CAPSULES
preliminary notes and applications from Bioanalytical Systems, Inc.

The Effect of Chloride on Corrosion

Key Terms
Corrosion, Pitting, Chloride, Mild steel, Potentiodynamic Plot, Corrosion Potential (E_{corr}), Corrosion Current (i_{corr}), Critical Pitting Potential, (E_{cp}) CV-27 w/ Log i option

Halide Ions, in particular chloride, significantly contribute to the corrosion of metals exposed to the environment and/or to industrial processes. The typical result is the pitting of the material, which is a localized corrosion process that can lead to a complete material failure.

The effect of chloride ions on the corrosion of metals can be examined and characterized by electrochemical methods. Potentiodynamic polarization is an electroanalytical technique that is used to investigate the corrosion behavior of a metal in solution. The resultant plot under a given set of conditions will yield both qualitative and quantitative information.

The corrosion rate obtained from the corrosion current, i_{corr}, and the corrosion potential, Ecorr, can give quantitative comparison between either different materials under fixed corrosive conditions or a single material under varying conditions. This information, combined with a more qualitative term, the Critical Pitting Potential, E_{cp}, will provide corrosion behavior data of the material and corrodant system under study.

In this example, a mild steel, C1020 was examined with and without added chloride ion in a noncorrosive solution environment. Potentiodynamic Plots were used to determine corrosion rates, corrosion potentials and critical pitting potentials.

Conditions
Specimen (working electrode): C1020 mild steel polished with a 6 micron diamond prior to each experiment. Area = 2.4 cm^2.
Medium: 0.1 M Borate buffer, pH 9.05
Reference electrode: Ag/AgCl
Scan Rate (all experiments): 1 mV sec.

Discussion
The effect of added chloride is seen in the Potentiodynamic Plots of Figure 1 and the resultant data in Table 1. An increase in chloride concentration increases the calculated corrosion rate, shifts the corrosion potential in the positive (active) direction and moves the critical pitting potential more negative (less noble). This latter parameter indicates that the onset of pitting would happen at a much lower potential, i.e., the chloride is promoting pitting.

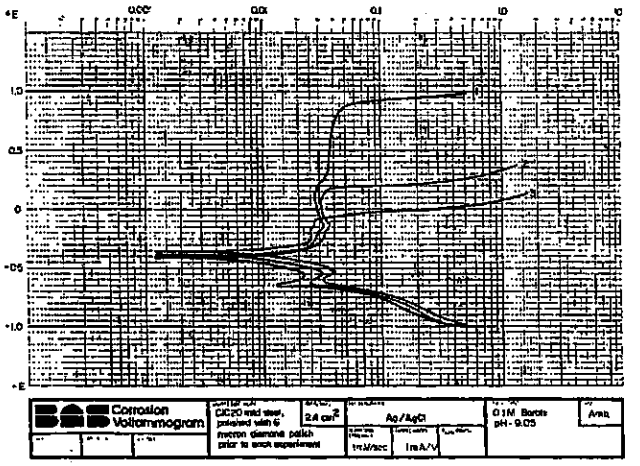

Figure 1. Potentiodynamic Plot. 1) no Cl⁻, 2) [Cl⁻] = 20mM, 3) [Cl⁻] = 50 mM

Table 1. Electrochemical corrosion data for C1020 mild steel in the presence of chloride ions.

[Cl⁻], mM	E_{corr}[a](Volt)	i_{corr}[b](μA)	E_{cp}[a](Volt)
0	-0.410	9.6	+0.90
20	-0.405	13.5	+0.20
50	-0.380	17	-0.10

a, All E vs. Ag/AgCl. b, The corrosion current, i_{corr}, was determined graphically.

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