Microstructure and Corrosion Behaviour of Carbon Steel and Ferritic and Austenitic Stainless Steels in NaCl Solutions and the Effect of *p*-Nitrophenyl Phosphate Disodium Salt

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The microstructure and corrosion behavior of carbon steel (CSA516) and ferritic (SS410) and austenitic (SS304L) stainless steels were studied and compared. Corrosion tests were carried out in 0.5 M NaCl solutions. Rates of corrosion were monitored based on weight loss, Tafel extrapolation and linear polarization resistance (LPR) methods. Rates of corrosion were ranked following the order: CSA516 >> SS410 > SS304L. The impact of *p*-Nitrophenyl phosphate disodium salt (NPP) on the corrosion rate of CSA516 was also studied using Tafel polarization and LPR measurements. Optical microscopy (OM), scanning electron microscopy (SEM/EDX), and X-ray photoelectron spectroscopy (XPS) were employed to assess the chemical compositions and morphologies of the corroded and inhibited surfaces. FT-IR analyses were also performed to assess the functional groups of the inhibited sample in a comparison with NPP itself. XPS and FT-IR studies revealed the presence of phosphate groups originating from tested inhibitor, thus proving formation of the protective layer on the steel surface. The microstructural and defect investigations of as-polished, corroded, and inhibited CSA516 samples were also carried out using positron annihilation lifetime (PAL) and positron annihilation Doppler broadening (PADB) techniques. Experimental findings revealed that NPP acted as an efficient

mixed-type inhibitor with anodic predominance. It reached about 97% inhibition efficiency at a low concentration of 0.02M.

Keywords: Monitoring rates of corrosion; Corrosion control; Steel and stainless steel materials; Tafel extrapolation method; Linear polarization resistance method; Positron annihilation spectroscopy

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