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Effect of pH on the Passive Film Characteristics of Lean Duplex Stainless Steel in Chloride-Containing Synthetic Tap Water

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The localized corrosion properties of lean duplex stainless steel and 316L stainless steel were compared using electrochemical testing and angle resolved X-ray photoelectron spectroscopy analysis. Electrochemical testing at pH 7 revealed that the pitting corrosion resistance of LDSS was superior to that of 316L, but the crevice corrosion resistance of 316L was better than that of LDSS. In potentiodynamic polarization testing, as the pH decreased, the pitting potential of 316L did not change significantly. However, the pitting potential of LDSS sharply decreased with decreasing pH, and was lower than that of 316L at pH 2. Electrochemical impedance spectroscopy results confirmed that the passive film of 316L is more stable than that of LDSS at lower pH. Regardless of the pH and film depth, the passive film compositions of 316L and LDSS were similar, except for Mo compounds. Mo peaks were not detected in either steel at pH 7, but pronounced spectra of the Mo were detected only for the 316L steel at pH 2. Mo oxides are not formed at a neutral pH, but formed at lower pH. The improved resistance to crevice corrosion of 316L resulted from the formation of the Mo-enriched passive film at low pH.

Keywords Lean duplex stainless steel, Pitting corrosion, Crevice corrosion, Passive film, ARXPS

FULL TEXT