cr17Ni8Si5Mn2Ti GRADE DURING CLADDING IN A PROTECTIVE ATMOSPHERE

Abstract. The positive effect of nitrogen on the formation of the structure and service properties of chromium-nickel-silicon steel under MAG cladding in a nitrogen-containing atmosphere of 70% N_2 + 30% CO_2 is considered. It is shown that the cladded metal of 10Cr17Ni8Si5Mn2Ti grade, doped with nitrogen from the gas phase, forms a more homogeneous structure, increases the volume fraction of austenite, and reduces the tendency to form a sigma phase. During the crystallization of the weld pool, nitrogen forms fine-dispersed nitrides and titanium carbonitrides in the structure, with particle sizes of 0.1–1.5 mm. The cladded 10Cr17Ni8Si5Mn2Ti metal, doped with 0.12–0.16% of nitrogen, has a high resistance to scoring at specific pressures up to 96 MPa. The coefficient of relative erosion resistance of the nitrogen-containing alloy is 1.73 times higher than that of the same alloy cladded in argon.

Keywords: cladded Cr–Ni–Si metal, nitrogen-containing atmosphere, sigma-phases, nitride particles, scuffing, erosion resistance.

The experience of the operation of thermal power plants and petrochemical facilities in Kazakhstan shows that for pipe fittings operating at temperatures up to 540 °C and specific pressures up to 60 MPa, a good wear resistance for metal-to-metal friction is possessed by a chromium-nickel-silicon alloy based on 08Cr17Ni8Si6Mn steel, cladded with CN-6L electrodes. For fittings operating at temperatures up to 570°C and specific pressures up to 78 MPa, the 13Cr16Ni8Mb5Si5Mn4Nb alloy cladded with CN–12M electrodes possesses such properties.

To mechanize the cladding of the sealing surfaces of the DN 50-80 fittings bodies (figure 1), respectively, powdered PP - Np-10Cr17Ni8Si5Mn2Ti and PP-Np-10Cr19Ni9Si5Mo2BMnTi wires in argon are used.

However, the use of these technologies is associated with certain difficulties due to the formation of the sigma phase in the cladded metal, which is the source of metal embrittlement and the initiation of cracks in it [1, 2]. The sigma phase can also be formed as a result of the temperature and time conditions of the cladding process and subsequent thermal treatment, the prolonged exposure to thermal loads at thermal power plants at operating temperatures of 500–600 °C, which generally reduces the service properties of the cladded metal [3-6].

At specific pressures above 60 MPa, the wear resistance of 10Cr17Ni8Si5Mn2Ti steel does not comply with its regulatory operation requirements for higher parameters. The effect of high specific pressures in combination with high temperature causes plastic deformation of the cladded sealing surfaces and the formation of scuffs on them. One of the solutions to these problems is the introduction of nitrogen into Fe-Cr-Ni-Si cladded metal as an austenizing and simultaneously reinforcing element under a suitable alloying system [5]. An economical and technological option for alloying the Cr-Ni-Si cladded metal with nitrogen is to use it as an independent protective gas or in a mixture with carbon dioxide in the process of cladding.