Development and Corrosion Characterization of Ultra-High-Strength Steels

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Potentiodynamic polarization and electrochemical impedance spectroscopy measurements were used to investigate the corrosion behavior and mechanical properties of three different quenched and quenched/tempered ultra-high-strength steel alloys in contact with alkaline and acid aqueous solutions. The results are analyzed on the basis of the corrosion potential E_{corr} and the corrosion current density I_{corr} . Continuous anodic dissolution is the main type of corrosion driven by a charge-transfer mechanism in all of the investigated steel conditions irrespective of the phases present. The observed solubilities of iron and its oxides and hydroxides respectively agreed with the reactions $\text{Fe}_2\text{O}_3 + \text{H}_2\text{O} \rightarrow \text{Fe}(\text{OH})_2^+$ and $2\text{Fe}^{3+} + 3\text{H}_2\text{O} \rightarrow \text{Fe}_2\text{O}_3 + 6\text{H}^+$. In addition, the Mo and V content played important roles in determining the corrosion levels, as did redox reactions and microconstituents present in the various steel phases. The quenched/tempered steel exhibited the best corrosion and mechanical properties.

Keywords: UHSS alloys, Corrosion resistance, Mo and V additions, Alkaline and acid solutions, Mechanical properties.

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