Comparative Study of Corrosion Resistance between High Manganese Steels and 9% Nickel Steel in Aqueous Solutions of NaCl and H2SO4 for Cryogenic Applications

Mauro CERRA FLOREZ1, Francisco DA ROCHA FILHO1, Marcelo GOMES DA SILVA1, Walney SILVA ARAÚJO1, Matheus DE LIMA VIEIRA2, Waydson MARTINS FERREIRA3

1 Universidade Federal do Ceará, Brazil
2 Universidade Federal do Ceara, Brazil
3 Universidade Federal do Piauí, Brazil

Abstract: Liquefied natural gas volumes which at present have to be stored and/or transported require that the materials engineering constantly develop materials such as aluminium alloys, austenitic stainless steels, 9% nickel steel alloys, among others. However, all these materials have disadvantages, such as high cost of production, welding difficulties, corrosion resistance, among others. The high manganese steel alloys offer an attractive alternative in reduction of manufacturing costs, presenting also good mechanical properties at low temperatures, thanks to manganese and carbon, which are stabilizers of austenite in steel, important for maintaining the ductile behavior in cryogenic temperatures when storing liquefied natural gas with suitable mechanical resistance properties.

The present study aims to characterize samples of alloys, carry out thermodynamic diagrams with their chemical compositions, evaluate the mechanical behavior and establish a comparative degree of corrosion resistance between four different alloys of high Mn steel in relation to the 9% Ni steel in two aqueous solutions. For this research, four steel alloys were used by varying the content of manganese and carbon as follows: 28%Mn - 0,2%C, 26%Mn - 0,3%C, 23%Mn - 0,45%C and 20%Mn - 0,6%C is the 9% nickel alloy that is widely used in petrochemical industry. For the characterization of alloys there will be used the following techniques and testing: X-ray Diffraction (XRD), Energy Dispersive X-ray Spectroscopy (EDX), Optical Emission Spectroscopy, X-ray Fluorescence, Hardness, Microhardness and the Charpy Test, Scanning Electron Microscopy (SEM). For the thermodynamic study, the computational program Thermo-Calc will be used to get the molar fraction diagrams and phase diagrams. The tests that will be carried out to compare the corrosion resistance are: Open Circuit Potential (OCP), Anodic Linear Polarization, Cyclic Polarization and Electrochemical Impedance Spectroscopy in aqueous solutions of NaCl and H2SO4. The results obtained so far show that the high Mn steels exhibit a resistance to corrosion below the 9% Ni steel.

Key Words: High Mn Steels, 9% Ni Steel, Corrosion.

References:


