

From: Darrell Dunn <ddunn@cnwra.swri.edu>
To: "Tae Ahn" <TMA@nrc.gov>
Date: 3/23/04 12:07PM
Subject: RE: Spent Fuel and Crevice Corrosion

(1) Based on our current knowledge of the waste package design localized corrosion perforations and stress corrosion cracking are more likely in the welded regions. External events such as rockfall and the formation of crevices may promote failure modes at other locations. Other than that I have no other concerns.

(2) I think I understand the question you are asking here. The tests are conducted under potentiostatic control. This allows us to test a wide range of conditions. Corrosion potentials in the range of 300 mV are possible with low pH solutions (pH < 4). Higher potentials are unlikely unless the system has oxidants other than oxygen (i.e. nitric acid, ferric ions, hydrogen peroxide). Transpassive dissolution seems unlikely because the corrosion potentials would have to be very high (typically > 500 mV vs SCE). When we report a repassivation potential of 300 mV vs SCE, it means that we observed localized corrosion was active at potentials higher than 300 mV vs SCE. In some cases, we observe the initiation of localized corrosion at very high potentials (550 - 600 mV vs SCE) but the localized corrosion does not continue propagate. In these cases the repassivation potential is very high.

There are two things that are important from the MRS paper. First, is the values of the repassivation potentials when the critical concentrations of inhibitors are present. As you have observed these values can be very high. This indicates that the possibility of initiating localized corrosion is restricted to strongly oxidizing environments. If such environments are not present, then localized corrosion will not be initiated. Second is the increase in the value of the repassivation potential when the inhibitors are added. Even when the concentration of inhibitors is insufficient to prevent the initiation of localized corrosion, the repassivation potential increases by hundreds of mV. When sufficient inhibitor concentrations are present, the increase can be 400 to 600 mV. Also, please note that the open symbols in the MRS paper indicate that we did not observe localized corrosion.

We have observed crevice corrosion and high repassivation potentials with mill annealed, welded, and thermally aged specimens under some conditions. It is not unique to a severe heat treatment but indicates that highly oxidizing conditions are required for localized corrosion initiation.

-----Original Message-----

From: Tae Ahn [mailto:TMA@nrc.gov]
Sent: Tuesday, March 23, 2004 9:52 AM
To: DDUNN@cnwra.swri.edu
Subject: Spent Fuel and Crevice Corrosion

** High Priority **

Darrell:

(1) In my presentation on spent fuel dissolution to MRS and YM Team Meeting, I am going to use what we went over regarding the randomness of perforation/cracks (half slide). I would like to acknowledge you. Pl. tell

me next week if you have any concern.

(2) In your MRS paper, I don't understand the crevice corrosion with inhibitors at (300 - 600) mV SCE of E_{rep}. How does it happen? (due to severe heat treatment?) Is transpassive dissolution concern in real solution of many ions? This paper, I believe, is very significant.