Evaluation of the Influence of Alumina Nano-Particle Size and Weight Composition on the Corrosion Resistance of Monolithc Aa1070 Aluminium

9 PagesPosted: 29 Jul 2021

Roland Loto
Covenant University

Phillip Babalola
Covenant University

Date Written: 2021

Abstract

Corrosion resistance of AA1070 aluminum alloy (AA1070) was compared to AA1070 reinforced with alumina at weight composition (wt. %) of 5% and 10%, and grain size of 150 nm and 600 nm. Potentiodynamic polarization and open circuit potential analysis were employed in 0.0125 M H_2SO_4, 3.5% NaCl and 0.0125 M H_2SO_4-3.5% NaCl solutions. Data showed 0.0125 M H_2SO_4-3.5% NaCl solution was the most deleterious with peak corrosion rate value of 6.682 mm/y while 3.5% NaCl solution was the weakest with peak value of 0.084 mm/y. AA1070 at 5% wt. % and 150 nm particle size generally displayed the highest corrosion rate. However, visible decrease in corrosion rate occurred with increase in alumina weight fraction and particle size due to growth of the protective oxide on the composite and reduction of discontinuities. Cathodic and anodic reaction mechanisms significantly differs with respect to the electrolyte. Anodic reaction mechanism appeared under activation control in the sulphate-chloride and chloride solution, compared to cathodic reaction mechanism in the sulphate and sulphate-chloride solutions. Significant anodic degradation reaction was prevalent on the anodic polarization plot in the sulphate solution. Plots from open circuit potential analysis shows the composites and monolithic Al were the most thermodynamically stable in H_2SO_4 solution. In the sulphate-chloride solution, significant potential transients coupled with high corrosion tendency are conspicuous. The plot showed chaotic thermodynamic behaviour active passive transition behaviour of the passive film.

Suggested Citation

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