

Monitoring Crevice Corrosion via the Coupling Current: Effect of Anodamine

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The electron coupling current that flows between the crevice and the external surface and the mixed open circuit potential were measured to monitor crevice corrosion on Type 410 SS in sodium chloride solution. The effect of the proprietary filming amine inhibitor, Anodamine, on the crevice corrosion behavior of 410 SS was also studied. As shown in Figure 1, as more Anodamine was added, the coupling current and open circuit potential (OCP) dropped to lower values and then stabilized. However, following brief periods of agitation (“stirs 2 and 3”) the coupling current was found to rise back to the immediately prior values. According to the Differential Aeration Hypothesis (DAH) and in concert with the Coupled Crevice Corrosion Model [1-3], Anodamine could mitigate ongoing crevice corrosion by suppressing the cathodic reaction on the external surface, thereby reducing the coupling current and hence reducing the driving force for transport of chloride ion into, and the production of H^+ in, the crevice. When the solution is stirred, the inhibitory effect is compromised, because Anodamine enters the crevice under forced convection conditions and also inhibits the reactions on the crevice wall, thereby reducing the difference between the crevice internal and external environments.

From Figure 2, the coupling current still increases in the presence of 100 ppm Anodamine. That is because H^+ gradually accumulates during the development of crevice corrosion and Anodamine only has a weak inhibitory effect on the anodic behavior in acidic solution. When the sample was further transferred to a solution without Anodamine, the coupling current increased to around $18\mu A$. Accordingly, although 100 ppm Anodamine could not eliminate crevice corrosion, it did inhibit crevice activity. Acidification plays an important role in the initiation of crevice corrosion in Type 410 SS in NaCl solution.

Figure 3 presents the result on a sample with doubled outer surface area. The steady coupling current was found to increase to around $70\mu A$ which is much higher than that observed with the original, smaller external surface. After reaching a steady state, the solution was deaerated. It is observed that both the coupling current and the OCP declined drastically. This situation is similar

to injection of Anodamine, which inhibits the cathodic reaction. The coupling current declines almost to zero as the oxygen is gradually eliminated during deaeration. Then 50 ppm Anodamine was injected into the solution. The coupling current still remains around $0\mu A$, while the mixed potential rose sharply. After that, the solution was stirred and more Anodamine was added, with little effect on the current or potential. Thus, Anodamine has little effect on the coupling current when there is no oxygen in solution. When deaeration was stopped, both the current and the potential increased, because oxygen begins to build up in the solution and participates in the corrosion process as the cathodic reaction on the external surface.

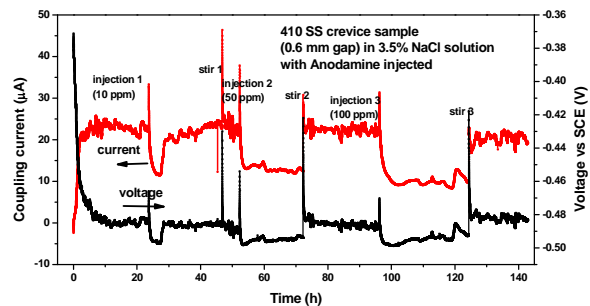


Figure 1. The plot of coupling current and open circuit potential (OCP) measured with 410 SS crevice sample at ambient temperature in 3.5 wt.% NaCl solution.

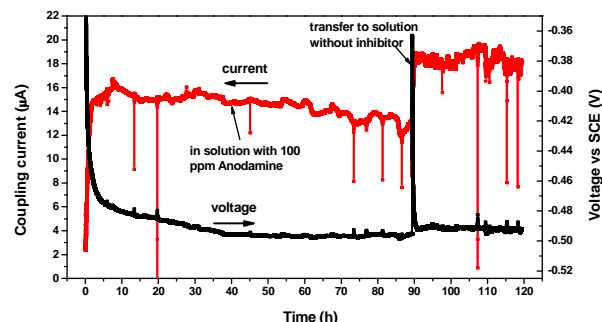


Figure 2. The plot of coupling current and open circuit potential (OCP) measured with 410 SS crevice sample at ambient temperature in 3.5 wt.% NaCl solution.

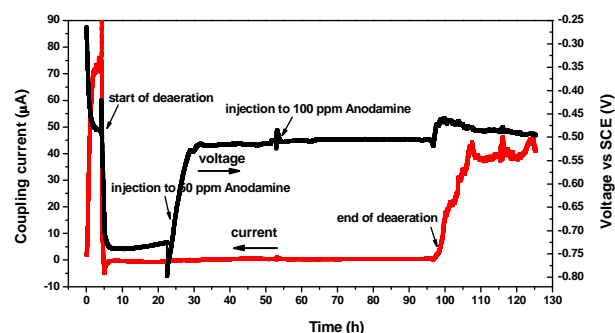


Figure 3. The plot of coupling current and open circuit potential (OCP) measured with 410 SS crevice sample at ambient temperature in 3.5 wt.% NaCl solution.

The authors gratefully acknowledge the support of this work by EPRI.

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