

LSNReviews

From: Lietai Yang [ltyang@cnwra.swri.edu]
Sent: Friday, January 27, 2006 12:41 PM
To: Yi-Ming Pan; Xihua He; Roberto Pabalan
Cc: Miriam Juckett; Ken Chiang; 'Gustavo Cragnolino'; darrell.dunn@swri.org; 'Vijay Jain'
Subject: RE: Test plan for corrosion of Alloy 22 by dust deliquescence
Attachments: Test_Matrix_Rev1.xls

Based on the responses (some in the form of e-mails and some in the form of verbal discussions), I have revised the test matrix.

For the high temperature tests, I think we should use ceramic as crevice formers. Teflon has dimension uncertainty over time at high T. It is hoped that the cracking of ceramic should not happen on heating and during the tests, because the heat expansion coefficient for ceramic is lower than that of the metal bolts. Cracking is likely to happen when the coupon is taken out and the the temperature decreases. As a precaution, we'll think about using a thin layer of Teflon washer (at opposite sides of the ceramic washers so the Teflon does not contact the metal surface). This layer of Teflon is relatively soft and hopefully, it would ease the tension. Also, it is difficult to get a perfect flat polished surface for the specimens and the crevice former. The Teflon washer would give a better contact between the ceramic crevice former and the specimen. Because the Teflon is thin, it should not change dimensions as much as the large Teflon crevice former.

I am not sure if we should use a thin layer of Teflon tape between the metal and the ceramic to form a better crevice. DOE's work with Teflon former has been criticized on the basis that Teflon former is not realistic because it is not to be expected in the repository.

For Part C and D, they cannot be easily combined because we need to do some of the tests in part C for different time duration.

For Part B. Ken will consider the ways to control the RH and provide a cost estimate for this work.

The filtration paper is used to even out the distribution of the salt particles at low RH. It is needed for the first mixture (100% salt, 0% of dust). For the test with the dust, the filtration paper may not be needed because the fine dust particles may provide the same function as the filtration paper (We should do a comparison test). We have done some baseline measurement for the conductivity of filtration paper alone in pure water. It did not lower the deliquescence RH.

Please let me know if there are other things we did not consider. We need to finalize the matrix soon because we have to order materials for some of the tests.

Thanks

-Lietai

Properties Page

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27 Jan 2006 11:39:36 -0600 (CST)
Date: Fri, 27 Jan 2006 11:40:47 -0600
From: Lietai Yang <ltyang@cnwra.swri.edu>
Subject: RE: Test plan for corrosion of Alloy 22 by dust deliquescence
In-reply-to: <004a01c62072\$0fa61120\$b7c8a281@cnwra.swri.edu>
To: 'Yiming Pan' <ypan@cnwra.swri.edu>, xhe@cnwra.swri.edu,
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Message-id: <015d01c62368\$cf523500\$3bc8a281@cnwra.swri.edu>
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Importance: Normal
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1/27/2006 updated

Corrosion under salt deposits at elevated temperatures

Part A Dust effect of Corrosion

Objective: To determine the effect of the presence of dust on corrosion by deliquescent salts at different relative humidities.
Environments: 1. NaCl+Dust* (Previous tests were conducted with KCl. This time, we choose NaCl because Na⁺ is about 4 to 12 times higher than K in YM deposition, see recent IM)
 2. NaCl-KNO₃-NaNO₃ three salt mixture +Dust*

	NaCl	Dust	Notes
Percentage Composition	100	0	Baseline tests. Need to have a filtration paper at bottom to spread the electrolyte evenly
Percentage Composition	50	50	With and without filtration paper
Percentage Composition	30	70	With and without filtration paper
Percentage Composition	10	90	With and without filtration paper
Percentage Composition	5	95	With and without filtration paper
Percentage Composition	1	99	With and without filtration paper

* Initial tests to be conducted with SiO₂ for better handle of the dust composition.

Temperature: T=room to 150 oC, for high temperature, the current probe design has a problem. Ken's new coating may be used to reduce or eliminate the crevice problem.
 T =50 to 90 oC for NaCl system at High RH (40 to 90%)
 T>90 oC for the three salt system at low RH

Equipment: 16 electrode-CMAS Probes made of carbon steel, four or five to run simultaneously
 CMAS instruments, real-time measurements

Test set up: Set up similar to the one described in previous MRS paper

Time: Partially completed by MRS paper abstract deadline (May?)

Part B Salt Decomposition-Real Time Weight Loss Measurements

Objective: Preliminary test has observed the decomposition of NaCl-KNO₃-NaNO₃ at elevated T. This study is to verify if this decomposition is true and how fast it goes.
Environments: NaCl-KNO₃-NaNO₃ three salt mixtures and their individual components under atmospheric condition, at T=130 to 300 oC
Equipment: TGA Real time measurements.
 For salt mixtures, the test should be conducted at constant relative humidity. The humidity may be maintained by flowing steam (nearly pure) into the TGA chamber so that the water vapor is close to 1 atm*.
 * Ken to provide a plan and cost on how to achieve the constant RH.
Time: MRS paper abstract deadline (May?)

Part C Salt Decomposition-Vapor Phase Characterizations

Objective: Preliminary and short-term tests have observed the formation of acid gases by heating NaCl-KNO₃-NaNO₃. This study is to verify the formation of acid gases, especially HNO₃ v.s. HCl
Environments: NaCl-KNO₃-NaNO₃ three salt mixture in vessels under atmospheric P at T=130 to 220 oC.
Equipment: Electrochemical test vessels. Condensate collection mechanism needs improvements to avoid the carry over of liquid.
Time: Ongoing and will be finished by end of April, 2006

Part D Alloy 22 Corrosion (localized and general) in Liquid and Vapor Phases of NaCl-NaNO₃-KNO₃ Mixture

Number of Coupons Required for Weight Loss Tests
 4 cells, 5 months Duration Tests

	Specimens	Number of Coupons				Total Coupons	
		130	160	190	222		
Liquid	Welded	4	4	4	4	16	2 at each T for weight loss, 2 for corrosion product+film passivity characterization (1 of each kind will be taken out after 60 days)
Liquid	M. Annealed	4	4	4	4	16	2 at each T for weight loss, 2 for corrosion product+film passivity characterization (1 of each kind will be taken out after 60 days)
Liquid	Ceramic Crevice**	2	2	2	2	8	1 welded and 1 MA at each temperature
Vapor*	Welded	4	4	4	4	16	2 at each T for weight loss, 2 for corrosion product+film passivity characterization (1 of each kind will be taken out after 60 days)
Vapor*	M. Annealed	4	4	4	4	16	2 at each T for weight loss, 2 for corrosion product+film passivity characterization (1 of each kind will be taken out after 60 days)
Vapor*	Ceramic Crevice**	2	2	2	2	8	1 welded and 1 MA at each temperature

Time: End of October, 2006

*The position of vapor specimens should be close to the liquid line to have the same temperature

**Because it is difficult to have perfect flat and parallel surfaces for the specimens and ceramic crevice former, thin Teflon washer or Tape will be used to ease the alignment problem (Will Teflon be in direct contact with the surfaces of the specimens? to be determined)