The study of Alloy 22 has been undertaken in several selected nitrate/chloride (NO$_3$/Cl) electrolytes. These electrolytes include chloride concentrations (CT) of 1.0, 3.5 and 6.0 molal with NO$_3$/Cl ratios of 0.05, 0.15 and 0.5 at various temperatures. Alloy 22 maintains its passivity in most industrial environments. As a result, it is highly desirable for numerous industrial applications including underground waste disposal systems. Alloy 22 possesses remarkably low general corrosion rates. It has exceptional resistance to localized corrosion including environmentally assisted cracking [1-7], Alloy 22 (NO6022) is a nickel (Ni) alloy and contains 22% chromium (Cr), 13% molybdenum (Mo), 3% tungsten (W) and about 3% iron (Fe).

The goal of this study was to determine the levels of NO$_3$ required for effective inhibition of crevice corrosion in Alloy 22. To achieve this, carefully designed statistical test matrices covering the selected range of CT compositions and temperatures were employed in carrying out the experiments. Specimens for these experiments were in the form of multiple crevice assemblies (MCA), optimized with 24 artificial potential crevice sites. Tests used in this investigation included open circuit potential monitoring, polarization resistance, and cyclic polarization experiments. Potentiostatic polarization tests were also employed.

Results showed that the crevice breakdown and repassivation potentials increased with increase in NO$_3$/CT ratio and decreased with increase in temperature (Figure 1). The absolute [CT] concentration was found to have less of an effect on these critical potentials (Figure 2) compared with temperature and the NO$_3$/CT.

Regression analyses were carried out and expressions were derived to describe the relationship between the critical potentials, temperature, [CT] and [NO$_3$] for all conditions tested. Figure 3 is a 3-D plot of the repassivation potential as a function of [CT] at 100 °C. The surface is derived from the regression analyses. Included in Figure 3 are experimental data points from the environments tested at 100 °C (with [CT] of 1.0, 3.5 and 6.0 molal and [NO$_3$]/[Cl] ratio of 0.05, 0.15 and 0.5).

References

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