

# IR VOLTAGE STABILIZED CREVICE CORROSION OF ALUMINUM 6XXX ALLOY IN CHLORIDE AND CHLORIDE FREE ENVIRONMENT

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## Abstract

Two main theories were proposed to explain crevice corrosion for metals and alloys; the pH-chloride theory<sup>(1,2)</sup>, which mainly discusses solution composition changes within the crevice and the IR voltage drop theory<sup>(3,4)</sup>, which attributes crevice corrosion to both the potential and composition changes within the crevice.

As IR voltage drop was proved to stabilize crevice corrosion of an Al 6XXX alloy in chloride and chloride-free environments<sup>(5)</sup>, the need to quantitatively study the effect of crevice geometry on crevice corrosion of Al 6XXX alloy increases significantly.

This research is a study of the relation between the crevice gap opening, the IR voltage drop and the crevice corrosion location on the crevice wall of an Al 6XXX alloy sample.

In this work, crevice corrosion of an Al 6XXX alloy is studied under both cathodic and anodic polarization conditions in different solutions at ambient and elevated temperatures. In one system crevice corrosion occurred immediately when the IR voltage produced  $E(x)$  values on the crevice wall that were in the active peak region of the polarization curve, i.e., a change in solution composition did not play a role in stabilization of the crevice corrosion process. Thus, in this case the IR voltage was the sole cause of the initial stabilization of crevice corrosion.

The aim of cathodic polarization in the second system was to simulate a condition known to produce an active peak during an induction period in the polarization curve, and to test if crevice corrosion will eventually occur (at the end of the induction period). In this case hydrogen evolution causes the local pH to rise which is the expected cause of breakdown of the passive film and, hence, of the formation of the active peak within some region of the more positive  $E(x)$  values (than the  $E_{x=0}$  value at the outer surface) that exist on the crevice wall. In this case the IR voltage may or may not have a role in stabilizing the crevice corrosion process. IR voltage would play a role if the passive film breakdown (local or general) occurred only in a certain  $E(x)$  potential window that was more positive than the  $E_{x=0}$  value. Furthermore, there is another role of the IR voltage that would come into play during the induction period (rather than during the crevice corrosion stabilization period discussed above), and that is it seemingly has the effect of prolonging the induction period. This follows since the pH would be expected to rise more quickly the higher is the HER rate, but the HER rate decreases as the IR increases since the overpotential for the HER decreases. Under this cathodic polarization condition, it was reported that the pH within the crevice and/or the crack is going to increase even in the presence of chloride ions.<sup>(6,7)</sup>

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