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Electrochemical corrosion behavior of Fe-15Cr-0.9Mo-0.3C-0.17N nitrogen substituted martensitic stainless steel in 3.5% NaCl solution

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ABSTRACT

High nitrogen martensitic stainless steel such as Fe-15Cr-0.9Mo-0.3C-0.17N (Cronidur 30) has shown great promise as bearing materials due to its excellent mechanical properties compared to the conventional bearing steels. In the present work, corrosion properties of Cronidur 30 have been evaluated and compared with conventional bearing steel AISI 440C. The effect of tempering temperature on the microstructure and vis-à-vis the corrosion resistance has been studied using potentiodynamic polarization. Surface morphology of the tested samples was examined using Scanning Electron Microscopy. The passive layers on the samples were analysed using X Ray Photoelectron Spectroscopy to characterize the thickness and enrichment of elements in the passive oxide film. The results showed that Cronidur 30 exhibited higher corrosion resistance (I_{corr} = 0.09 µA/cm^2) compared to AISI 440C (I_{corr} = 0.89 µA/cm^2). Cronidur 30 tempered at 475 °C showed lower corrosion resistance than the one tempered at 165 °C. The decrease in corrosion resistance at higher tempering temperature is attributed to the precipitation of nitrogen containing phases such as Cr_2N. Precipitation of secondary phase causes depletion of chromium which in turn promotes the pitting corrosion resulting in low corrosion resistance. The presence of the nitrides was confirmed by Transmission Electron Microscopy-EDS analysis. The results in general indicated that Cronidur 30 exhibited good corrosion resistance and proved to be a better alternative to AISI 440C steel.

Keywords: Corrosion behavior, Cronidur 30, AISI 440C