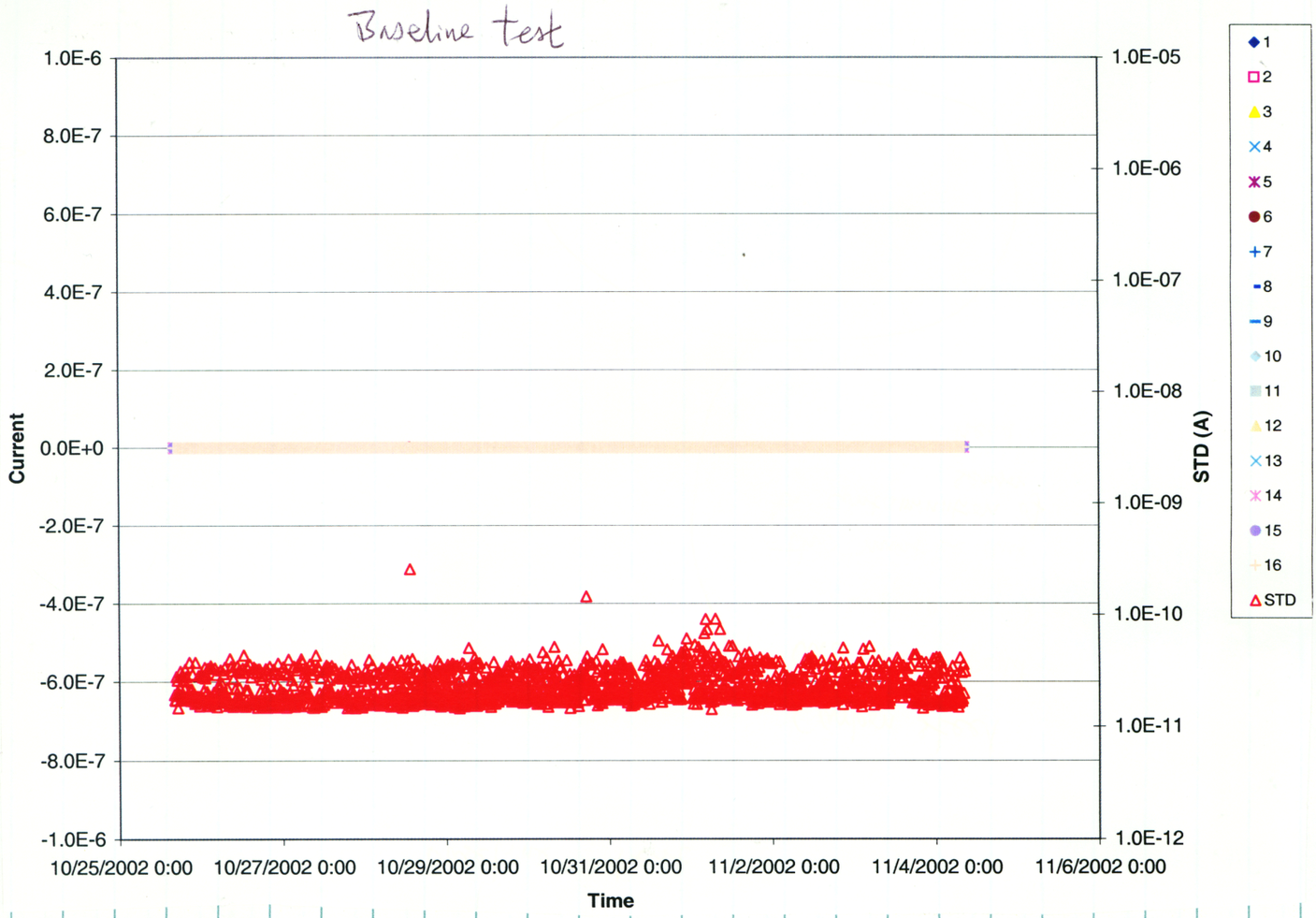
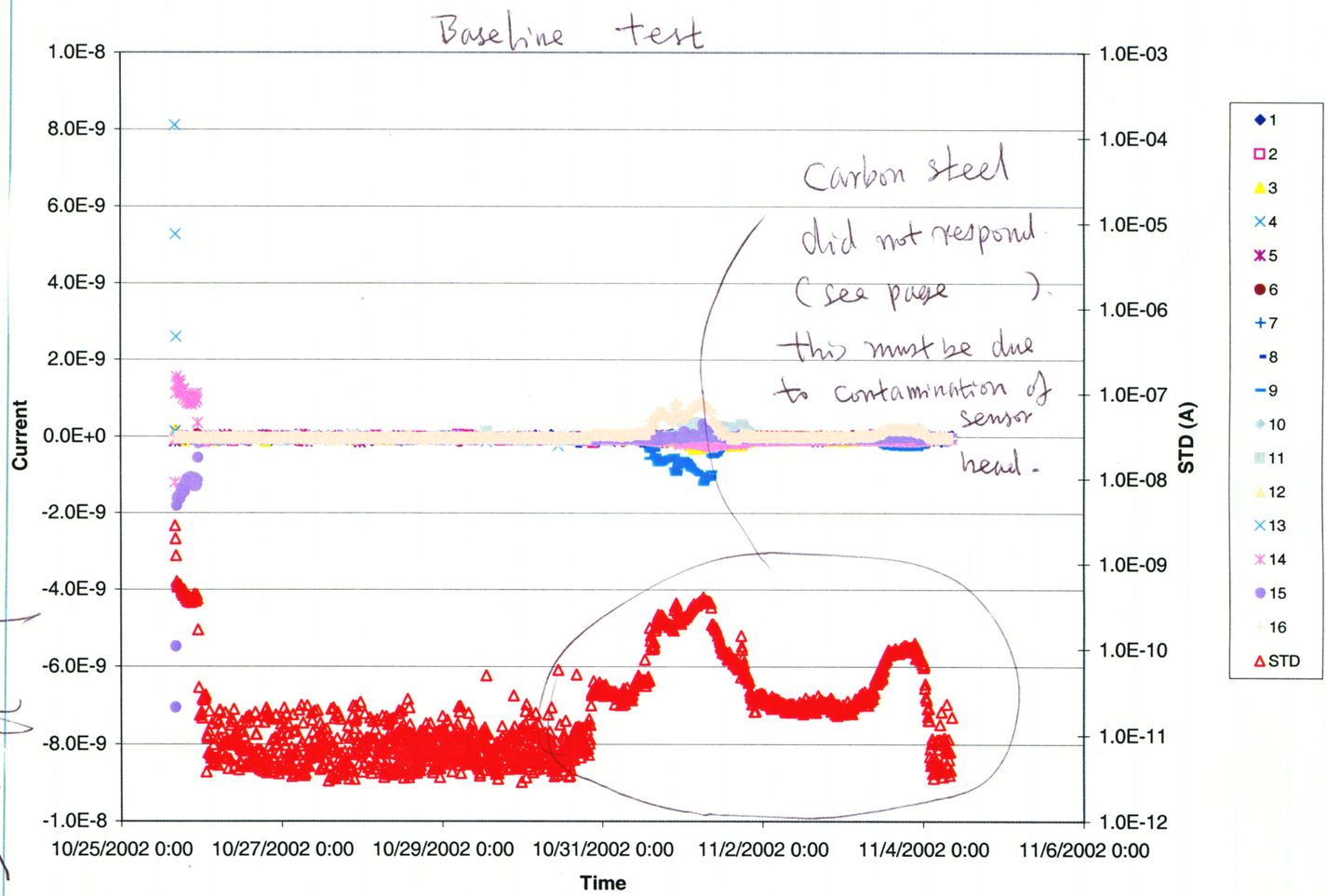
02_0927a03_02_1028a01_Salt Chart_CS1010-1

Baseline test



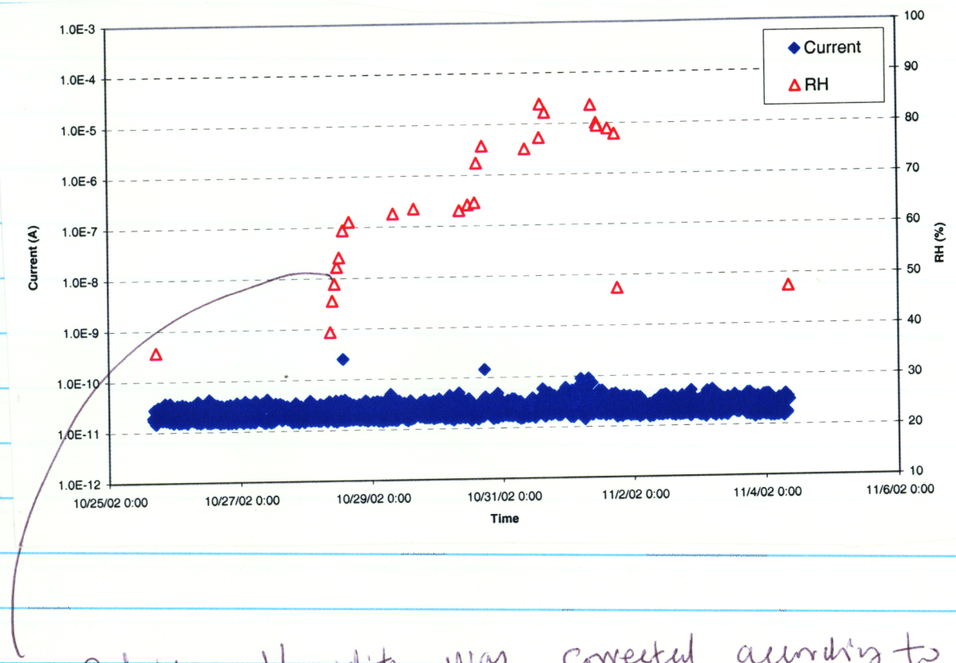
02_0927a03_02_1028a01_Salt Chart_SS316-1

Baseline test



02_0927a03_02_1028a01_Salt

Tab: Summary



Relative Humidity was corrected according to

$$RH(\text{corrected}) = \frac{RH(\text{measured}) + 0.6667}{1.2}$$

See page 92 for the calibrated parameters.

J. Yu
11/21/02

Pages 49 – 98 copied for QA records

J. Yu
4/3/03

Distribution of DRH over a wide Temp. Range. for future TPA.

From: Lietai Yang [ltyang@cnwra.swri.edu]
Sent: Thursday, January 08, 2004 4:02 PM
To: 'Osvaldo Pensado'
Cc: Roberto Pabalan; Lauren Browning
Subject: DRH distribution bounds

Osvaldo,

As discussed on the phone, enclosed may provide the basis for a distribution range of the DRH at different temperatures. The upper bound may be the Na-K-Cl-NO3 system and the lower bound may be the Ca-Na-Cl (or Ca-K-Cl, these two are close to each other) system. The regression equations are shown in the enclosed diagram.

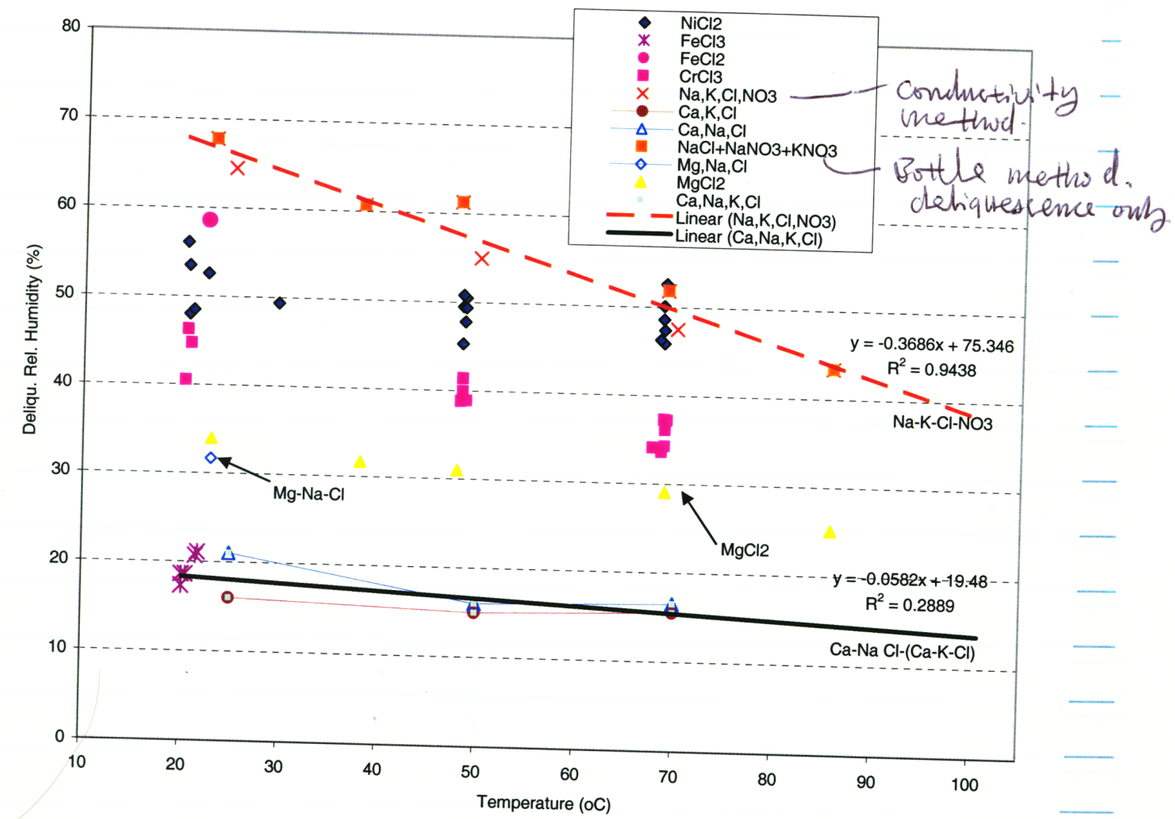
As the Na-K-Cl-NO3 mixture is a very like salt mixture either from the seepage water or from the dusts, more weight should be given to the Na-K-Cl-NO3 system rather than the Ca-(Na,K)-Cl system. Please find a suitable distribution.

Also, the measurements for the enclosed data are on going; the data are preliminary. Some of the values obtained at higher temperatures may have problems with full saturation. We are going to repeat some of those measurements.

L. Yang

Figure given to Osvaldo

File: Summary_11_04_Modified_04_01_08 /Tab: Chart_C_Data



L. Yang

1/13/04

Data for Page 101

New Data from Miriam File Results_10_30, NTBK#596, The original data file were updated, see File: Results_11_14

		Test Condition	T oC	NiCl2	FeCl3	FeCl2	CrCl3	Na,K,Cl,NO3	Ca,K,Cl	Ca,Na,Cl	NaCl+NaNO_3+KNOs	Mg,Na,Cl	MgCl2	Ca,Na,K,Cl
			Relative Humidity (%)											
	Bottle Test	Increasing 1	20.6	48.0										
		Increasing 1	48.3	49.5										
		Increasing 1	68.8	52.6										
		Decreasing 1	68.7	47.4										
		Decreasing 1	48.6	49.4										
		Decreasing 1	29.6	49.4										
		Increasing 2	20.5	53.5										
		Increasing 2	48.3	45.3										
		Increasing 2	68.7	45.9										
		Decreasing 2	68.6	48.6										
		Decreasing 2	48.5	47.8										
		Decreasing 2	22.4	52.6										
		Increasing 3	20.3	56.1										
		Increasing 3	48.6	50.5										
		Increasing 3	68.3	46.3										
		Decreasing 3	68.6	50.1										
		Decreasing 3	48.3	50.8										
		Decreasing 3	21.0	48.5										
		Increasing 1	20.6		18.6									
		Increasing 2	20.2		18.6									
		Increasing 3	20.2		17.3									
		Decreasing 2	21.8		21.1									
		Decreasing 3	21.6		20.7									
		increasing	22.4			58.6								
		Increasing 1	20.5				46.3							
		Increasing 1	48.4				41.4							
		Increasing 1	68.6				33.6							
		Decreasing 1	68.9				34.3							
		Decreasing 1	48.8				38.9							
		Increasing 2	20.8				44.7							
		Increasing 2	48.2				38.8							
		Increasing 2	68.9				36.1							
		Decreasing 2	68.8				37.3							
		Increasing 3	20.3				40.5							
		Increasing 3	48.4				39.9							
		Increasing 3	67.7				34.1							
		Decreasing 3	69.1				37.2							
		Decreasing 3	48.7											
		Decreasing 3	22.7											
	Conductivity Test	Conductivity test	25											
		Conductivity test	50					64.5						
		Conductivity test	70					55						
		Conductivity test	25					47.5						
		Conductivity test	50						16					
		Conductivity test	70						15					16
		Conductivity test	25						15.5					15
		Conductivity test	50							21				15.5
		Conductivity test	70							16				21
										16.5				16
														16.5
Page 150 BOOK 464		Old Data												
	Bottle Test	Page 150 BOOK 464	23											
		Page 150 BOOK 464	38.13					67.7707			67.7707			
		Page 150 BOOK 464	48					60.74343			60.74343			
		Page 150 BOOK 464	69					61.27929			61.27929			
		Page 150 BOOK 464	85.8					51.83473			51.83473			
		Page 150 BOOK 464	23					43.40252			43.40252			
		Page 150 BOOK 464	23											
		Page 150 BOOK 464	38.13									31.69045		
		Page 150 BOOK 464	48										33.94177	
		Page 150 BOOK 464	69										31.693	
		Page 150 BOOK 464	85.8										31	
													29.05652	
													25.11103	

1/13/04

updated original Data

File: Results_11_14

Bottle Tests Recorded in Scientific Notebook 596

Components	Type	Run #1 Temperature (C.)	Humidity (%)	Date/page	Run #2 Temperature (C.)	Humidity (%)	Date/page	Run #3 Temperature (C.)	Humidity (%)	Date/Page
NiCl2	Increasing	20.6	48.0	8/8/03 p. 24	20.5	53.5	8/19/03 p. 27	20.3	56.1	8/26/03 p. 28
NiCl2	Increasing	48.3	49.5	8/8/03 p. 24	48.3	45.3	8/22/03 p. 27	48.6	50.5	8/26/03 p. 28
NiCl2	Increasing	68.8	52.6	8/11/03 p. 24	68.7	45.9	8/15/03 p. 26	68.3	46.3	8/26/03 p. 28
NiCl2	Decreasing	68.7	47.4	8/26/03 p. 28	68.6	48.6	9/11/03 p. 32	68.6	50.1	9/12/03 p. 32
NiCl2	Decreasing	48.6	49.4	8/26/03 p. 28	48.5	47.8	9/11/03 p. 32	48.3	50.8	9/17/03 p. 33
NiCl2	Decreasing	29.6	49.4	8/26/03 p. 28	22.4	52.6	9/10/03 p. 31	21.0	48.5	9/11/03 p. 32
FeCl2	Increasing	22.4	58.6	8/8/03 p. 24						
FeCl2	Increasing	48.5	63.5	8/12/03 p. 25						
FeCl2	Increasing	68.7	62.8	8/12/03 p. 25						
FeCl2	Decreasing									
FeCl2	Decreasing									
FeCl3	Increasing	20.6	18.6	9/10/03 p. 31	20.2	18.6	9/12/03 p. 32	20.2	17.3	9/12/03 p. 32
FeCl3	Increasing									
FeCl3	Increasing	68.7	1.0	8/13/03 p. 25	68.5	1.1	8/14/03 p.26			
FeCl3	Decreasing									
FeCl3	Decreasing	48.7	1.4	8/14/03 p. 26						
FeCl3	Decreasing	20.5	5.0	8/18/03 p. 26	21.8	21.1	9/11/03 p. 32	21.6	20.7	9/16/03 p. 33
CrCl3	Increasing	20.5	46.3	8/29/03 p. 29	20.8	44.7	8/28/03 p. 29	20.3	40.5	9/12/03 p. 32
CrCl3	Increasing	48.4	41.4	8/28/03 p. 29	48.2	38.8	9/16/03 p. 33	48.4	39.9	9/17/03 p. 33
CrCl3	Increasing	68.6	33.6	8/28/03 p. 29	68.9	36.1	8/29/03 p. 29	67.7	34.1	9/16/03 p. 33
CrCl3	Decreasing	68.9	34.3	8/29/03 p. 29	68.8	37.3	9/10/03 p. 31	69.1	37.2	9/11/03 p. 32
CrCl3	Decreasing	48.8	38.9	8/28/03 p. 29	48.6	37.5	8/29/03 p. 29	48.7	34.5	9/10/03 p. 31
CrCl3	Decreasing	24.7	31.7	8/29/03 p. 29	22.3	31.7	9/10/03 p. 31	22.7	28.5	9/11/03 p. 32

FeCl2 oxidizes on hea

Numbers in red indicate an uncertain value due to change in oxidation state or hydration number.

"Increasing" or "Decreasing" refers to whether the target temperature was reached by increasing or decreasing the temperature of the solution.

Humidity Chamber Tests

Components	Temperature	File Name	Deliq/Efflor	Observed RH%	
Blank (H2O only)	50	JULY13BLANK	Deliquescence	NONE	7/11/03 p. 14
Ca, K, Cl	25	July30Sol5	Deliquescence	12-20% (rough)	7/30/03 p. 21
Ca, K, Cl	50	Aug05Sol5	Deliquescence	15%	8/5/03 p. 23
Ca, K, Cl	50	Aug05Sol5	Efflorescence	13% (rough)	8/5/03 p. 23
Ca, K, Cl	70	Aug12Sol5	Deliquescence	15-17%	8/12/03 p. 25
Ca, K, Cl	70	Aug12Sol5	Efflorescence	14-16%	8/12/03 p. 25
Ca, Na, NO3, Cl	50	Aug20Sol6	Deliquescence	Below 16%	8/20/03 p. 27
Ca, Na, NO3, Cl	50	Aug22Sol6	Efflorescence	Below 20%	8/22/03 p. 27
Na, K, Cl, NO3	50	JULY15SOL2	Deliquescence	50-60%	7/15/03 p. 14
Na, K, Cl, NO3	25	July23Sol2	Deliquescence	63-66%	7/23/03 p. 18
Na, K, Cl, NO3	50	July16Sol2	Deliquescence	54-56%	7/16/03 p. 14
Na, K, Cl, NO3	70	July21Sol2	Deliquescence	46-49%	7/21/03 p. 17
Ca, Na, Cl	25	July25Sol4	Deliquescence	19-22%	7/25/03 p. 19
Ca, Na, Cl	50	July25Sol4	Deliquescence	16% (rough)	7/25/03 p. 19
Ca, Na, Cl	70	July29Sol4	Deliquescence	16-17%	7/29/03 p. 20

1/13/04

From: Lietai Yang [ltyang@cnwra.swri.edu]
Sent: Tuesday, January 13, 2004 12:15 PM
To: 'Osvaldo Pensado'
Subject: RE: Deliquescence RH

Osvaldo,

For the Na-K-NO3-Cl system, we only have data up to 86oC; for the Ca,(Na orK)-Cl system, we only have data up to 70 oC.

It is very difficult to extrapolate to 145 oC for the NaKNO3-Cl system. I feel comfortable for the extrapolation to 100 oC. The curve may not be as steep if temperature goes up further.

For the Ca,(Na orK)-Cl system, the temprature dependence is not steep. It might be OK to do some extrapolation. However, DOE has reported that CaCl2 got decomposed at 150oC (not much decomposition at 125oC). Perhaps we should limit the extrapolation to 125 oC for the time being.

It would be nice to do some high temperature measurements. However, we have not found an appropriate humidity chamber for temperature above 100 oC.

-----Original Message-----
From: Osvaldo Pensado [mailto:opensado@cnwra.swri.edu]
Sent: Monday, January 12, 2004 3:16 PM
To: Lietai Yang
Subject: Deliquesence RH

Please see the attachment to check if this is what you had in mind. I think it makes sense.

For the Na, K,Cl, NO3-, I found that the deliquesence RH at the intersection point is practically a constant, equal to 0.219 at 145 °C. Therefore, I am working beyond the range experimental measures. Would it be valid to extrapolate?

For the Ca, Na, K, Cl system, I got deliquesence RHs of the order of 0.1 at 163 °C. Again, I needed to extrapolate.

Therefore, if extrapolating your data is appropriate, a film of solution could develop at RH as low as 10%. This is significantly different from previous data in the TPA code.

Probably extrapolating the data is not appropriate. There may exist a lower plateau in the deliquescence RH versus T curve. I do not know.

/13/2004

What do you think?

Continued on page 107

L. Y.
1/13/04

Data Questionnaire for TPA Version 5.0
Constants

The following is a questionnaire to obtain the final values for the TPA Version 5.0 code constants that are supported by sound technical bases. This questionnaire represents a series of interactions that will take place between the process modelers and the PA to ensure that a consistent set of standards was used in selecting the values. In this questionnaire, staff members are requested to provide qualitative/quantitative arguments, original data, and documentation that substantiate the choice of the constants. Because of the limited time available prior to the TPA production runs, please respond by **12/31/03**.

Part 1. Identification

L.Y. 1/16/04

1a. Responder Name: ~~Osvaldo Pensado~~ Lietai Yang

1b. Section in *tpa.inp*: Ebsfail

1c. TPA Parameter
Parameter Name: DecayingConstantRadiolysis[1/yr]
Distribution Function: constant
Description: Constant controlling the exponential decay of the *radiolytic potential*. See Eqs. (6-8) and (6-9).; value: 7.0e-5; Dummy value selected to avoid overflow and/or underflow in the computations.

Part 2. Examination of Current Data *(Please refer to the current input file for TPA and its description in the TPA user's manual (Mohanty et al. 2000. Check as applicable.)*

	Fully Agree	Agree	Disagree	Fully Disagree
Parameter description is acceptable	☑	☐	☐	☐
Current data type is satisfactory	☑	☐	☐	☐
Data uncertainties are dealt with	☐	☐	☑	☐
Data should be updated	☐	☐	☑	☐

(Provide written comments if needed. For example, you might provide a better parameter description or you might recommend an update that better describes parameter uncertainty using a different data type. Contact S. Mohanty if you require help. If you supply new data below, continue this questionnaire presuming that data is in use. If you believe the data should be updated, but cannot do so at this time, when might it be available?)

Comments on current data: Equations (6-8) and (6-9) are heuristic equations designed to study the potential importance of radiolysis. It was considered that radiation fields are not intensive enough to influence the corrosion potential. Therefore, as part of the base case, CLST decided to set the increase in the corrosion potential equal to zero. The contribution of radiolysis to the uncertainty in the corrosion potential should be 209 minimal compared to other sources of uncertainty.

December 11, 2003

This Writeup was by Osvaldo P.

L. Y. 1/16/04

L. Yang 2/14/06

My input to Osvaldo:

Additional Response: To Questionnaire for TAP version 5.0 Constant

It was reported that no significant radiation effect were observed on general corrosion of stainless steels and nickel alloys at dose rate ≤10Gy/hr. Pitting and crevice corrosion of C-4 alloys in a very aggressive Mg^{2+}-containing environment were observed at 10 Gy/hr, but not at 1 Gy/hr (Shoesmith and King, 1999).

page 33, Table 27.

The DEO has conducted bounding case dose rate calculation for the waste packages with PWR (CRWMS M&O 2001a) and BWR CRWMS M&O 2001b) spent fuels. The maximum dose rate at the outside surface of the WP with 21 PWR spent fuel assemblies is 27 Gy/hr for a 5.5-wt% initial ^{235}U, 75.0-Gwd/MTU burnup, and a 5-year decay time case (CRWMS M&O 2001a) with no basket. The maximum dose rate at the outside surface of the WP with 44 BWR spent fuel assemblies is 27.5 Gy/hr for a 5.5-wt% initial ^{235}U, 75.0-Gwd/MTU burnup, and a 5-year decay time case (CRWMS M&O 2001b). The potential drift will be ventilated for about 50 years. During the ventilation period, the temperature would be moderate and the relative humidity would be lower because the ventilation air is relatively dry for the drift temperature. Model simulation has shown (Osvaldo to provide a reference) that after the closing, the relative humidity will be below the deliquescence points of the hygroscopic salts that are likely to be present in on the waste packages for at least 50 years. Therefore no aqueous solution is likely to be present and cause aqueous corrosion for the first 100 years after emplacement. After this 100-year period, the does rate at the WP surface will be decreased to below 1 Gy/hr according to the calculation results for an earlier waste package design (SU, 1997).

with No basket

page 29, Table 19 -

Reference:

D.W. Shoesmith, F. King, "The Effect of Gamma Radiation on the Corrosion of Candidate Materials for the Fabrication of Nuclear Waste Packages, Pinawa, Manitoba, Canada: Atomic Energy of Canada Limited, AECL-11999, July, 1999.

CRWMS M&O 2001a, Dose Rate Calculations for the 21-PWR UCF Waste Package, CAL-UDC-NU-000002REV01, Las Vegas, Nevada: CRWMS M&O, 2001.

CRWMS M&O 2001b, Dose Rate Calculations for the 44-BWR UCF Waste Package, Cal-UDC-NU-000003REV01, Las Vegas, Nevada: CRWMS M&O.

S.Su and M.N. Haas, MGDS Subsurface Radiation Shielding Analysis (BCAE00000-01717-0200-00001 Rev 00, OCRWM (Office of Civilian Radioactive Waste Management) Report (1997).

1/16/04

From TPA 4.0

6.3.7 Radiolysis

Page 13 + Page 12

Radiation from the SF (α and γ) affecting the WP environment may cause the production of oxidizing species such as H_2O_2, O_2, and short-lived oxidizing radicals (i.e., HO, HO_2). The presence of these oxidizing species may cause an increase in the corrosion potential, which may suffice to change the corrosion mode from general to localized. Uncertainties in the near-field environment, incomplete experimental data, and lack of understanding of the details of the phenomenon have precluded the formulation of a detailed radiolysis model. No matter how complicated this phenomenon may be from the point of view of the degradation of the WP materials, one of the most important issues is the increase in the corrosion potential. This increase in the corrosion potential decays with time (possibly exponentially) because the radiation level decays exponentially with time. In the TPA Version 4.0 code, the increase in the corrosion potential, ΔE, is modeled by

$$\Delta E = \Delta E_o e^{-\lambda t} \tag{6-8}$$

where

ΔE_o	—	increase in the corrosion potential at $t = 0$ [V]
λ	—	decaying constant [1/yr]
t	—	time variable [yr]

The parameters ΔE_o and λ are specified in the *tpa.inp* file as DeltaPotentialDueToRadiolysis[V] and DecayingConstantRadiolysis[1/yr], respectively. The corrosion potential, E_{corr}, is computed as

$$E_{corr} = E_{corr}^{\text{no radiolysis}} + \Delta E \tag{6-9}$$

where

$E_{corr}^{\text{no radiolysis}}$	—	corrosion potential calculated on the basis of a kinetic expression for the cathodic reduction of oxygen and water and the passive current density for the anodic oxidation of the metal [V]

Prior to the failure of the WP, α radiation is totally confined within the WP. Thus, radiation effects on the environment outside of the WP are mainly the result of γ radiation. Because of the heat generated by the SF for the first several hundreds of years after the emplacement, there is only air and water vapor surrounding the WP. Because the radiation yield for H_2O_2 is low in the moist-air gas system, the concentration of H_2O_2 is expected to be negligible in the gas-phase environment (Reed and Van Konynenburg, 1993). Furthermore, the radiation yield of H_2O_2 in water vapor is zero (Spinks and Woods, 1990), and H_2O_2 is unstable and decays into more stable species such as H_2O, OH^-, and O_2. Therefore, H_2O_2 cannot accumulate in the environment in the proximity of the WP during the dry and humid period. After the long dry-air and humid-air periods, water will condense on the surface of the WP and form a thin film. Under this condition, H_2O_2 may be formed by irradiation. The irradiation level must be high enough to guarantee a continuous supply of oxidizing species and increase the corrosion potential. By the time of the formation of the water film, however, the energy absorption rate on the environment in the proximity of the WP will be so low (computed to be less than 0.005 J/kg-hr after 1,000 yr in the EDA II) that the production of H_2O_2 is expected to be negligible. For this reason, in the basecase for TPA Version 4.0 code, it is considered that $\Delta E_o = 0$ (a dummy value is assigned to the parameter λ). Parameter values can be found in appendix A.

1/16/04

Trm Page 104

Discussion with Osvoldo:

If assume the DEL for the Na, K,Cl, NO_3 system is extrapolated to 116 0C or so, the DRH may be 27%. then the deliquescence may be started at the time the WP T=137.5 oC. Assuming 137.5 oC is the critical stable point for CaCl2 (DOE has demonstrated that when T=150 oC, it not stable; when T=125oC, it is stable). The low DRH from CaCl2 would have no meaning before 137.5oC, even if it is low (15%) because CaCl2 is assumed to decompose. Only after 137.5 oC, the CaCl2 would present, however, at this temperature, the RH in the drift is already above DRH of the CaCl2.

Sent: Wednesday, January 14, 2004 10:40 AM
To: 'Osvaldo Pensado'

Osvaldo,
I do not understand why defining a distribution for DEL in TPA is incorrect. Also, you mentioned that " We are not certain whether a deliquescence solution can exist at such high temperature. I suggest disregarding the Ca-Cl system, because we are not certain deliquescence solutions can exist at such high temperatures" We know that at 125oC, CaCl2 is stable, even though it not stable at 150oC. We can still use the DEL of Ca-Na-K-Cl at 125 oC, which is much lower than that of 35%. Of course, the probabilities of the occurrence of CaCl2 from both the dusts and from the seepage water are low.
Unless we can prove that CaCl2 is not likely present in the system, we should not exclude the use of the DEL of CaC2.

A recent paper published by DOE contractor shows that CaCl2 will decompose at 150oC. We can assume that CaCl2 would not present and would not be accumulated before the time the WP T>=150oC. However, more proof is need for the unlikelyhood of the presence of CaCl2 after T<150oC.
-Lietai
From: Osvaldo Pensado [mailto:opensado@cnwra.swri.edu]
Sent: Tuesday, January 13, 2004 5:45 PM

I learned that defining a distribution for deliquesence in TPA is incorrect .
The deliquescence point for use in TPA should be the minimum defensible deliquescence point (at a high temperature).

Na, K,Cl, NO_3 system: By assuming that the deliquescence flattens at 110 °C

1/14/04

(i.e., deliquescence RH is a constant at higher temperatures), I got that the deliquescence RH at the intersection point is 0.35 (= deliquescence at 110 °C). The temperature of the WP at the intersection point is ~129 °C.

For **Ca, Na, K, Cl system**, the temperature of the waste package at the intersection point is greater than 150 °C. Based on our discussion today, I do not feel comfortable is using the deliquescence of the Ca, Na, K, Cl system. The temperature at the intersection point is so high that a deliquescence solution is not likely to exist.

Therefore, in TPA I suggest using 0.35 as the value of the deliquescence point, corresponding to the deliquescence point of Na, K, Cl, NO3 at 110 °C. I suggest defining it as a constant value (not as a distribution).

If you know the deliquescence point of a credible salt at a higher temperature, we should use that value instead.

Please check the attachment for the analysis. You can skip the first three pages, as you have already seen them. If you have a recommendation, better speak now, as I will be providing recommendation for the TPA input file.

Osvaldo

1/14/04

2/12/04

Corrosion test in evaporative environments
Initial Entry see page 0 (Back of cover sheet).

Alloy C22 Heat # XX1977BG11 sample analysis Page 88 Notebook 503
9 lengths of 6" wire to 1121°C for 10 min. then rapid water quenched.
9 lengths of 6" wire to 870°C for 5 min. for thermal age.

Alloy 825 Heat # HH52301F see page 142
9 lengths of 6" wire to 954°C for 10 min. then air cooled.

RSD 5-4-04
SS 304 GoodFellow PO # 1831325 Chemical Analysis Page 4 Notebook B522
9 lengths of 6" wire to 1100°C for 10 min. then rapid water quenched.

SS 316 GoodFellow P.O # 1844395 Chemical Analysis Page 153 Book 497
9 lengths of 6" wire to 1100°C for 10 min. then rapid water quenched

Titanium -7 wire MS Heat # P914 (see page 141)
RSD 9 lengths of 6" wire to 708°C for 2 hours air cooled

Alloy 276 PO. 1844395 See page 153 Chemical Analysis See page 177 book 423
9 lengths of 6" to 1121°C for 10 min rapid water quenched

Roger J Dykes 2/12/04

2/12/04

Polished all specimens to 240 grit finish.

2/13/04

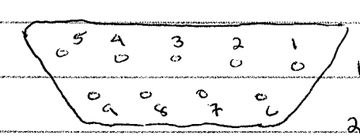
Polished all specimens to 600 grit finish
Cleaned all wires with isopropanol Alchohol.
Attached pin ends to wires
part # 512-9017 from Electric Store room

Mixed up Epoxy RSD 2-12-04 10:100 ratio
Arcmco products 2300-A-1018 Expires 7/31/04
Arcmco products 2300 B-1018 7/31/04
RSD 2-12-04

Coated wires with Epoxy

2/17/04
Made wire harness out of 22 AWG Dearborn/CDT wire & cable. SPC .008 teflon coating

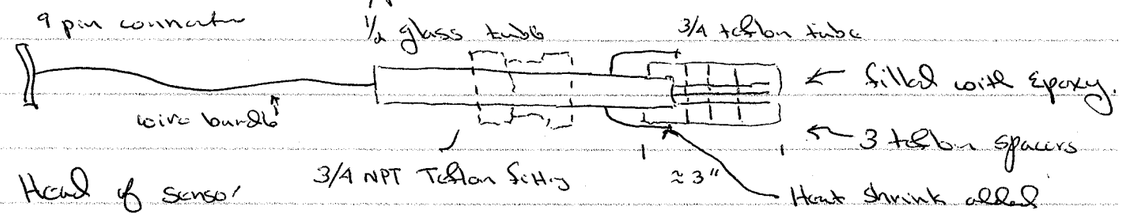
rear view of 9 pin connector



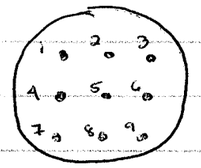
1 black
2 red
3 orange
4 green
5 yellow
6 blue
7 gray
8 purple
9 white

Roger J Dykes
2/17/04

2/17/04 typical sensor fabrication



Head of sensor



1 black	4 green	7 gray
2 red	5 yellow	8 purple
3 orange	6 blue	9 white

Assembled 316, C22 (1121°C), C22 (870°C) probe. Epoxy was added for 2 day cure.

2/18/04

Assembled C276, T17, SS304, C22 (1121°C), 825 probe. Epoxy was added for 2 day cure.

2/19/04

Assembled C276, T17, SS304, C22 (870°C), 825 & 316 probe. Epoxy was added for 2 day cure.

2/20/04

RSD 2/20/04 ~~Finished~~ Polished sensors to 600 grit finish. Checked to ensure no cross contamination on finish polish by using separate 600 grit wheel for each sensor.

Checked continuity of all sensor wires ⇒ ok.

Roy [illegible]
2/20/04

2/20/04

Cut 9 6" pieces of wire for Heat treatment

1) 316
1) 304
2) C22
1) 825

made cradles to ensure wire will stay together during heat treatment.

Ordered more high temp wire for sensor fabrication.

2/23/04

C22 wire thermally aged 9 pieces 6" long Heat # XX1977 0611
(heated @ 870°C for 5 min) page 88 notebook 503

2/24/04

SS304 wire thermally aged a pieces 6" long
(heated @ 1100°C 10 min, rapid H_2O Quench)
PO 1831328 page 4 notebook B582

SS 316 wire thermally aged a pieces 6" long
(heated @ 1100°C 10 min, rapid H_2O Quench)
PO 1844395 page 153 notebook 497

C22 wire thermally aged a pieces 6" long
(heated @ 1121°C 10 min, rapid H_2O Quench)
page 88 book 503

Alloy 825 thermally aged a 9 pieces 6" long
(heated @ 954°C 10 min, air cooled)
see page 142

10/4/04

Subject: Corrosion test in evaporative environments; Corrosion test on effect of fabrication process

Roger,

As discussed, please considering making the following probes (some of them will be used in the immediate tests, others will be used later):

C-22 wire, 1 mm dia, solution annealed (1121 oC, 10 Min, rapid water quenching)

C-22 wire, 1 mm dia, Thermally aged (heated at 870 oC for 5 min) , air cooled

Alloy 825, 1 mm dia, solution annealed (heated at 954 oC for 10 Min, rapid air cooling)

SS 304, 1 mm dia, solution annealed (Mill Annealed, If not, heat it at 1100 oC for 10 Min, followed by rapid water quenching)

SS 316, 1 mm dia, solution annealed (Mill Annealed, If not, heat it at 1100oC oC for 10 Min, followed by rapid water quenching)

Ti-7 wire, annealed (if not, heat it at 708 oC for 2 hours followed by air cooling).

Alloy 276, 1 mm dia, solution annealed at 1121 oC 10 Min followed by rapid water quenching

All the probes shall be tube like, flush mounted (enough length to be mounted in a bottle), good for temperatures up to 150 oC.

2/25/04 mixed up chemicals for 2 liters of UZ x 1293

$CaCl_2 \cdot 2H_2O$	115g	Lot # 025259
$MgSO_4 \cdot 7H_2O$	10.76g	Lot # 034516
KNO_3	8.63g	Lot # 010186
NaF	2.42g	Lot # 006679
$NaHCO_3$	0.163g	Lot # 028966
$MgCl_2 \cdot 6H_2O$	84.52g	Lot # 030320
NaCl	28.35g	Lot # 035421
KCl	3.959g	Lot # 006242

no $SiO_2 \times H_2O$ was available

total of 80 ml of DI was added R J Rykstra 2/27/04

2-27-04

Temperature of Htr set to 100°C
Gas phase inside vessel is 63°C

Hooked up the following channels

I-1	Alloy 22*	liquid	sensor 21704-13 (not in liquid yet)	Resistors 1KΩ-W1
~~II~~ I-2	Ti-7	liquid	sensor 21704-11 (not in liquid yet)	1KΩ-W2
I-3	316SS	liquid	sensor # 21704-16 (not in liquid yet)	1KΩ-W3
I-4	Alloy 22*	gas	sensor # 21704-14	10KΩ-#8
II-1	Ti-7	gas	sensor # 21704-12	10KΩ-#1

0907 started V.B program
file name 2-27-04 Dust 00.txt

0929 fixed wires 39 : 40 return.

2112 changed out RTD glass well for longer one. Now on is all the way down in solution

0950 Made 100ml of 0.001 m NaOH
Added 0.26g of 0.001m NaOH to test

* Alloy 22 1121°C annealed probes

Roger J Rykstra
2/27/04

2·27·0A

Below is the Recipes for UZ x 1234.

RECIPES FOR VARIOUS GROUDWATERS

Solute	Introduced Concentration, mg/L					
	1xUZ	62xUZ	UZx1243	J13x1	J13x157	250xJ13 rewetted
$CaCl_2 \cdot 2H_2O$	159	6512	57767	15	0.2	11
$CaSO_4 \cdot 2H_2O$	73					
$MgSO_4 \cdot 7H_2O$	111	3961	5382	21	12	0.8
$Mg(NO_3)_2 \cdot 6H_2O$	16					
KNO_3	5.2	719	4205	4.1	1533	3456
KF	3.3					
NaF	2.4	84	1198	5.1	707	1748
$NaHCO_3$	28	14	61	145	8197	18210
$SiO_2 \cdot xH_2O$, 84% SiO_2	12	599	644	12	1671	3950
$MgCl_2 \cdot 6H_2O$		1499	42264			
NaCl		982	14211		1810	4342
KCl			1975			
$Ca(NO_3)_2 \cdot 4H_2O$				10		
K_2SO_4				8.0		
$NaNO_3$		207			626	988
	Introduced NaOH (g/L)*					
0.001 M NaOH	.007	.32	.12	.24	.724	1.992

*added to achieve mass balance for Na

note: no $SiO_2 \times H_2O$ (84% SiO_2) was used in our test.

1057 Htr temp 120°C, inside liquid temp 83°C
1250 Htr temp 120°C, inside liquid temp 89°C
1300 Htr ↑ temp 150°C
1405 Changed out RTD to type K thermocouple for liquid temp.
Hooked up Type K thermocouple between #33 and 40 for V.B program.
No temperature compensation for that thermocouple is made. Ref for V.B program.

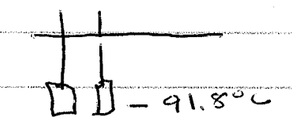
Roger [illegible] 3/2/04

1430 Changed Htr ↑ 160°C
1500 Htr temp = 160°C, Inside liquid temp 113°C
1520 Htr temp = 160°C, Inside liquid temp 116°C
Channel 33 = 3801 (Inside liquid Tc)

3/1/04

0745 Htr temp = 160°C, Inside liquid temp 119°C

0820 Temperature @ probe level for all probes is 91.8°C



0825 lowered all probes to ≈ 1" from salt solution
0915 Temperature @ probe level is 96.8°C

1228 Lowered three probes into the salt SS316, Alloy 22, Ti-7

1400 Htr temperature = 150°C, Inside liquid temp 121°C

3/2/04
0945 Htr temp = 150°C, Inside liquid temp 116.3°C
1045 Closed the vent for the cell

Roger [illegible]
3/2/04

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Institute Quality Systems
Institute Calibration Laboratory
Phone: 210-522-5215 Fax 210-522-3692

ACCREDITED
Certificate #
0972-01

Certificate of Calibration

Submitted By:	DIV20	**Work Order:**	444057635
Address:	B57	**Date Issued:**	Feb 26, 2004
Contact:	LIETAI YANG	**Calibration Date:**	Feb 26, 2004
Manufacturer Model:	VAISALA HMP77B	****Calibration Due:**	Feb 26, 2005
Description:	TEMPERATURE/HUMIDITY PROBE	**Calibration Location:**	Bldg. 64
Serial No:	Z0750005	**Environment:**	Temp. 79.0°F Hum. 23 %RH
Asset No:	010701	***As Found:**	IN TOLERANCE
Procedure:	TEMPERATURE/HUMIDITY, MAR/03	***As Left:**	IN TOLERANCE

This certificate documents traceability to the National Institute of Standards and Technology (NIST) and the International System of Units (SI). The Laboratory quality system conforms to ISO/IEC 17025, 1999 and ANSI/NCSL Z540-1-1994 which are equivalent to relevant requirements of the ISO 9000-1994 series of standards. This certificate may not be reproduced, except in full, without the written approval of the Southwest Research Institute Calibration Laboratory. The results of this calibration relate only to the individual instrument described above. This certificate shall not be used to claim product endorsement by the American Association for Laboratory Accreditation (A2LA) or any agency of the U. S. Government.

Uncertainty evaluation includes the item under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor of k=2 to approximate a 95% confidence level. The calibration process provides a Test Uncertainty Ratio (TUR) of less than or equal to 25% (4:1) of the test limit unless otherwise stated in remarks or an attachment.

*The client has sole responsibility for determination of in/out of tolerance or compliance/noncompliance. An in/out of tolerance opinion is provided for your convenience based only on the Test Instrument (TI) reading(s) and limits as reported. The reported uncertainty relates only to the results at the time of calibration and does not imply any short or long term stability of the TI.

**Calibration interval is determined by the client and does not assure the instrument will remain within tolerance until this date. Any number of factors may cause the instrument to be out of tolerance before the next calibration date.

Remarks: Calibrated as a system with Vaisala MI70 Indicator S/N Z0730015.

Standards Used

Asset	Manufacturer	Model	Description	Cal Due
006404	THUNDER SCIENTIFIC	2500	HUMIDITY GENERATOR	Jun 10, 04

Approved by: Walt Hill
Metrology Group Leader
m:\a2la1.rpt Rev date 15, August 02

Measurements by: Mark Romero
Metrology Technician

1 of 1

3/2/04

Southwest Research Institute
Calibration Laboratory
Calibration Report

Work Order	444057635	Mfr	Vaisala	Tech:	Mark Romero
Asset No.	010701	Model	HMP77B		
Serial No.	Z0750005	Type	Temperature/Humidity Probe	Cal Date:	26-Feb-04
Remarks: Calibrated with Vaisala Indicator MI70 S/N Z0730015.					

Function/Range	Test Point	TI Reading	Difference	+/-Limits	+/-Uncertainty	Found/Left
HUMIDITY	%RH	%RH	%RH	%RH	%RH	Results
	34.99	34.50	-0.49	1.00	0.50	Pass
	50.07	49.77	-0.30	1.00	0.50	Pass
	74.95	74.41	-0.54	1.00	0.50	Pass
TEMPERATURE	Deg C	Deg C	Deg C	Deg C	Deg C	
	20.33	20.43	0.10	0.20	0.16	Pass

END OF REPORT

Rev 0, Mar/03 Page 1 of 1 THERMOHYGROMETER

3/2/04

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Institute Quality Systems
Institute Calibration Laboratory
Phone: 210-522-5215 Fax 210-522-3692

ACCREDITED
Certificate #
0972-01

Certificate of Calibration

Submitted By: DIV20
Address: B57
Contact: LIETAI YANG
Manufacturer Model: VAISALA HMP77B
Description: TEMPERATURE/HUMIDITY PROBE
Serial No: Z0750006
Asset No: 010700
Procedure: TEMPERATURE/HUMIDITY, MAR/03

Work Order: 444057636
Date Issued: Feb 26, 2004
Calibration Date: Feb 26, 2004
****Calibration Due:** Feb 26, 2005
Calibration Location: Bldg. 64
Environment: Temp. 79.0°F Hum. 23 %RH
***As Found:** IN TOLERANCE
***As Left:** IN TOLERANCE

This certificate documents traceability to the National Institute of Standards and Technology (NIST) and the International System of Units (SI). The Laboratory quality system conforms to ISO/IEC 17025, 1999 and ANSI/NCSL Z540-1-1994 which are equivalent to relevant requirements of the ISO 9000-1994 series of standards. This certificate may not be reproduced, except in full, without the written approval of the Southwest Research Institute Calibration Laboratory. The results of this calibration relate only to the individual instrument described above. This certificate shall not be used to claim product endorsement by the American Association for Laboratory Accreditation (A2LA) or any agency of the U. S. Government.

Uncertainty evaluation includes the item under test and is calculated in accordance with the ISO "Guide to the Expression of Uncertainty in Measurement" (GUM). The uncertainty represents an expanded uncertainty using a coverage factor of k=2 to approximate a 95% confidence level. The calibration process provides a Test Uncertainty Ratio (TUR) of less than or equal to 25% (4:1) of the test limit unless otherwise stated in remarks or an attachment.

*The client has sole responsibility for determination of in/out of tolerance or compliance/noncompliance. An in/out of tolerance opinion is provided for your convenience based only on the Test Instrument (TI) reading(s) and limits as reported. The reported uncertainty relates only to the results at the time of calibration and does not imply any short or long term stability of the TI.

**Calibration interval is determined by the client and does not assure the instrument will remain within tolerance until this date. Any number of factors may cause the instrument to be out of tolerance before the next calibration date.

Remarks: Calibrated as a system with Vaisala MI70 Indicator S/N Z0730015.

Standards Used

Asset	Manufacturer	Model	Description	Cal Due
006404	THUNDER SCIENTIFIC	2500	HUMIDITY GENERATOR	Jun 10, 04

Approved by: Walt Hill
Metrology Group Leader
m:\a2la1.rpt Rev date 15, August 02

Measurements by: Mark Romero
Metrology Technician

3/2/04

Southwest Research Institute
Calibration Laboratory
Calibration Report

Work Order	444057636	Mfr	Vaisala	Tech:	Mark Romero
Asset No.	010700	Model	HMP77B		
Serial No.	Z0750006	Type	Temperature/Humidity Probe	Cal Date:	26-Feb-04
Remarks: Calibrated with Vaisala Indicator MI70 S/N Z0730015.					

Function/Range	Test Point	TI Reading	Difference	+/-Limits	+/-Uncertainty	Found/Left
HUMIDITY	%RH	%RH	%RH	%RH	%RH	Results
	35.01	34.45	-0.56	1.00	0.50	Pass
	50.06	49.72	-0.34	1.00	0.50	Pass
	74.96	74.35	-0.61	1.00	0.50	Pass
TEMPERATURE	Deg C	Deg C	Deg C	Deg C	Deg C	
	20.33	20.42	0.09	0.20	0.16	Pass

END OF REPORT

3/2/04

3/3/04 0740 Htr temp 150°C, Inside salt temp = 113.5°C
* 0759 Htr temp 160°C, Inside salt tm = 119.8°C
* looked @ cell, the Htr temp element was not all the way in htr, did not adjust heat. Inside element was not all the way down.

Made rock dust from ~~Yata~~ RSD 3.3.04 Yucca Mountain rock UN/1A2 TSW2 Topach spring Tuff.

1045 Htr temp 157°C, Inside salt temp = 118°C

3/4/04
0919 Removed TC and well to fill with oil. Broke end off and introduced a 10ml of oil into test
0937 Replaced TC well, oil and TC for monitoring salt temp
1235 Hooked up TC to channel 34 to monitor temp @ probe level that are not in solution

Ambient room temp is ~~16°C~~ 25°C RSD 3.4.04
1314 Htr temp 160°C, Inside salt 119.8°C

1443 ↑ Htr temp to 170°C

Rg H Hy
3/5/04

3/5/04 0750 Htr temp 170°C, Inside salt temp 124.5°C
↑ Htr temp to 175°C Ambient temp = 22°C

0830 ↑ Htr temp to 180°C

1038 ↑ probe height for gas phase by ≈1 inch

1254 Htr temp 180°C, Inside temp = 120.4°C
Ambient temp = 24°C

1538 Removed Alloy 22 gas phase probe it failed and had H2O coming up glass tube.

RSD 3/8/04
3/6/04
0740 Ambient 34°C
Htr temp 180°C Inside temp 129.7°C

0930 Shut Htr off to cool down cell for dismantle.

1000 Took pictures of Alloy 22 Gas probe from salt test (2 pictures) Cleaned inside glass with Isopropanol. Dry in oven @ 110°C

1200 Removed probes and cleaned cell & Probes

to be continued on page 127,

10/4/04

The Conductivity Behavior of Salt Deposits on the Surface of Engineered Barrier Materials for the Potential High-Level Nuclear Waste Repository at Yucca Mountain, Nevada

Lietai Yang, Miriam R. Juckett, and Roberto T. Pabalan
Center for Nuclear Waste Regulatory Analyses,
San Antonio, TX 78238–5166, U.S.A.

ABSTRACT

Information potentially subject to copyright protection was redacted from this location. The redacted material was published by the Materials Research Society in 2004.

Note: All Files are in this Notebook's directory.

3/3/04

Information potentially subject to copyright protection was redacted from this location. The redacted material was from an article published by the Materials Research Society in 2004.

Figure 2. Response of baseline impedance of filter paper soaked with pure water to changes in RH. The equilibration time was 2 hrs.

File: Copy of October 29 Blank 50C / Tab: Imp&RH vs. Time

Figure 3. Baseline impedance vs. RH for filter paper soaked with pure water.

File: Copy of October 29 Blank 50C / Tab: Chart_R vs RH

2/14/06

Information potentially subject to copyright protection was redacted from this location. The redacted material was from an article published by the Materials Research Society in 2004.

RH (%)

Figure 4. Impedance vs. RH curves for the Na-K-Cl-NO_3 system. The equilibration time was 4 hrs for the deliquescence curve at 25 °C, and 2 hrs for all other curves

Data File Name

File: Feb04SolA70C Jan17SolA50C Jan12 SolA 25C Feb 14 SolA 25C

Humidity 70C, Eff 70C, Del 50C, Eff 50C, Del 25C, Eff, 2hr 25C, Del, 2hr 25C, Eff, 4hr 25C, Del, 4hr
60 2.383942764

File: Conductivity_CaKCl_System / Tab: Chart

File: Conductivity_CaNaCl_System / Tab: Chart

Information potentially subject to copyright protection was redacted from this location. The redacted material was from an article published by the Materials Research Society in 2004.

RH (%)

Figure 5. Impedance vs. RH curves for the Ca-K-Cl system. The equilibration time was 2 hrs for all curves

RH (%)

Figure 6. Impedance vs. RH curves for the Ca-Na-Cl system. The equilibration time was 2 hrs for all curves

File: Conductivity_CaNaCl_System

Data files:

Nov 24 SolB 70C Eff Nov 24 SolB 70C Del Dec 05 SolB 50C Nov18 SolB 25C Nov14 SolB 25C
rescence
idity 70C, Eff 70C, Del 50C, Eff 50C, Del 25C, Eff 25C, Del 25C, Eff, N25C, Del, Nov 14

File: Conductivity_CaNaCl_System

Data Files:

Nov 24 SolB 70C Eff Nov 24 SolB 70C Del Dec 05 SolB 50C Nov18 SolB 25C Nov14 SolB 25C
Efflorescence
Humidity 70C, Eff 70C, Del 50C, Eff 50C, Del 25C, Eff 25C, Del 25C, Eff, N25C, Del, Nov 14

3/2/04

FiLe: DRH_NaKClNO3_System / Tab: Chart

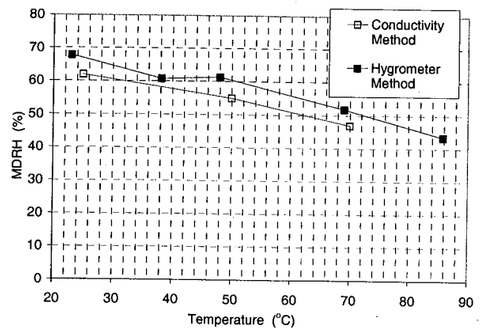


Figure 7. MDRH values obtained in this study using the conductivity method and in a previous study [2] using the hygrometer method.

File: DRH_Ca_NaKCl_System /Tab: Chart

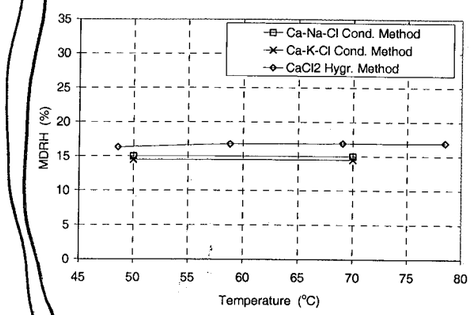


Figure 8. MDRH values obtained using the conductivity method and the hygrometer method.

Data File: Summary_DRH&ERH

Humidity	Conductivity Method
25	62
50	55
70	47

23
38.13
48
69
85.8

File: DRH_test_Hygrometer_summary
Hygrometer Method

67.7707
60.74343
61.279287
51.834728
43.402524

Data Data File: Summary_DRH&ERH

Files	Conductivity_CaNaCl_System	Conductivity_CaKCl_System
	Ca-Na-Cl	Ca-K-Cl
T oC	Ca-Na-Cl Cond. Method	Ca-K-Cl Cond. Method
25		
50	15	14.5
70	15	14.5

38.47
48.58
58.8
69.04
78.49
78.49

File:Single Salt Bottle Tests_2004_02_24

$CaCl_2$ Hygr. Method

16.335
16.802
16.8825
16.9375
16.9375

File: Summary_DRH&ERH

Files:	Conductivity_CaNaCl_System		Conductivity_CaNaCl_System		Conductivity_CaKCl_System	
	Na-K-Cl-NO3		Ca-Na-Cl		Ca-K-Cl	
Temp oC	MDRH (%)	MERH (%)	MDRH (%)	MERH (%)	MDRH (%)	MERH (%)
25	63	54	18.5	-	16.5	-
50	55	53	15	13.5	14.5	14
70	47	45	15	14	14.5	14.5

3/4/04

From P. 123.

3/8/04

1300 Took pictures of probes after cleaning with DI H_2O

Polished probes with 320 then 600 grit sand paper.

Took pictures of probes after polishing.

Set up cell with DI H_2O to monitor probes over night to ensure good base line values. (Alloy 22 gas probe is under repair. Put heat srink around probe head. Mixed up epoxy to fix crack in glass.

1534 started V.B. program to test probes

Alloy 22 gas probe is not in cell yet.

Have cell with DI H_2O heating up to 95°C.

3/9/04

0723 Added Alloy 22 probe to cell.

Htr ↑ to 120°C

0823 Internal temp = 86.9°C

1002 Internal temp = 86.2°C

1228 Replaced Alloy 22 gas probe with Alloy 22 (870°C heat treated probe)

Internal temp = 86.1°C

3.9.04

3/9/04

1443 Changed out 316 SS probe with one not used yet. Internal temperature = 86.6°C

1500 Repolished the Alloy 22 probe & ~~Alloy~~ 316 SS probe removed today. Will install tomorrow to see if not enough surface was removed 1st polish RSD 3.9.04

3/10/04

0759 Removed the Alloy 22 probe & 316 SS probes and replaced with original Alloy 22 (yes) and original 316 SS.

1240 Removed probes & replaced RSD 3/10/04
Water. Water was yellow in ~~color~~ color
→ salt from probes maybe

1254 Started heatup of test.

3/11/04
Shut Htr off. Stopped V.B. Program.

3/11/04 Dismantled the SS 316 sensor & the two C22 sensors to use the wiring.

SS 316 sensor # 21704-10
C22 sensor # 21704-13
21704-14

Roy [illegible]
3.11.04

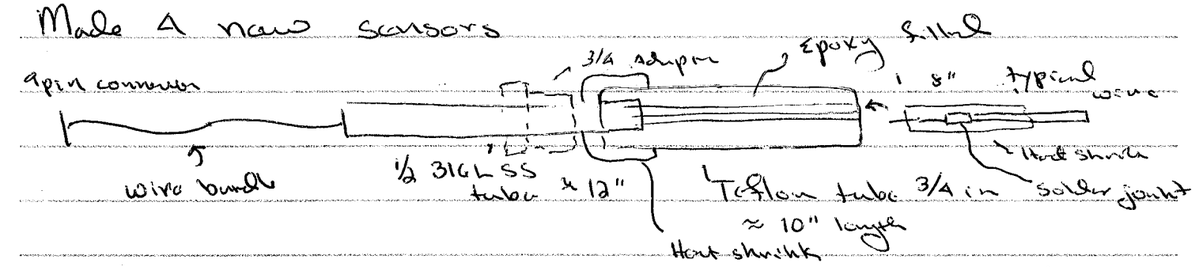
3/17/~~03~~04 RSD 3.17.04

Mixed up chemicals for 2 liters of UZ x 1243

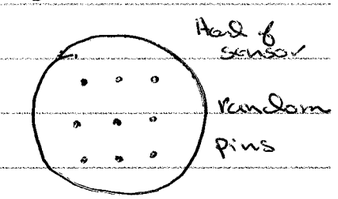
$CaCl_2 \cdot 2H_2O$	115g	lot # 025259
$MgSO_4 \cdot 7H_2O$	10.62g	lot # 034816
KNO_3	8.61g	lot # 010186
NaF	2.41g	lot # 006679
$NaHCO_3$	0.157g	lot # 028966
$MgCl_2 \cdot 6H_2O$	84.21g	lot # 036320
NaCl	26.39g	lot # 035421
KCl	4.00g	lot # 006292
0.001M NaOH	0.26g	

Added 100 ml H_2O (DI)

Made 4 new sensors



316	1100°C	rapid H_2O quench
C22	1121°C	rapid H_2O quench
304	1100°C	rapid H_2O quench
Alloy 825 ~~C276~~ RSD 3.17.04	954°C	air cooled



				Epoxy
C22	1121°C	sensor #	31704-1	Aremco 2300-A-1018
316	1100°C	sensor #	31704-2	Aremco 2300-B-1018
825	954°C	sensor #	31704-3	expires 7/31/04
304	1100°C	sensor #	31704-4	

Roy [illegible]
3.17.04

3/18/04 RSD 3.18.04

Polished probes to 600 grit finish.

Set probes in cell (all in gas phase) with DI H_2O in cell.

1430 Hooked up following sensors

			Resistor
Alloy 22	#31704-1	channel I-1	1KΩ - W1
TI-7	#21704-11	channel I-2	1KΩ - W2
316	#31704-2	channel I-3	1KΩ - W3
Alloy 825	#31704-3	channel I-4	10KΩ - #8
304	#31704-4	channel II-1	10KΩ - #1

Late entry sensors made on 2-17-04

C276	1121°C	H_2O	Quenched	sensor #	2-17-04-1
"	"	"	"	"	21704-2
C22	870°C	Air	Cooled	"	21704-3
"	"	"	"	"	21704-4
SS304	1100°C	H_2O	Quenched	"	21704-5
"	"	"	"	"	21704-6
Alloy 825	924°C	Air	Cooled	"	21704-7
"	"	"	"	"	21704-8
SS 316	1100°C	H_2O	Quenched	"	21704-9
"	"	"	"		21704-10
TI-7	708°C 2hr	Air	cooled		21704-11
					21704-12
C22	1121°C	H_2O	Quenchd		21704-13
					21704-14

RSD
3.18.04

3/18/04

3/18/04 RSD 3/18/04

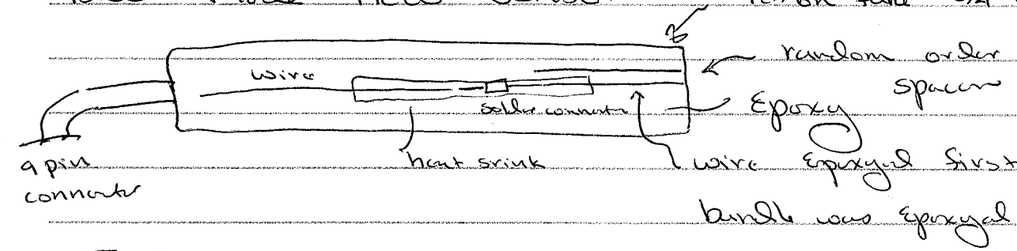
~~13:11~~ 1510 Turned on Htr to 75°C

3/19/04 Htr temp = 75°C, Internal temp 54°C

0750 ↑ Htr temp to 100°C

0824 ↑ Htr temp to 120°C

1200 Made new sensor



Total of 9 wires used C22 870°C Air cooled

Sensor # 3/19/04-1 Epoxy 2300-A-1018

2300-B-1018

3.22.04 Expires 7/31/04

0846 Replaced Alloy 825 #31704-3 on channel I-4 with C22 870°C sensor # 31904-1

1358 Replaced 304 #31704-4 on channel II-1 with ~~TI~~ I-7 serial # 21704-12

RTD 3.22.04

3.23.04

0824 Placed all probes in salt bath cell

U2 x 1243 mixture

All probes are in the gas phase of cell at this time.

3.18.04

Make Sov 2 Liters of Solution

$CaCl_2 \cdot 2H_2O$	115g	lot #	025259
$MgSO_4 \cdot 7H_2O$	10.2g	lot #	034516
KNO_3	8.61g	lot #	010186
NaF	2.41g	lot #	006679
$NaHCO_3$	1.57g	lot #	028966
$MgCl_2 \cdot 6H_2O$	84.21g	lot #	030320
NaCl	28.39g	lot #	035421
KCl	4.00g	lot #	006242

no $SiO_2 \times H_2O$

total of 80 ml of DI

Added 0.25g of 0.001m NaOH.

Alloy C22 Heat # XX1977 BG11

16 lengths of 6" wire 1121°C for 10 min H_2O Quench

16 lengths of 8" wire 1121°C for 10 min H_2O Quench

Alloy 825 Heat # HH 5230F see page 142

16 length of 6" wire 954 °C for 10min Air cooled

16 lengths of 8" wire 954 °C for 10min Air cooled

SS316 Good Fellow PO# 1844395 Chemical Analysis Page 153 Book 497

16 length of 6" wire 1100°C for 10 min H_2O Quench

16 length of 8" wire 1100°C for 10min H_2O Quench

SS304 Good Fellow PO# 1831328 RD 54.01 Chemical Analysis Page 4 Note Book 522

8 lengths of 6" wire 1100°C for 10 min H_2O Quench

R[illegible]
3.22.04

3.22.04 RTP 3.22.04

0842 Added 125 g of 115-250 mesh rock dust to cell; Added 128g of 60-115 mesh rock dust to cell. All probes still in gas phase.
Set Htr for 80°C UN/1A2 TSW2 Topach spring Tuff

0950 Set Htr for 100°C

1027 Set Htr for 110°C, Int temp = 68°C

1106 Set Htr for 120°C, Int. temp = 76°C

1257 Set Htr for 130°C, Int Temp = 83°C

Alloy C22 Heat # XX1977 BG-11 see page 88 notebook 503

16 lengths of 6" wire 870°C for 5min, air cooled

16 length of 8" wire 870°C for 5min, air cooled

P.O# 1831325 page 89 Book 423

C276 Good Fellow LS214715 BG NI 145150/1 see page 152 Chemical Analysis.

16 lengths of 6" wire 1121°C for 10min, H_2O Quench

16 lengths of 8" wire 1121°C for 10min, H_2O Quench

1336 Set Htr for 140°C, Int Temp = 87°C

3.24.04 1013 Removed Alloy 22 probe I-1 Serial # 31704-1. Repolished and coarse finish

R[illegible]

1025 Placed probe in DI H_2O 3.22.04

3.24.04

1305 Placed probe in air

1354 Removed probe from I-1 to get baseline non connecting data

-0.058 -0.348 -0.267 -0.331 -0.504 -0.459 -0.838 -0.398

1418 Reconnected probe to I-1.

1430 Placed probe into DI H_2O

3.25.04

Replaced probe on I-1 with new probe C22 854°C serial # 21704-1, serial # 31704-1

0851 switched I-1 & I-2

real-time prior to switch

I-1	12.077	15.341	-17.675	-0.193	11.814	7.329	-0.223	-4.172
I-2	-1.623	-1.44	-0.957	-0.862	-1	-1.043	-1.215	0.946

I-1	0.17	0.045	-0.047	0.097	-0.056	-0.222	-0.794	-.406
I-2	7.641	10.366	-17.267	-2.397	9.53	4.554	0.917	-8.324

0914 switch I-1 & I-2 back.

I-1	7.488	9.312	-18.829	5.874 (0.928)	4.281	0.25	-7.386	
I-2	0.051	-0.122	0.241	-0.849	-0.127	-0.115	-1.09	0.628

9.29 Replaced probe 21704-1 with 31704-1 on I-1, probe 31704-1 was repositioned.

Regina

3.24.04

3.25.04

1016 Replaced probe 31704-1 with probe 21704-1 on I-1. In air no Hot DI H_2O

0.041 -0.237 -0.168 -0.024 -0.488 -0.313 -0.681 -0.32

1211 Placed probe 21704-1 in Hot DI H_2O

4.244 4.548 -12.508 0.256 1.983 4.391 -2.859 -3.676

1249 Removed probe 21704-1 to air.

0.139 -0.145 -0.197 -0.101 -0.353 -0.386 -0.44 -0.438

1311 Placed probe 21704-1 in cell

Htr temp 160°C, int temp 91°C.

3.26.04

0843 Lowered Alloy 22 870 # 21704-1, SS 316 31704-2, TP-7 #21704-12 into rock & salt mixture

Htr temp 140°C, Internal temp 92°C

3.29.04 Htr temp = 140°C, Internal temp 94°C

4.8.04 ↑ Htr temp to 160°C, RTO action

0810

4.8.04 ↑ Htr temp to 180°C, Internal temp 103°C RTO 4.8.04

4.9.04 ↑ Htr temp to 180°C, Internal temp 107°C

0730

Regina

4.9.04

4.23.04 1600

		#2	#4	
Alloy 22	#21704-1	-364.086	716.721	(in solution)
Ti 7	#21704-11	#3 -3.636	#2 2.617	(out of solution)
SS316	#31704-2	#1 -3700.923	#2 613.071	(in solution)
Alloy 22	#31904-1	#1 RSD 4.23.04 ~~-9260.034~~	#2 RSD 4.23.04 ~~7360.307~~	(out of solution)
Ti 7	#21704-12	#4 -428.427	#2 325.533	(in solution)

hermocouple ambient 97.17

hermocouple in solution 3761.338

4/23/04

Verification of the performance of Keithley 2182. (S/N 0772682) and 7001 (S/N 0796137)

When Channel #33 connected to a thermocouple at time: 10:53 J.Y. 4/23/04

The reading is: ~~3857.58~~ 3729.038 μV As displayed by the software (VB software for the map probe).

When the same Thermocouple is connected to a Keithley 614 (S/N 0555368, AN: 002792, calibrated March, 04), The reading is 3.78 mV.

Difference: $\frac{(3.729038 - 3.78)\ mV}{3.78\ mV} \times 100\% = -1.37\%$ — Acceptable.

Randomly connected Ch. 37 to a battery, this battery is also connected to the above Keithley 614. The reading from 2182 for Ch #37 is: 128.5422 mV at 11:04 a.m. The reading from Keithley 614 for the same battery is 128.54 mV.

Difference: $\frac{128.5422 - 128.54\ mV}{128.54} \times 100\% = 0.0017\%$ Acceptable.

The channel connections at the terminal are correctly displayed by software values and verified. Therefore the software is also

J. Yang 4/23/04.

4.26.04 0845

Alloy 22 #21704-1 #4 199.162 #7 -2.801 (in solution)
Ti-7 #21704-11 #3 1.782 #7 -3.023
SS 316 #31704-2 #2 955.89 #6 -1899.868 (in solution)
Alloy 22 #31904-1 #3 5566.776 #2 ~~631.966~~ -35941.936 RD 4-26-04
Ti-7 #21704-12 #2 187.023 RD 4-26-04 #3 ~~8~~ -196.467 (in solution)

4.27.04 0843

Alloy 22 #21704-1 #4 341.004 #2 -218.863 (in solution)
Ti-7 #21704-11 #7 5.009 #3 -3.408
SS 316 #31704-2 3 7 RD 4.26.04 #5 641.901 #6 -1962.172 (in solution)
Alloy 22 ~~Ti-7~~ #31904-1 ~~#21704-12~~ 1 RD 4-26-04 #5 678.274 #2 -2662.342
Ti-7 #21704-12 #5 186.885 #1 -61.52 (in solution)
Solution TC 3857.486 (108 °C)
Ambient TC 17.998 (22 °C)

4.28.04 1340

Alloy 22 #21704-1 #6 349.095 #3 -322.605 (in solution)
Ti-7 #21704-11 #4 6.538 #6 -6.242
SS316 #31704-2 #8 934.99 #3 -971.251 (in solution)
Alloy 22 #31904-1 #7 14264.269 #4 -48700.63
Ti-7 #21704-12 #2 111.732 #3 -145.74 (in solution)

J. 10/4/04

4.29.04 1220

Alloy 22 #21704-1 #4 677.639 #7 -1341.959
Ti-7 #21704-11 #4 12.053 #2 -10.473
SS316 #31704-2 #8 378.95 #3 -665.914
Alloy 22 #31904-1 #5 5352.826 #2 -23002.099
Ti-7 #21704-12 #6 192.217 #1 -133.974
Ambient TC 18.904
Solution TC 3612.606

4.30.04 1340

Alloy 22 #21704-1 #1 733.12 #8 -1625.668
Ti-7 #21704-11 #1 2.584 #5 -1.907
SS316 #31704-2 #8 701.423 #6 -545.438
Alloy 22 #31904-1 1 RD 4.30.04 #7 ~~#8~~ 4777.727 ~~626.51~~ #8 -5145.774
Ti-7 #21704-12 #8 54.862 #1 -29.524
Ambient TC 125.444
Solution TC 3937.39

5.3.04 The V.B. multiway program stopped over weekend. Restarted. File name 5-03.04a.

J. 10/4/04

RSD 5.4.04

5.4.0~~3~~4

Alloy 22	#21704-1	#7 167.602	#3 -378.054
TI-7	#21704-11	#8 -564.596	#1 6.484
SS 316	#31704-2	#8 -2528.88	#7 2650.982
Alloy 22	#31904-1	#5 4066.567	#3 -768.629
TI-7	#21704-12	#1 99.993	#1 -5175104.69

11:12. Found that the configuration was:

1 — 9

10 — 18

⋮

73 — 80.

Program shut down, and restarted using config file: DustCon-2.

11:17 Started test

RSD 5.5.04

5.5.0~~3~~4 0830

Alloy 22	#21704-1	#2 -157.132	#6 66.792
TI-7	#21704-11	#3 -21.874	RSD 5.5.04 #7 27.56
SS316	#31704-2	#3 -59.425	#6 186.125
Alloy 22	#31904-1	#3 -3138.632	#2 4871.023
TI-7	RSD 5.5.04 #21704-12	#3 -64.043	#2 58.031

1041 Removed all probes from cell cleaned with H_2O & reg.

CONAM KAWIN

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SOUTHWEST RESEARCH INST. 7010
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P. O. DRAWER 28510
SAN ANTONIO TX 78284
SEAN BROSSIA

P. O. # 50138

DESCR 01-25-00 PO# X94367X
REQ# 505956

REPORT DATE: 02/15/2000

LAB NO: 0128-005 / 04

JOB NO:

ASTM B265 GR 7 TI-GR 7 WIRE HEAT# MSP914/Z1812

CHEMICAL ANALYSIS

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PAGE 4 OF 16

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10/4/04

CONAM KAWIN

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Got TO 5184

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P.O. DRAWER 28510
SAN ANTONIO TX 78284
DARRELL DUNN
(11 pages)

P.O. # 50138
DESCR 10-09-98
RELEASE ORDER# 20476
REPORT DATE: 10/29/98

LAB NO: 1015-035 / 01
JOB NO: 10/16 #34

INC 825 WIRE HEAT# HH5230F

CHEMICAL ANALYSIS

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PAGE 1 OF 5

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2/14/04

5.6.04 0930
Placed all probes in DI H_2O, started to ↑ temperature.

5.7.04 0825
Removed probes and placed in air.

5.7.04 1330
Removed probes from Equipment

Continued Page 167

2/14/04

7/14/04.

Two samples Received from Marith Reheis at USGS lab.

The samples are marked with:

T3-4/04 ~~Dust - 0404 - T14~~ (T14) 0.2015 grams L.Y. 7/14/04

T14-4/04 ~~Dust - 0404 - T3~~ 0.1400 grams.

On Aug. 5/2004. These Two samples were logged into our data base by Ch. Jucket see below:

(Assigned new ID.)

Mandatory Fields

Sample ID	Sample Description	Collect Dt	Entry Dt	Entry By	Storage Location
DUST-0404-T14-4/04	Death Valley atmostpheric dust collected by USGS	4/1/2004	8/5/2004	MRJ	Lab 106
DUST-0404-T3-4/04	Death Valley atmostpheric dust collected by USGS	4/1/2004	8/5/2004	MRJ	Lab 106

L. Y. 8/16/04

The two samples from USGS were given to J. Spencer.

FORM FOR REQUESTING WORK FROM OTHER DIVISIONS

A. TO BE COMPLETED BY DIVISION 20 PERSONNEL

Requester: Lietai Yang **Request Date:** 8/6/04
Project No.: 06002.01.071 **Phone No.:** 2483
Description of Work Requested:
① SEM and EDX on selected particles;
② EDX on combined particles.
③ EDX and XRD on fine particles after being ground.

☐ Optical Microscopy ☑ SEM ☐ Hardness ☐ Profilometer ☐ Auger ☐ Other

***QUALITY REQUIREMENTS:** The work requested is governed by the CNWRA Quality Assurance Program which addresses requirements of 10CFR50, Appendix B. Personnel performing this work shall be qualified under the CNWRA QA program or equivalently under the SwRI Nuclear QA program. Test and analysis methods shall be documented by approved procedures or recognized, standard methods. Measuring and test equipment shall be calibrated and controlled according to CNWRA and SwRI Nuclear QA program requirements.*

Sample Identification	Description
DUST - 0404 - T14 - 4/04	Dust from USGS
DUST - 0404 - T3 - 4/04	Dust from USGS

B. TO BE COMPLETED BY DIVISION PERFORMING WORK[1]

☐ Optical Microscopy ☑ SEM ☐ Hardness ☐ Profilometer ☐ Auger ☐ Other

Person Assigned: JIM SPENCER **Signature:** J. Spencer
Division: 18 **Date:** 8/10/04

Make, Model & Serial No. of Equipment Used (*attach list if necessary*): AMRAY MODEL 1645 SEM - S/N 16455010

Software Used (If any): KEVEX SIGMA QUASAR EDS SOFTWARE

Standards Used (If any): Cu Std. #482 (NIST)

Photographic Negative Numbers (If Applicable): 58270 ~ 58276 inclusive (digital images - no negatives)

L. Yang 8/16/04

continued on page 151

SUMMARY of ATMOSPHERIC DUST COMPOSITION AND ITS POTENTIAL EFFECT ON THE CORROSION OF WP AND DS

Lietai Yang
May 18, 2004

Background:

The Department of Energy has conducted analysis on the dust deposition and its impact on the corrosion of in Engineered Barrier Systems (BSC 2003a) However, the dust samples used in DOE salt analyses discussed in the technical basis document were collected in an exploratory study facility, where the majority portion was the rock dust produced during the construction of the tunnel (Peterman, 2003). During the ventilation period, a large portion of the dust on the WP and DS is expected to be consisted of the atmospheric dusts. This document presents the key components that are important to corrosion from the atmospheric dusts.

Data from USGS:

The United States Geological Survey (USGS) has a dust trap network consisting of about 40 sites in the southern California and Southern Nevada region. These dust traps were designed to study the rate of deposition, grain size, and mineralogical and chemical composition of dust. The dust traps collect not only mineral dust and aerosol, but also wet deposition such as rain and snow [Reheis, 2002]. Because of the object of the study, the analyses on the samples from these dust traps have been focused mainly on the metals in the raw and soluble-salt-removed dusts. Very few of the samples were analyzed for soluble salt constituents. Table 1 shows the composition of the key components analyzed from the dust samples collected at Owens Valley, California:

Table 1 Comparison of selected elements between processed (salts and organics removed), unprocessed, and soluble-fraction of dust samples collected at Owens Valley, California (Reheis, 2002).

File: Reheis_Paper_Elements

Sample number	Sample Type	Fe	Ca	Na	K	Mg	Ba	Li	P	Pb	Rb	Sr	Zn
		wt%					Ppm						
T62-0595	proc.	2.8	7.3	2.9	3.6		1180				136	1070	4080
T62-0595	unproc.	2.4	5.1	2.1	9.2	2.6	1054	414	540	65	116	843	3240
T62-0595	salts	0	0.6	#	35	0	26	3	92	0	1	22	17
T62-1095	proc.	1.9	5.7	2.2	13		532				87	774	4250
T62-1095	salts	0	0.7	#	33	0	45	37	380	1	3	49	64
T-62-0599	unproc.	2.2	4.4	2	14	2.3	560	305	570	44	110	600	245

Detection limit exceeded by amount of element present.

5/18/04

Tables 1 shows that the main metals in the soluble salts are Na and K and the content of Ca is low (0.6 to 0.7 wt%). Most or all of the Ca, Mg and Fe are in the insoluble form. Table 1 also shows that the soluble salt contains considerable P.

Recently, a large number of the dust samples collected by Reheis at the USGS were analyzed by Izbicki et al (Personal communication, 2004) for anions in the soluble salts. Table 2 shows the average anion concentrations in the leachate of the atmospheric dusts collected in the southwestern United States region from winter 2001 to spring 2003 (ppm). The NO_3-to-Cl ratios were 1.63/0.75= 2.17 for the samples collected near the Yucca Mountain area and 3.11/3.62= 0.859 for the samples collected over the southern Nevada and California region. Significant amounts of other inhibiting specie, NO_2 and SO_4, were also found. In addition, Bromide and phosphate were significant. The effect of these two ions on the corrosion of drip shield and waste package outer layer should be assessed.

Table 2. The Average anion concentrations in the leachates of the atmospheric dusts collected in the southwestern United States region from winter 2001 to spring 2003

File: Izbicki dust salts 3.25.03 NV-CA_Analyzed

		N in N02	N in NO3	Cl	Br	P in PO4	SO4
Average of 36 Samples Collected near Yucca Mountain	ppm	16.38	22.80	26.67	29.45	2.38	73.59
	mM	1.17	1.63	0.75	0.37	0.077	0.77
Average of 89 Samples Collected in Southern California and Nevada	ppm	32.58	43.56	128.47	50.87	2.87	269.85
	mM	2.33	3.11	3.62	0.64	0.092	2.81

Source: Data were derived based on personal communication between Lietai Yang and John Izbicki, USGS Geochemical Laboratory, San Diego, April, 2004.

Data from the Atmospheric Deposition Monitoring Networks

The National Atmospheric Deposition Program/National Trends Network (NADP/NTN) operates a nationwide network of wet precipitation monitoring sites. The network is a cooperative effort between many different groups, including the State Agriculture Experiment Stations, U.S. Geological Survey, U.S. Department of Agriculture, and numerous other governmental and private entities. The NADP has over 200 monitoring sites in the continental United States, Alaska, Puerto Rica and the Virgin Islands. The NADA analyzes the constituents important to precipitation chemistry, including those affecting rainfall acidity and those that may have ecological effects. The NADP

5/18/04

measures sulfate, nitrate, hydrogen ions, ammonia, chloride, and base cations (Ca, Mg, K).The sampling site at Death Valley, California may be considered the most relevant to the Yucca Mountain project because of its closeness to Yucca Mountain and the prevailing wind direction near Yucca Mountain area. The NADP system does not collect dry deposition samples.

The Clean Air Status and Trends Network (CASTNET), created by the U.S. Environmental Protection Agency and the National Oceanic Atmospheric Administration, provides atmospheric data on the dry deposition. The CASTNET data includes sulfate nitrate, ammonia, sulfur oxide, and nitric acid, and the meteorological conditions required for calculating dry deposition rates. The CASTNET operates about 70 sites across the United States, including one at Death Valley, California. Unfortunately, the CASTNET does not provide data on chloride and bromide.

Another network, the Atmospheric Integrated Monitoring Network (AIRMoN) provides atmospheric data on both dry and wet depositions with greater temporal resolution. The AIRMoN was sponsored by National Oceanic and Atmospheric Administration - Air Resources Laboratory to provide a research based foundation for the routine operations of the above-mentioned two deposition monitoring network- the NADP for wet deposition, and the CASTNET for dry deposition. The AIRMoN provides similar data as the NADP and CASTNET, except the samples are collected at a more frequent interval (daily). Currently, there are nine sites within the AIRMoN network. They are all located in the central and eastern parts of the Unites States. None of them are close to the Yucca Mountain area.

Table 3 shows summary of the NADP data for the precipitation samples collected at Death Valley, California in recent years. The samples from the NADP were filtered through 0.45 micron filters prior to analysis. Therefore, the data in Table 3 are considered as soluble ions. The three-year average NO_3-to-Cl ratio is 0.042/0.012 = 4.77 from the reported concentration measurements and 11.0/2.6 = 4.18 for the reported deposition amounts. The value of each constituent for the deposition amount was computed based on the concentration of the constituent in the wet precipitation and the amount of rainfalls. The two NO_3-to-Cl ratios should be the same. The small difference between the two ratios was probably due to errors in the computation of the source data.

Table 3 also shows that there were significant amount of Ca and Mg in the soluble salts collected from the wet precipitation. The molar concentration of Ca is close that of K and the molar concentration of Mg is twice as high as that of Na

Table 3, Summary of the soluble constituents in the wet precipitation samples collected at Death Valley, California in recent years

Concentration in Wet Precipitation									
Year	Mg	Ca	K	Na	NH4	NO3	Cl	SO4	pH
	mg/L								

NADP 2.22. 5/18/04

File: ~~N~~ADA_Death_Valley_Data

2000	0.58	0.066	0.023	0.22	0.82	1.9	0.3	0.74	6.49
2001	0.18	0.019	0.022	0.097	0.69	1.51	0.15	0.53	5.46
2002	2.91	0.191	0.145	1.114	1.1	4.31	0.83	2.27	6.2
Average	1.223	0.092	0.063	0.477	0.870	2.573	0.427	1.180	6.050
	mM								
2000	0.024	0.002	0.001	0.010	0.051	0.031	0.008	0.008	
2001	0.007	0.000	0.001	0.004	0.043	0.024	0.004	0.006	
2002	0.120	0.005	0.004	0.048	0.069	0.070	0.023	0.024	
Average	0.050	0.002	0.002	0.021	0.054	0.042	0.012	0.012	
	Deposition from Wet Precipitation								
	kg/ha								
Year	Mg	Ca	K	Na	NH4	NO3	Cl	SO4	
2000	0.26	0.029	0.01	0.098	0.37	0.85	0.13	0.33	
2001	0.11	0.011	0.013	0.058	0.41	0.9	0.09	0.32	
2002	0.2	0.013	0.01	0.078	0.08	0.3	0.06	0.16	
Average	0.190	0.018	0.011	0.078	0.287	0.683	0.093	0.270	
	mole/ha								
2000	10.700	0.725	0.256	4.261	23.125	13.710	3.667	3.434	
2001	4.527	0.275	0.332	2.522	25.625	14.516	2.539	3.330	
2002	8.230	0.325	0.256	3.391	5.000	4.839	1.693	1.665	
Average	7.819	0.442	0.281	3.391	17.917	11.022	2.633	2.810	

Source: National Atmospheric Deposition Program (NRSP-3)/National Trends Network. (2004). NADP Program Office, Illinois State Water Survey, 2204 Griffith Dr., Champaign, IL 61820, Website: http://nadp.sws.uiuc.edu Downloaded May 17, 2004.

Summary:

1. Limited data analyzed from two atmospheric dust samples collected near Yucca Mountain show that the soluble portion (soluble salts) of the dusts contains high concentration of Na and K, but low concentration of calcium and negligible amount of Mg.

2. The data analyzed from the atmospheric dusts collected near Yucca Mountain (36 samples) and in southern California and Nevada region (89 samples) indicate that the soluble portion of the dusts contains significant amount of corrosion inhibiting specie such as nitrate, sulfate and nitrite. The average ratio of nitrate-to-chloride is 2.17 near the Yucca Mountain area and 0.86 in the southern California and Nevada region.

3. The three year (2000 to 2002) data from the wet precipitation samples collected by the National Atmospheric Deposition Program at Death Valley, California also show high ratio of nitrate-to-chloride (4.2 to 4.8).

4. The three year (2000 to 2002) data from the wet precipitation samples also shows that there were significant amount of Ca and Mg in the soluble salts. The

molar content of Ca is close that of K and the molar content of Mg is twice as that of Na.

5. The data from the atmospheric dust collected near Yucca Mountain also shows that the soluble portion of the dust samples contain significant amount of bromide and phosphate.

References:

BSC, 2003a. "Technical Basis Document No. 5: In-Drift Chemical Environment." Rev. 1. Las Vegas, Nevada: Bechtel SAIC Company LLC. 2003.

Peterman, Z.E., Paces, J.B., Neymark, L.A., and Hudson, D., 2003. "Geochemistry of Dust in the Exploratory Studies Facility, Yucca Mountain, Nevada." Proceedings of the 10th International High-Level Radioactive Waste Management Conference (IHLRWM), March 30-April 2, 2003, Las Vegas, Nevada. Pages 637-645. La Grange Park, Illinois: American Nuclear Society. TIC: 254559. ACC: MOL.20030624.0313.

REHEIS, MARITH C.,* JAMES R. BUDAHN, and PAUL J. LAMOTHE , Geochimica et Cosmochimica Acta, Vol. 66, No. 9, pp. 1569–1587, 2002

J.W.O
4/10/04

Continued from page 149

Two dust samples studied by Jim Spencer
SEM, EDS, XRD, elemental map.
for grains two. Results see Notebook #5.33 Salt directory: USGS Dust-Sample Folder done Aug. 2004

8/24/04.
Sample given to Miriam Juckett
weigh.
Three washes with 18.2 Mohm/cm water.
Supernates from each sample wash go to conductivity cell.
Solids collected, weighed to give to Jim for SEM + XRD + EDS + elem. map.
Solids back from Jim will be used to do wet chem analysis for total elements (ICP). (After acidified)
Results see same Folder done 12/29/2004.
plans to do two conductivity tests, if not enough salt, may combine the two supernates.

4 What man filter paper given to Jim too.
Samples given to chem lab.
See page 175. also Pages 176-178 updated 5/10/05 J.Gans

J.W.O
10/4/04

ACCREDITED
Certificate # 286.01
Certificate # 286.02

staveleyservices MATERIALS TESTING

192 Internationale Blvd.
Glendale Heights, IL 60139
Telephone 630-681-0008
Facsimile 630-871-5520
www.staveleymt.com

TEST REPORT

SOUTHWEST RESEARCH INST. 7010
6220 CULEBRA RD
P.O. DRAWER 28510
SAN ANTONIO TX 78284
LEITAI YANG

P.O.# 476577P

DESCR 05/05/04
REQ# 04015441
ALLOY C-276
REPORT DATE: 09/22/2004

LAB NO: 0922-007 / 01 RECEIVED DATE: 09/22/2004 JOB NO: 05/26 #28

SAMPLE LS214715BG

see Scien. Notebook. #423, page 89
P.O. 1831325
updated 5/10/05
J.Y.

CHEMICAL ANALYSIS

Si	.08	Mn	.48	C	.001
P	.022	S	.001	Ni	BASE
Cr	15.11	Mo	15.15	Cu	.14
Al	.23	V	.20	Ti	.01
Co	.68	Fe	7.06	W	3.61
Cb	.01				

TEST METHODS: ASTM E-1024-97 ; ASTM E-1019-02 ; ASTM E-354-93(2000)e1* ; ICP* ;

Bill Sungo
QA INSPECTOR

ALL CHEMICAL TEST RESULTS ARE REPORTED IN WEIGHT PERCENT UNLESS OTHERWISE NOTED.

SAMPLE RESULTS RELATE ONLY TO THE SAMPLE TESTED

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J. Yang 2/14/06 see page 133.

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Certificate # 286.02

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TEST REPORT

SOUTHWEST RESEARCH INST. 7010
6220 CULEBRA RD
P.O. DRAWER 28510
SAN ANTONIO TX 78284
LEITAI YANG

P.O.# 476577P

DESCR 05/05/04
REQ# 04015441
ALLOY C-276
REPORT DATE: 09/22/2004

LAB NO: 0922-007 / 02 RECEIVED DATE: 09/22/2004 JOB NO: 05/26 #29

SAMPLE LS22350/EM

see Sci. Notebook ~~17~~ 423 page 177, P.O. 1844395
J.Y. 5/10/05
updated J.Y. 5/10/05

CHEMICAL ANALYSIS

Si	7.28	Mn	1.75	C	.037
P	.009	S	.005	Ni	11.02
Cr	18.51	Mo	2.09	Cu	.08
Al	.18	V	.07	Ti	.01
Co	.16	W	.01	Cb	<.01

TEST METHODS: ASTM E-1024-97 ; ASTM E-1019-02 ; ASTM E-354-93(2000)e1* ; ICP* ;

Bill Sungo
Q.A. INSPECTOR

ALL CHEMICAL TEST RESULTS ARE REPORTED IN WEIGHT PERCENT UNLESS OTHERWISE NOTED.

SAMPLE RESULTS RELATE ONLY TO THE SAMPLE TESTED

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Pages 94-153 copied for QA Record 10/4/04.

see page 110

J. Yang 2/14/06

Deliquescence Relative Humidity Measurements
Using an Electrical Conductivity Method

Lietai Yang, Roberto T. Pabalan, and Miriam R. Juckett
Center for Nuclear Waste Regulatory Analyses
San Antonio, TX 78238-5166, U.S.A.

ABSTRACT

Relative Humidity (%)

Figure 1. Specific conductivity of NaCl and $NaNO_3$ single salts at 25 °C [77 °F] as a function of relative humidity calculated using StreamAnalyzer, Version 1.2. Also shown are the calculated concentrations of NaCl and $NaNO_3$ as a function of relative humidity. The solid diamond and square symbols indicate the calculated solubilities of NaCl (6.15 m) and $NaNO_3$ (10.22 m), respectively.

Information potentially subject to copyright protection was redacted from this location. The redacted was an article published by the

Materials Research Society in 2005.

Figure 2. Calculated relative humidity at 25 °C [77 °F] over an aqueous solution saturated with either NaCl or $NaNO_3$, or both, as a function of salt mixture composition. Also shown is the calculated specific conductivity of the saturated solution.

Using Stream Analyzer 1.2

L. Yang
3/9/05

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Figure 3. Calculated specific conductivity at 25 °C [77 °F] as a function of relative humidity of an NaCl-$NaNO_3$ mixture with a eutonic composition (x_C in Figure 2). Also plotted is the calculated aqueous concentration of NaCl and $NaNO_3$ as a function of relative humidity. The calculated solubilities of NaCl and $NaNO_3$ at 25 °C [77 °F] are 4.55 and 6.78 m, respectively.

File:

NaNO3_NaCl_Pure_Salt_&_Mixture_Conductivity Chart_Eutonic_Cond

File:

NaNO3_NaCl_Pure_Salt_&_Mixture_Conductivity_Bobby Figure 4

Figure 4. Calculated specific conductivity at 25 °C [77 °F] as a function of relative humidity of an NaCl-$NaNO_3$ mixture with composition x_A (see Figure 2). Also plotted is the calculated aqueous concentration of NaCl and $NaNO_3$ as a function of relative humidity.

File:

NaNO3_NaCl_Pure_Salt_&_Mixture_Conductivity_Bobby Figure 5

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Figure 5. Calculated specific conductivity at 25 °C [77 °F] as a function of relative humidity of an NaCl-$NaNO_3$ mixture with composition x_B (see Figure 2). Also plotted is the calculated aqueous concentration of NaCl and $NaNO_3$ as a function of relative humidity.

3/9/05

File:

October 29 Blank 50C_Bobby Chart_time

Figure 8. Measured impedance of a wet filtration paper to stepwise changes in relative humidity (2-hr equilibration time)

3/9/05

File:

Blank_50C_Summary_Bobby Chart1

File:

Na2SO4 50C_Summary_Bobby Chart_Combined

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Figure 9. Measured impedance vs relative humidity at 50 °C [122 °F]for a conductivity cell with pure water only (2- or 24-hr equilibration time). The measurements were made in the direction of increasing and decreasing relative humidity.

3/9/05

Figure 10. Impedance vs relative humidity at 50 °C [122 °F] for a conductivity cell containing Na_2SO_4 (4-or 23-hr equilibration time). The deliquescence curve was measured in the direction of increasing relative humidity and the efflorescence curve was measured in the direction of decreasing relative humidity. From the data, the estimated DRH of Na_2SO_4 at 50 °C [122 °F] is 86.5 ± 1.5 %.

3/9/05

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Figure 11. Measured impedance vs relative humidity at 50 °C [122 °F] for a conductivity cell containing Na_2SO_4 (23-hr equilibration time).

Figure 13. Measured impedance vs relative humidity at 50 °C [122 °F] for a conductivity cell containing $CaCl_2$ (8-hr equilibration time).

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/ Tab: Chart

3/4/07

Figure 12. Measued impedance vs relative humidity at 50 °C [122 °F] for a conductivity cell containing $CaCl_2$ (4- or 8-hr equilibration time). The deliquescence curve was measured in the direction of increasing relative humidity and the efflorescence curve was measured in the direction of decreasing relative humidity. From the data in this figure and in Figure 13, the estimated DRH of $CaCl_2$ at 50 °C [122 °F] is 15 ± 1 %.

3/4/07

Figure 14. Measured impedance vs relative humidity at 25, 50, and 70 °C [77, 122, and 158 °F] for a conductivity cell containing a mixture of $NaCl+NaNO_3+KNO_3$. The impedance was measured in the direction of increasing relative humidity (deliquescence) or decreasing relative humidity (efflorescence).

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Figure 15. Comparison of DRH of Na_2SO_4 and $CaCl_2$ salts and MDRH of $NaCl+NaNO_3+KNO_3$ salt mixture determined using conductivity and hygrometer methods.

File: DRH_CaCl2_&_Na2SO4-Bobby /Tab: Figure 15

J. Yang 3/9/05

Table 1. Comparison of DRH of $CaCl_2$ and Na_2SO_4 and MDRH of $NaCl+NaNO_3+KNO_3$ obtained using two methods

File: DRH_NaKCINO3_System_Two_Methods / Tab:Data

	File: Summary_DRH&ERH	DRH (%) File: DRH_test_Hygrometer_summary*		Regression Trend = -0.3749x + 76.794	Error (%)
Temp (oC)	Conductivity Method	Hygrometer Method		DRH (%)	Error (%)
25	62			67.4275	0.080494
50	55			58.055	0.052623
70	47			50.557	0.070356
23		67.7707			0.067824
38.13		60.74343			
48		61.279287			
69		51.834728			
85.8		43.402524			

*Data File in NoteBook464_Salt folder; and used in Yang, R. T. Pabalan and L. Browning, "Experimental Determination of the Deliquescence Relative Humidity and Conductivity of Multicomponent Salt Mixtures," *Scientific Basis for Nuclear Waste Management XXV*, ed. B. P. McGrail and G.A. Cragnolino, (Mater. Res. Soc. Proc. 713, Warrendale, PA, 2002) pp. 135-142.

J. Yang 3/10/05

Pages 153 to 165 copied for
JJ record.

J. [illegible]

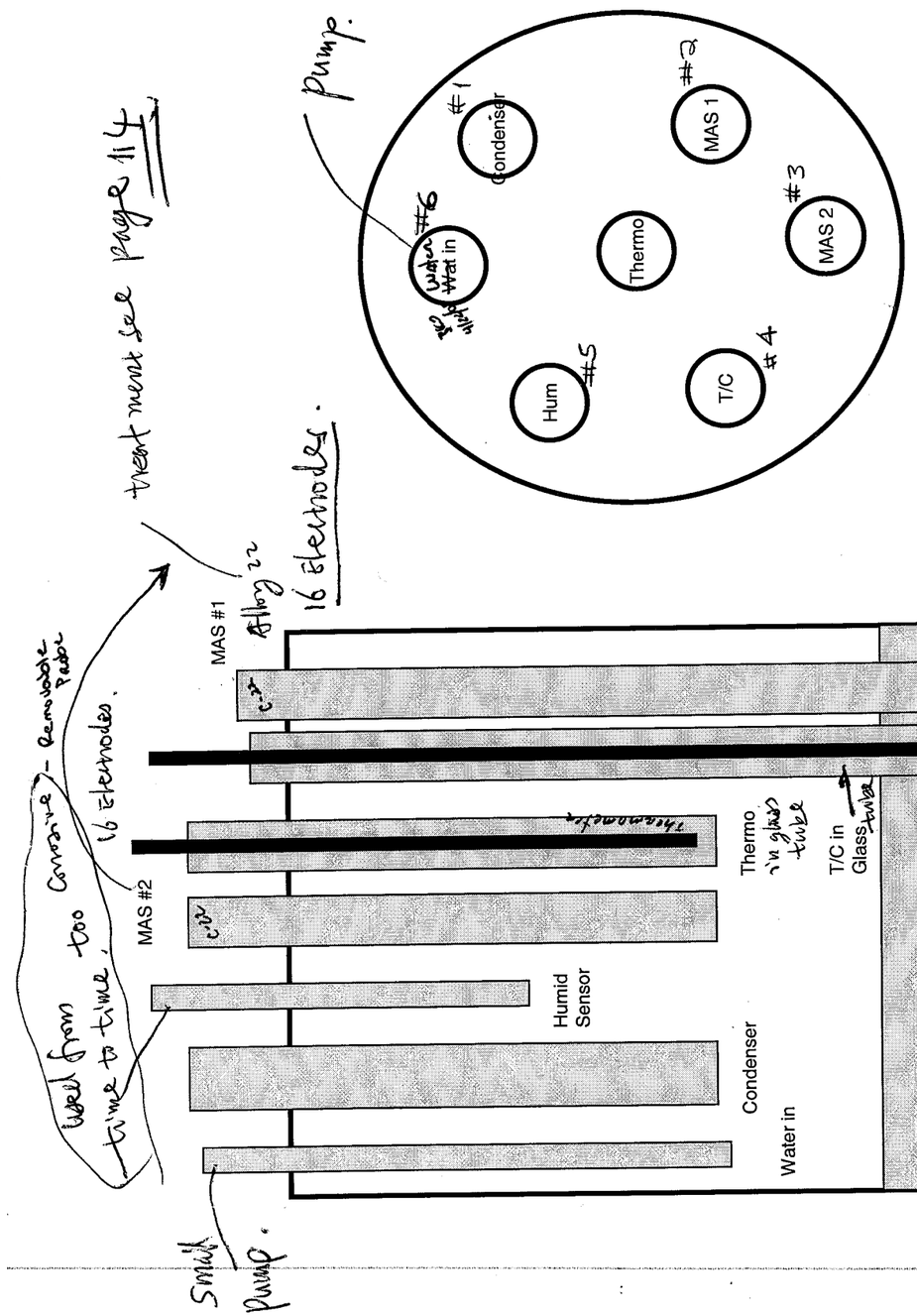
4/15/05.

Jvy. 1/22/05

Continued from page ~~143~~. 143.

Under salt corrosion
Revised Initial see page 171

4/22/05



Location of sensor and condenser

Test Cell for Under Salt Corrosion tests

salts:

Imital test NaCl – NaNO3 – KNO3

~~Hall – NaNO3 – KNO3~~, July. 5/3/05

equal-molar 500 g. total.

Initial test for Temperature distribution

14°C, 16°C.

Sodium Chlorine - Sodium Nitrate - Potassium Nitrate

Chemicals	MW	grams	* Amount was doubled to equal:
NaCl	58.44	119.802	~~239.63g~~
NaNO3	84.99	174.2295	348.46g
KNO3	101.11	207.2755	~~414.57g~~
Total grtams:		501.307	1,002.66g Total
	Moles for each	2.05	

Put 200 ml DI Water

5/5/05

Tset: 160

2:28 RTD Temp: 164° T/C Temp (Location #6): 166°

raised @ 1" 164° after 2 mins
from bottom

" " 2" 163° " " "

* controller had stopped heating up " " 3" 161° " " "

lowered to 0" 159°C.

T/C Temp #2

RTD 159.9° at bottom 0" 161° after 2 mins.

2:50 T set 160.9° SBY 5/6/05 RTD 162°C 0" T/C 166° #2

RTD	Temp Set	T/C	location	
161°	160.0°	165°	#4	0" after 2 mins

Pump set at 3

RTD	T/C	#4	0"
161.3	162		

Pump set at 6

RTD	T/C	#4	0"
3:36 156.2°	157°		

Stopped @ 3:44 Pump set at 6

RTD	T/C	#4	0"
143.4°	147°		

SY 5/6/05

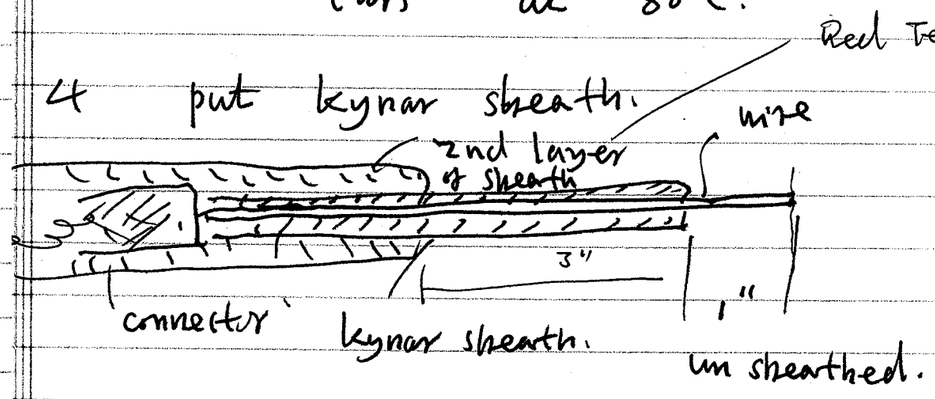
1. wire Heat treat to 1121 °C 15 hrs
Quench in Water.

2. polishing the wire with 300 grit paper

3. Coat the wire with about CP-2070 of Aremco

. Dry 48 hrs at RT or
4 hrs at 80 °C.

4 put kynar sheath.



5. port the 16 wire as a boundle
in CP-2070.

J. Yang
8/10/05

Project # 06602.01.322

Revised Initial Entries for Under-salt Corrosion Tests:

Title: Corrosion of Alloy 22 in Salt Environment at Elevated Temperatures

Names of the individuals performing the activity:
Lietai Yang, Steve Young
Objectives and the proposed approach or procedure:
Measurement of non-uniform corrosion rate of Alloy 22 in the liquid and vapor phases of a system containing mixed salts (NaCl-NaNO3-KNO3) at elevated temperatures. Coupling multielectrode array sensor (MAS) probes will be used in the test.
Equipments and measurement parameters:
The signal from the MAS probes will be measured with a Keithly 2182 nanovolt meter and Keithley 7001 Mainframe Switch. The salts will be placed in an electrochemical cell which will be heated by a temperature controller. The temperature will be measured with a calibrated thermocouple (SN 293376W) and a calibrated temperature meter (SN:T-94140)

Software:
In-house developed visual basic code was used to control the two Keithley meters and to store the data in a computer hard drive. The visual basic code was verified (see page 45, Scientific Note Book # 423).
Test equipment calibration, accuracy, and precision requirements:
The two Keithley meters and the visual program were verified on a regular basis. The latest verification was performed on 8/26/2004. See page 294, Scientific Note Book # 604 for details. This instrument has been used continuously for the microbially influenced corrosion test. The verification will be conducted as soon as the present test is completed and by 8/26/2005.
Thermocouple: SN293376W, Cal'd: Apr 05, 2005, Due: Apr 05, 2006
Temperature Meter: SN: T-94140, Cal'd: May 12, 2005, Due: Nov 11, 2005
Required level of accuracy:
Temperature: ±3 oC, Currents: ±10 nA; Relative Humidity ±5% J.Y. 4/20/06
Potential Source of Uncertainty:
Noise from power line or nearby equipment may affect readings from the probes. Pumps and heaters should not be close to the test cell.
Special personnel training or qualification requirements:
None
Material/chemical:
Probe will be made of Alloy 22 wire, solution annealed at 1121 oC for 10 minute followed by water quenching.
Special personnel training or qualification requirements:
None
Material/chemical:
Varies (see in-progress entries).

J. Yang
7/22/05

SY.

5/13/05 New Test – Temp Variation from DI Drip

Contents:

		Actual	
NaCl	239.604 g	239.60 g	+ 300 mls D.I.
$NaNO_3$	348.459 g	348.46 g	
KNO_3	414.551 g	353.61 g	* 60.941 g short

System was dried before beginning drip.

pump started @ 2:15 — T set: 160°C — Cal not required

speed @ Level 1 — T = 159°C

stopped @ 2:22 — T#4 = 159°C — cal: Jun 5, 05 / Jul 7, 05 date Cal # SN: 3130900

@ 2:23 — T set = 160°

pump rate: Level 3 — T = 161°

dripping started @ 2:33 — T_4 = 160°

@ 3:10

reduced rate to: Level 0.5 — Tset = 160° — * Salts are ~~completely~~ mostly disolved SY 5/13/05

T = 163°

T_4 = 168°

Speed Setting		Pump Drip Rate			per/hr
3	@	30 mins.	=	30 mls	60 mls
2	@	30 mins.	=	21 mls	42
1	@	30 mins.	=	8.5 mls	17
Fully Counter Clk.	@	~~30~~ 60 mins SY 5/13/05	=	2.0 mls	2
1.5	@	60 mins	=	30. mls	30
0.5	@	60 mins	=	7.75 mls	7.75

J.Y.S. 9/16/05

SY.

5/13/05 – 3:10 (2) Partially Coated (epoxy) (CP 2070 of Aremco) Sensor Wires (C-22) and (1) Epoxy cube (I wt: 1.22307 g) were placed in salt solution of pg. 172

continued pg. 172 – Tset = 160°, T = 168, T_4 = 180 (SN: 3130900) more liquified

4:11 p.m. Water collected after condenser pH = 8.4. ! may have residue water from previous test the water collector rinsed several times. J.Y. 5/13/05

5/17/05
8:33 Tset = 160°, T = 159.
Vessel Bottom: liquid + crystals.
Water pump not pumping water.
Yellow liquid (1 ml) collected after condenser.
pH of this yellow liquid = 8.04.

SY.
5/17/05
SN: T-94140
cal. date: 5/12/05
due: 11/11/05

10:40 Tset = 160°, T = 161, T_4 = 161.6

10:42 Increased drip rate to 1.0 (had to purge air from line)

10:54 Drip began. * at 0.5 water had back flowed
* Pump is having difficulty at low rates, may need to elevate.

1:00 Stopped test because of inconsistant drip.

1:10 Added 250 mls DI to solution in order to dislodge Epoxy cube and sensor wires added to solution on 5/13/05, temperature was increased to 180° C.

4:30 – Cube and sensor wires were removed for cleaning. The coat on wire seems to hold its integrity. Cube was dried at 60° C for 1 hr, then weighed: 1.18878 g, weight loss = 0.03429

J.Y.S. 9/16/05

Page 41.

SAMPLE LIST/CHAIN OF CUSTODY

Southwest Research Institute®
Chemistry and Chemical Engineering Division
6220 Culebra Road
San Antonio, Texas 78238-5166

Shipper Name/Address:

Client: Lietai Yang, Divison 20.

Client Purchase Order/Other ID: 06002.01.211, 1.20

Site/Zone ID:

Requested Turnaround:
- ☑ 2 Weeks
- ☐ 3 Weeks
- ☐ Other:

SwRI Contact:

Analyses Requested

Sample ID	Sample Collection Date (mm/dd/yy)	Sample Collection Time	Matrix Type	Sample Type	# of Containers
Dust-0404-T14	04/04			Dust	1
Dust-0404-T3	04/04			Dust	1
Dust-T14+T3 Soluble	04/04			soluble on filtration paper	

Blend T14 and T3. Do a complete analysis on all cations and all anions after fully dissolve the solid.
Dissolve everything on filtration paper in Water at room temperature.
Analyze all cation, ~~all~~ 2.3. 12/9/04
all anions in water.

REMARKS
Preservation
- **a** = HCl to pH <2
- **b** = HNO_3 to pH <2
- **c** = H_2SO_4 to pH <2
- **d** = NaOH to pH >12
- **e** = Cool (4°C±2°C)
- **f** = Other (specify)

Matrix Types:
- **A** – Air
- **B** – Biota
- **D** - Dust
- **E** – Emission/Stack
- **L** - Liquid
- **P** – Product
- **Sd** - Solid
- **S** – Soil
- **SED** – Sediment
- **T** - Tissue
- **W** - Water
- **WP** - Wipe

Sample Types:
- **D** - Duplicate
- **ER** – Equipment Rinsate
- **ES** – Environmental Sample
- **FB** – Field Blank
- **FD** – Field Duplicate
- **MS** – Matrix Spike
- **MSD** – Matrix Spike Dup
- **TB** – Trip Blank

Temp:

Therm #:

Comments:

Relinquished by (Print/Signature)	Date	Time
Lietai Yang 2.yg	12/9/04	12:00
Received by (Print/Signature)	Date	Time
Relinquished by (Print/Signature)	Date	Time
Received by (Print/Signature)	Date	Time
Relinquished by (Print/Signature)	Date	Time

SwRI Project#:

Received by SwRI Lab: (Signature)

Date | Time

Samples Disposed: Date | Time

Samples Disposed by:

Div 01 COC Form 01-01-001, Rev 8/02

Page 1 of 1

12/29/04

MEMORANDUM

TO: Lietai Yang
Division 20 Bldg. 57

FROM: Jackie Ranger

RE: Project No.: 06002.01.211
Task Order: 050119-1
SRR: 27044
Samples Received: January 06, 2005

Analysis of Dust and Filter samples for IC and ICP analysis.

Raw data and nuclear safety documentation for this project are archived in Division 20 records control and Division 01 QA.

DATE: May 06, 2005

Enclosed, please find the sample results for the analyses referenced above.

The analyses performed comply with the SwRI Program Quality Plan, Document No. PQP-Nuclear Rev. 1, 10CFR 50 Appendix B, 10CFR 21, and 01-QPP-015 Revision 4.

If there are any questions, please feel free to contact me by voice mail at 522-3320 or by fax at 522-3649. I look forward to our continued analytical support of your projects.

Jackie Ranger
Group Leader

Jo Ann Boyd

Manager, Div. 01 Quality Assurance

5/10/05

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Dust
Lab System ID: 257326

Sample ID: Dust-0404-T14/T3
Client: Division 20 ICP
Date Received: 12/29/04
Project No.: 06002.01.211
SRR: 27044
Task Order: 050119-1

Analysis	Sample Result (mg/Kg)	Reporting Limit (mg/Kg)
Aluminum		
Antimony		
Arsenic		
Barium		
Beryllium		
Bismuth		
Boron		
Cadmium		
Calcium		
Chromium		
Cobalt		
Copper		
Iron		
Lanthanum		
Lead		
Lithium		
Magnesium		
Manganese		
Molybdenum		
Nickel		
Palladium		
Phosphorus		
Potassium		
Selenium		
Silicon		
Silver		
Sodium		
Strontium		
Sulfur		
Thallium		
Thorium		
Tin		
Titanium		
Tungsten		
Uranium		
Vanadium		
Yttrium		
Zinc		
Zirconium		

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SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Filter
Lab System ID: 257327

Sample ID: Dust-T14+T13 Soluble
Client: Division 20 - ICP.
Date Received: 12/29/04
Project No.: 06002.01.211
SRR: 27044
Task Order: 050119-1

Analysis	Sample Result (ug/sample)	Reporting Limit (ug/sample)
Aluminum	<1.25	1.25
Antimony		
Arsenic		
Barium		
Beryllium		
Bismuth		
Boron		
Cadmium		
Calcium		
Chromium		
Cobalt		
Copper		
Iron		
Lanthanum		
Lead		
Lithium		
Magnesium		
Manganese		
Molybdenum		
Nickel		
Palladium		
Phosphorus		
Potassium		
Selenium		
Silicon		
Silver		
Sodium		
Strontium		
Sulfur		
Thallium		
Thorium		
Tin		
Titanium		
Tungsten		
Uranium		
Vanadium		
Yttrium		
Zinc		
Zirconium	<0.125	0.125

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SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Dust
Lab System ID: 257326

Sample ID: Dust-0404-T14/T3 IC. solid.
Client: Division 20
Date Received: 12/29/04
Project No.: 06002.01.211
SRR: 27044
Task Order: 050119-1

Analysis	Sample Result (mg/Kg)	Reporting Limit (mg/Kg)
Bromide	<0.66	0.66
Chloride		
Fluoride		
Nitrate-N		
Nitrite-N		
Phosphate-P		
Sulfate		

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SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID
Dust-T14+T13 Soluble

1-C

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Filter
Lab System ID: 257327

Client: Division 20
Date Received: 12/29/04
Project No.: 06002.01.211
SRR: 27044
Task Order: 050119-1

Analysis	Sample Result (ug/sample)	Reporting Limit (ug/sample)
[illegible]	[illegible]	[illegible]

Carbonate can't be analyzed!

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J. [illegible] 5/10/05

SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID
Whatman Paper Blk.

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Filter
Lab System ID: 257328

Client: Division 20
Date Received: 12/29/04
Project No.: 06002.01.211
SRR: 27044
Task Order: 050119-1

Analysis	Sample Result (ug/sample)	Reporting Limit (ug/sample)
[illegible]	[illegible]	[illegible]

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SOUTHWEST RESEARCH INSTITUTE
SAMPLE ANALYSIS DATA SHEET

Sample ID
Whatman Paper Blk.

1 cp

Lab Name: Southwest Research Institute
Lab Code: SwRI
Matrix: Filter
Lab System ID: 257328

Client: Division 20
Date Received: 12/29/04
Project No.: 06002.01.211
SRR: 27044
Task Order: 050119-1

Analysis	Sample Result (ug/sample)	Reporting Limit (ug/sample)
Aluminum		
Antimony		
Arsenic		
Barium		
Beryllium		
Bismuth		
Boron		
Cadmium		
Calcium		
Chromium		
Cobalt		
Copper		
Iron		
Lanthanum		
Lead		
Lithium		
Magnesium		
Manganese		
Molybdenum		
Nickel		
Palladium		
Phosphorus		
Potassium		
Selenium		
Silicon		
Silver		
Sodium		
Strontium		
Sulfur		
Thallium		
Thorium		
Tin		
Titanium		
Tungsten		
Uranium		
Vanadium		
Yttrium		
Zinc		
Zirconium		

J. [illegible] 5/10/05

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5/31/05.

17:02. MAS program started. File: 2005-05-31a. in My Document folder.

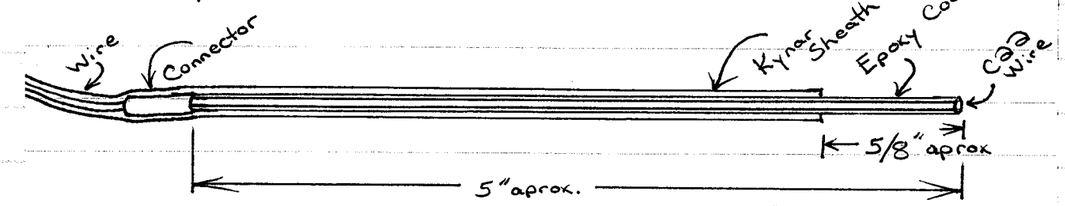
9/16/05

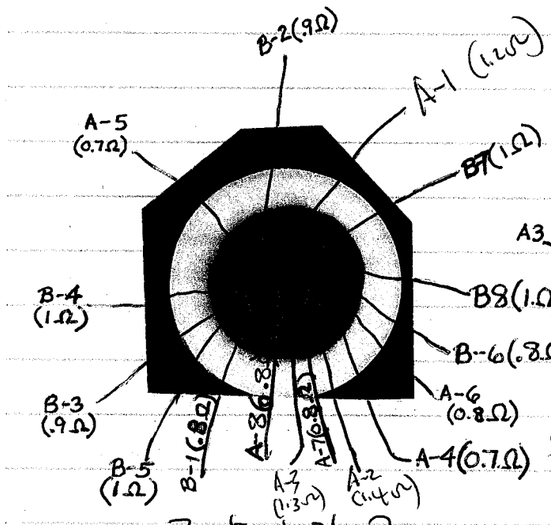
6/3/05 SBY

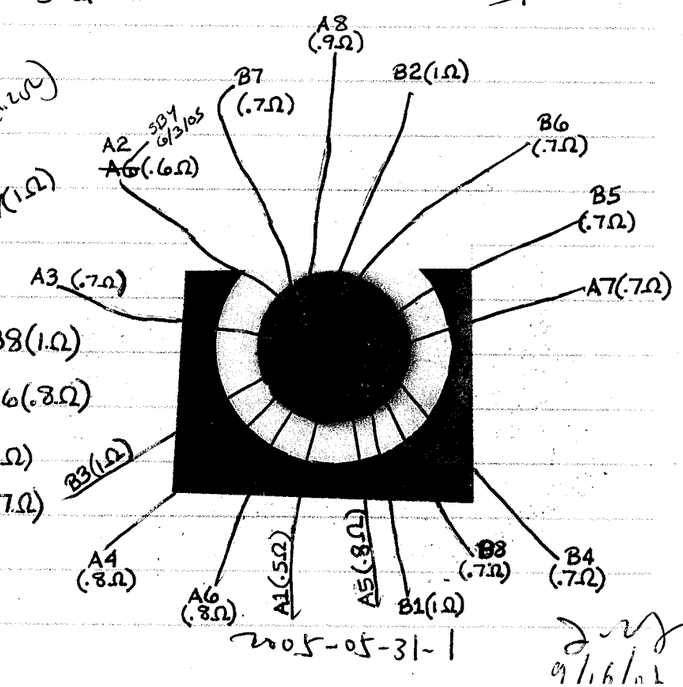
Fabrication of Alloy 22 Probes.

Alloy 22 wire:

2 - New Probes, using (16) C22 wires each (Heat # XX 1977BG11, heated to 1121°C for 10mins, H_2O quenched) C22 wires were individually coated with Aremco (CP2070) Epoxy leaving 1/4" bare as to fit wire connectors. Kynar sheath was used (single layer) to cover each C22 wire with its connector and aprox. 4" of flexible wire, with the exception of aprox 1/2"-3/4" of C22 wire at sensor end of probe.







9/16/05

ID: 2005-05-31-1 MAS 1 — 2005-05-31-2

13:09. (Probe #1) and (Probe #2) MAS 2

A to I-1 — A to I-3

B to I-2 — B to I-4

Data #799 Coupling resistors all 1k.

(Probes are in Air)

Data Cycle #806 – probes put in 1M NaCl Lot: 045904

15:45. Reference probe placed in beaker and

Data # 817 connected. MAS Ch. 33, 34, 35, 36

for I-1, I-2, I-3, and I-4.

S/N 3328225P_2

16:04, #820. Currents: A I-1 – 0.03 – – 0.669 mA

B I-2 – 10.717 – + 0.56

C I-3 – 0.52 – + 1.49

D I-4 – 2.481 – 1.04.

potentials: A – 292.8, B – 292.8, C – 234.8, D – 235.5 mV

sample I-1 A and I-2 B, I-3 C and I-4 D

Calibrated T/Cs being used:

SN: 293376W (1) T/C con – used w/ Watlow Temp. Control (no cal. req.)

(2) T/C4 – used w/ calibrated meter SN: T-94140

(8) T/C5 – T-94140

(12) T/C12 – w/ ch. 39 SBY 10/4/05 J. [illegible] 9/16/05

ID: 2005-05-31-1 — ID: 2005-05-31-2

6/6/05 8:00 100mls DI added to cell to make soluble enough to place MAS 1 and MAS 2 in proper locations in cell.

10:03 Cycle 1378 – Probes and Ref were disconnected and removed from 1M NaCl solution to be placed in cell

SBY 6/21/5

10:56 Placed probe ~~#1~~ (MAS 1) #2, 3/4" from bottom of cell (in solution)

Placed P2 (MAS 2) #1, 4 1/2" from bottom (in vapor only).

Removed 55mls from bubbler, ph = 8.0, rinsed and filled bubbler with 10mls DI, ph = 6.3

11:01 Cycle 1386 – Start of 24hr/140°C

T/C controller: 142°C, T/C #4: 141°C

6/7/05 7:46 T/C controller: 154°, T/C #4: 154°C

* Heater controller unstable, switch from Watlow to to different Watlow.

10:04 MAS Program (File 2005_05_31a) stopped.

10:06 MAS program Restarted (File: 2005-06-07 a)

A thermocouple (Th1) placed in the same port as Anoxic and connected to ch. 40 for trend information only (need to be compared with readings from calibrated T/C) — no calibration required, trend only

Connect I-3. removed for repair, Pin 5 was found broken.

10:40 Connections in I-3 fixed, plugged back to service.

10:53 Ch. 40: 3.910 mV → T/C Reading: 116.3°C

12:56 and T/C (Th2) (T/C #12) connected ch. 39. J. [illegible] 6/14/05 J. [illegible] 9/16/05

T/C #12 in ambient. SBY 10/4/05

13:37 Bubbler fluid removed (27mls) ph: 8.0, (10 mils) DI added ph: 6.3

6/9/05

8:49. Ch. 39 = 27.6 μV, ch 40 = 4.01 mV

Th. Couple reading = 117.1 °C. (T/C #4)

Pump Flow Rates with new 0.11 ID pump tube

Pump Setting
- 0.5 = 3.4 mls / 1 hr.
- 1.0 = 6.77 mls / 1 hr.
- 1.5 = 16.7 mls / 1 hr.

10:00 ch 39 = , ch 40 = T/C control = 118° T/C #4 117°

Bubbler ph = 6.7, 7 mls 10 mils DI added, ph = 5.4

10:13 — 50 mils DI added to cell.

10:31 — Temp. Controller adj. to 130°C (Cycle 257)

10:42 Cycle 259 — Start ~~120~~ 130°C for 24 hrs. SBY 6/8/15

11:26 Ch: 40 (Th1) = 4.261 mV, T/C #4 = 124.6°C

12:45 T/C controller = 126°C, T/C #4 = 124°C

Starter DI drip 6.77 mls/hr

14:25 Cycle 297 — Increased drip rate to 16.7 mls/hr.

T/C controller = 126°C, T/C #4 = 125°C

15:15 Cycle 306 — Turned off drip — T/C con = 125°, T/C 4 = 124°C

ch 39 = 11.23 μV, ch 40 = 4.18 mV

16:22 program stopped

16:39 program restarted File: 2005-06-08a

6/10

9:17 Vessel inspected. Crystal at bottom 1.25" thick. 0.75" thick of liquid above crystal.

9:56 (Cycle 185) T/C con = 127°, T/C 4 = 127°, T/C 5 = 95°, ch 39 = 6.98 μV, ch 40 = 4.2 mV

T/C #5 inserted to vessel at same level as Probe #2 (MAS 2)

J. Vyro 9/16/07 SBY 10/4/05

6/9/05 10:56 (cyc. 195) ch 39 = 7.15 μV, ch 40 = 4.27 mV, T/C con = 129°, T/C 4 = 128°, T/C 5 = 97°

10:59 (cyc. 196) Increased control temp to 140°, bubbler ph = 8.0, mls = 30, 7 mls DI added

11:46 (cyc. 204) ch 39 = 13.5 μV, ch 40 = 4.64 mV, T/C con = 140°, T/C 4 = 141°, T/C 5 = 128°

140°C — Start

14:46 (2:46) (cyc. 236) ch 39 = 27.3 μV, ch 40 = 4.57 mV, T/C con = 140°, T/C 4 = 138°, T/C 5 = 104

6/10/05 7:44 (cyc. 411) ch 39 = 15.2 μV, ch 40 = 4.69 mV, T/C con = 140°, T/C 4 = 137°, T/C 5 = 111° mls = 24 bub. ph = 8.2

~~7:59 (cyc 413)~~ SBY 6/10/15 Increased controller temp. to 150°C

12:52 (cyc. 462) ch 39 = 29.0 μV, ch 40 = 4.66 mV, T/C con = 139°, T/C 4 = 139°, T/C 5 = 104°, Bub. ph = N/A, mls = N/A

14:19 150°C — Start

cyc. 477, ch 39 = 238 μV, ch 40 = 5.11 mV, T/C con = 151°, T/C 4 = 151°, T/C 5 = 151°, Bub. ph = 6.8 mls = 31

16:02 (cyc. 494) ch 39 = 27.8 μV, ch 40 = 5.05 mV, T/C con = 149°, T/C 4 = 150°, T/C 5 = 174°,

6/13/05 8:01 (cyc. 1084) ch 39 = 19.0 μV, ch 40 = 4.86 mV, T/C con = 147°, T/C 4 = 147°, T/C 5 = 223°, Bub. ph = 4.2 mls = 6.

Removed test cell from heater for inspection. Liquid solution 1 3/8" from bottom of cell, ball shaped salt formations filling bottom 5/8" of cell. Additional salt formations in and above liquid solution gathered around thermo wells and Probe #2. Salt in bottom of cell is white while liquid is yellow in appearance. All area above solution is slightly blackish-brown. Fluid from bubbler was slightly yellow in appearance and smelled similar to burnt plactic. It's ph = 4.2 where as all previous measurements were around ph = 8.

8:44 (cyc. 1090) — placed cell back into heater, and adjusted to 160°C

10:44 (cyc. 1107) — unable to reach temp. above 147° (T/C con = 147) T/C 4 = 147, T/C 5 = 21

Added some insulative shielding — but had no notable effect on temp..

Dropped controller temp to 100°.

13:54 (cyc. 1132) ch 39 = 14.5 μV, ch 40 = 3.27 mV, T/C con = 102°, T/C 4 = 102°, T/C 5 = 74°

Condensor cooling water turned off to remove moisture from cell in effort to raise temp. to 160°C.

15:17 (cyc. 1144) ch 39 = 17.6 μV, ch 40 = 5.68 mV, T/C con = 160°, T/C 4 = 160°, T/C 5 = 136°

160° — Start SBY 10/4/05 J. Vyro 9/16/07

16:01

/13/05 (4:01) (cyc.1150) ch39=14.1μV, ch40=5.66mV, T/C con=160°, T/C4=163°, T/C5=136°

/14/05 8:22 (cyc.1286) ch39=19.0μV, ch40=5.69mV, T/C con=160°, T/C4=161°, T/C5=134°

10:50 (cyc.1304) T/C #12, SN 2933766W was added in conjunction with T/C5 in same location (vapor only) but level same as MAS2 tip. then connected to Ch.39. J.y.y. 8/14/05

Thermometer SN4418 was placed in vent hood to replace T/C which was previously conn. to ch.39 for ambient air measurement.

11:08 (cyc.1308) ch39=4.49mV, ch40=5.62mV, T/C con=161°, T/C4=162°, T/C5=130°, ~~T/C12=~~ Tair = 23° SBY 6/14/05

Chiller – was turned on.

3:52 (cyc.1345) ch39=4.40mV, ch40=5.58mV, T/C con=161°, T/C4=162°, T/C5=131, Tair=24°

/15/05 7:44 (cyc.1473) ch39=4.57mV, ch40=5.70mV, T/C con=160°, T/C4=162°, T/C5=131° Tair=21°, bub.ph=3.4, mls=33

7:52 (cyc.1474) Heater adjusted to 170°C. Chiller – turned off.

8:28 (cyc.1479) ch39=5.10mV, ch40=6.19mV, T/C con=168°, T/C4=171°, T/C5=144°, Tair=22°

A – 170°C – Start, chiller turned on

10:57 (cyc.1499) ch39=5.64mV, ch40=6.12mV, T/C con=169°, T/C4=172°, T/C5=163°, Tair=22°

3:56 (cyc.1537) ch39=5.41mV, ch40=6.09mV, T/C con=171°, T/C4=174°, T/C5=157°, Tair=24°

/16/05 8:03 (cyc.1666) ch39=5.23mV, ch40=6.22mV, T/C con=170°, T/C4=174°, T/C5=150°, Tair=22°, Bub.ph=3.1 mls=18

Set new test temp. to 150°C. Removed cell for photos.

8:53 (cyc.1673) Added 30mls DI to attempt a ballance of vapor temp. vs. solution temp.

* Temp of 150°C can not be met w/out adding water after lowering from 170°C.

9:03 (cyc.1674) ch39=4.15mV, ch40=4.77mV, T/C con=148°, T/C4=~~148°~~ 157° SBY 8/16/05, T/C5=149°, Tair=22°

9:43 (cyc.1679) ch39=4.45mV, ch40=5.27mV, T/C con=149°, T/C4=150°, T/C5=130°, Tair=22°

Start 150°C – stable – added additional 3mls DI to increase Vapor Temp.

10:07 (cyc.1682) ch39=4.55mV, ch40=5.23mV, T/C con=149°, T/C4=151°, T/C5=142°, Tair=22°

– added 1mls DI (34mls DI total)

10:55 (cyc.1688) ch39=5.01mV, ch40=5.27mV, T/C con=150°, T/C4=151°, T/C5=150°, Tair=22°

13:11 (cyc.1706) ch39=4.78mV, ch40=5.24mV, T/C con=150°, T/C4=151°, T/C5=143°, Tair=24°

16:10 (cyc.1728) ch39=4.52mV, ch40=5.13 mV, T/C con=150°, T/C4=151°, T/C5=137°, Tair=25°

SBY 10/4/05 J.y.y. 9/16/05

6/17/05 7:31 (cyc.1849) ch39=4.69mV, ch40=5.26mV, T/C con=150°, T/C4=152°, T/C5=137°, Tair=22°

9:29 (cyc.1863) ch39=4.58mV, ch40=5.27mV, T/C con=150°, T/C4=152°, T/C5=136°, Tair=24°, Bub.ph=3.2, mls=6

cool down to 130° for next test, ~~added 30mls DI.~~ SBY 6/17/05

Pictures were taken of cell at 170° and 150°. At 150° the solution was 1" from bottom.

11:19 (cyc.1878) ch39=3.26mV, ch40=4.56mV, T/C con=130°, T/C4=132°, T/C5=94°, Tair=23°

Vessel taken out. More crystal settled. Liquid became cloudy, more yellow looking.

Corrosion rate in liquid very high! due to gas back to the liquid?

solution was clear. trasparent. liquid probe in solution, but well above crystal.

11:24. T/c #5 taken out and put back, not much corrosion. good!

~~13:00~~ 13:53 J.y.y. 6/17/05 ch39 = 2.96 ch40 = 4.37 T/c con = 130°, T/c4 = ~~129°~~ 130.5°, T/c5 = 98.°, Tair = 24°, J.y.y. 6/17/05

Data # 1897

15:03 #1906 ch39 = 3.274, ch40 = 4.436, T/c con = 130°, T/c4 = 136°, T/c5 = 100°, Tair = 25°

15:22 → T/c4 = 130.0° T/c5 = 96.7°

6/20/05 7:43 (cyc.2388) ch39=3.22mV, ch40=4.40mV, T/C con=129, T/C4=135°, T/C5=100°, Tair=22°, Bub ph=4.0, 7.4 = mls

Set cell temp. to 100°C.

10:32 (cyc.2408) ch39=2.25mV, ch40=3.25mV, T/C con=101°, T/C4=103°, T/C5=70°, Tair=23°,

Start 100°C – stable

14:22 (cyc.2434) ch39=2.13mV, ch40=2.93mV, T/C con=99°, T/C4=102°, T/C5=75°, Tair=24°

15:54 (cyc.2445) ch39=2.10mV, ch40=2.92mV, T/C con=100°, T/C4=102°, T/C5=75°, Tair=25°

6/21/05 7:39 (cyc.2556) ch39=2.21mV, ch40=3.05mV, T/C con=100°, T/C4=101°, T/C5=69°, Tair=22°, Bub.ph=NA, mls=NA

10:44 (cyc.2576) ch39=2.11mV, ch40=2.91mV, T/C con=99°, T/C4=102°, T/C5=71°, ~~T/C~~ Tair=22° SBY 6/21/05, Bub.ph=4.8, 7.2 mls

Stop – 100°C test – solution is all crystalized – no liquid SBY 10/4/05 J.y.y. 9/16/05

6/21/05 10:59 – Added 50mls D1 to cell and raised set temp. to 130°C.

13:16 (cyc. 2593) ch39=3.01mV, ch40=4.27mV, T/Ccon=127°, T/C4=128°, T/C5=94°, Tair=22°

Added 50mls D1 to dissolve salt for probe removal.

15:03 (cyc. 2606) ch39=3.91mV, ch40=4.16mV, T/Ccon=128°, T/C4=128°, T/C5=99°, Tair=24°

Removed Probe#2 (in solution) for inspection, then placed Probe# 1 (vapor) into solution for comparison. Solution (liquid) is about 1" above crystals in bottom of cell. Probe#2 is placed in .5M NaCl @ 23°C.

Probe tip washed with D1 water; Epoxy seems expanded. Electrodes recessed by ~ 1mm in depth; Electrode surface still has machining mark.

Probe put in 0.5M NaCl soln at 24°C. Connected to I-1, I-2

15:35 (cyc. 2610) ch39=~~-220mV~~ -230mV SBY 6/21/5, ch40=4.07mV, T/Ccon=128°, T/C4=127°, T/C5=103°, Tair=23°

16:04 (cyc. 2613) ch39=-44.6mV, ch40=4.10mV, T/Ccon=129°, T/C4=127°, T/C5=103°, Tair=23°

Placed Probe#2 out of .5M solution and back into cell in vapor (4½" from bottom) only.

16:35. Found bad data for Ch. 39, data ~~[illegible]~~ L.M. 6/21/05 due to bad connection, fixed

6/22/05 8:40 (cyc. 2731) ch39=4.11mV, ch40=4.35mV, T/Ccon=130° T/C4=131°, T/C5=103°, Tair=22°

8:49 (cyc 2732). T/C 5 = 119.1°C ! T/C cont = 130°C, ch.39: 4.031 mV

8:51 (cyc 2733) T/C 5 = ~~119.9°C~~ ! T/C cont = 130°C, ch39. 4.136 mV

9:21 (cyc 2736) 120.6 L.M. 6/22/05

T/C 5 = 102.0°C, T/C cont = 129°C ch39: 4.075 mV

10:03 (cyc. 2741) ch39=4.06mV, ch40=4.11mV, T/Ccon=130°, T/C4=131°, T/C5=101°, Tair=22°

10:08 Moved P2 from vapor state back to solution state.

10:08 Removed P1 from solution state to out of cell, into .5M NaCl.

10:17 (cyc. 2742) Modifications completed.

10:21 (cyc. 2743) ch39=3.98mV, ch40=3.96mV, T/Ccon=129°, T/C4=130°, T/C5=114°, Tair=22°

10:46 (cyc. 2746) ch39=3.95mV, ch40=4.00mV, T/Ccon=130°, T/C4=130°, T/C5=105°, Tair=22°

11:38 (cyc. 2752) Corr Rate of probe P1 very high in 0.5M NaCl, T=24°C

SBY 10/4/05 P1 taken out of 0.5M NaCl, wiped dry. L.M. 9/16/05

6/22/05 13:26 (cyc. 2765) ch39=3.95mV, ch40=4.32mV, T/Ccon=130 T/C4=129°, T/C5=103°, T/air=22°

Removed P1 and P2 to cut and polish ends.

15:23 (cyc. 2779) ch.39=3.96mV, 40=4.18mV, T/Ccon=131°, T/C4=131°, T/C5=115°, T/air=23°

P2 – was reconnected and placed in air (23°C) after having removed 3/8" from tip and polishing to 600 grit.

16:16 (cyc # 2785), Chan. I-3 + I-4 – 0.267 → + 0.64, P2 has been in air, put in 0.5M NaCl.

6/23/05 8:06 (cyc. 2900) ch39=3.97mV, ch40=4.45mV, T/Ccon=130°, T/C4=131°, T/C5=116°, Tair=22°

Placed P2 into cell in vapor phase.

9:11 (cyc. 2908) ch39=3.91mV, ch40=4.35mV, T/Ccon=130°, T/C4=130°, T/C5=103°, Tair=22°

10:55 (cyc. 2920) ch39=3.87mV, ch40=4.40mV, T/Ccon=131°, T/C4=129, T/C5=106°, Tair=23°

12:43 (cyc. 2933) ch39=3.90mV, ch40=4.38mV, T/Ccon=130°, T/C4=~~116~~ 131° SBY 6/23/5, T/C5=116°, Tair=24°

15:36 (cyc. 2953) ch39=3.94mV, ch40=4.40mV, T/Ccon=128°, T/C4=131°, T/C5=119°, Tair=25°

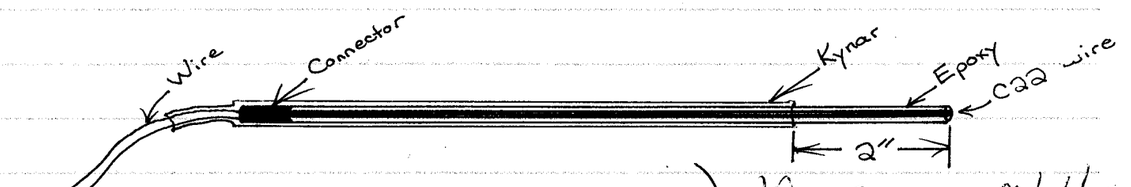
15:40 – Placed P2 into solution.

6/24/05 7:39 (cyc. 3068) ch39=3.97mV, ch40=4.23mV, T/Ccon=129°, T/C4=130°, T/C5=115°, Tair=21°

7/5/05 12:~~45~~ 40 SBY 7/5/5 Two T/C in vapor were removed to prevent corrosion.

7/12/05 9:13 2 – New Probes, using (16) C22 wires each. C22 wires were blasted with 50 micron aluminum oxide for better adhesion of Aremco (CP 2070) Epoxy. Kynar sheath was used to cover each C22 wire with it's connector and aprox. 4" of flexible wire, except the first 2" of probe. Teflon tubes (13"L x ½ ID) were filled with 30mls each of CP 2070, then C22 wires placed inside.

* Thermally aging proceedure of C22 wires on pg. 190.



SBY 10/4/05 L.M. 9/16/05

6/23/05
2:34

THERMALLY AGED PROCEDURE

Quanity/Specimens = (70) C22 Alloy wires (.045)
Heat # XX1977BG11

OVEN= Lindberg Model # 51333
SN # 909172

OVEN SETPOINT= 1132° C

OVEN TEMPERATURE= 1137.2° C

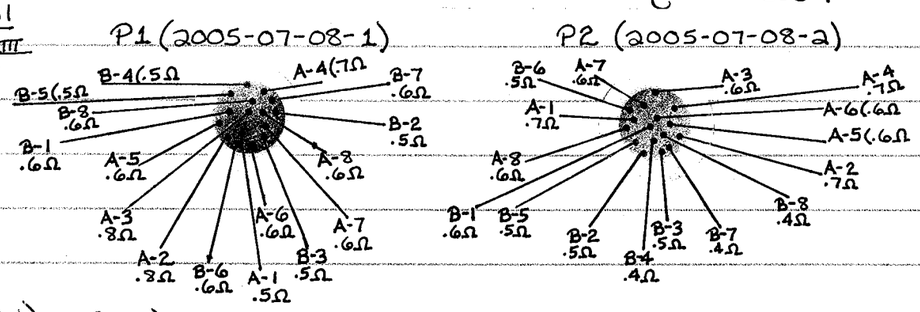
Measurement taken with OMEGA MICROPROCESSOR THEMOMETER MODEL# HH22

Thermocouple= SN#= T94140 CAL= 5/12/05 DUE= 11/11/05
SN#= 328 Cal = 2/7/05 Due = 8/5/05

AMOUNT OF TIME = 1125° for 20 mins.

DETAILS= Placed wires in oven for set amount of time – removed and water quenched.

12/05 – 13:31
Fluke 87 III
SN: 73980497
cal. 12/7/5
due 12/7/06



(08-1) (08-2)

14:06 P1 + P2 were placed into .5M NaCl (22°C) for preliminary readings.

(cyc. 6250) ch39 = -16.83 μV, ch40 = +17.87 μV

15:03 New test cell solution was prepared and set @ 115°C.

Solution: NaCl = 239.63g, $NaNO_3$ = 348.46g, KNO_3 = 414.57g } + 200 mls.
Lot: 045904 Lot: 020809 Lot: 050073 } D1

Connectors: I-1 to 07-08-1 A ; I-3 to 07-08-2A
I-2 to 07-08-1 B ; I-4 to 07-08-2 B

Ch 39 to location #3 (vapor)
Ch 40 to location #4 (liquid)

SBY 10/4/05

9/16/05

7/13/5 Matrix: Measurements will be taken at 115°, 130°, 140°, 150°, 160°, 170°

a:– cyc. 6391. Probe #P1 (08-1) in vapor phase, P2 (08-2) in liquid phase

24 hr.
115°C – Start – stable

10:08 (cyc. 6398) ch.39 = 2.66mV, ch40 = 3.72 mV, T/C con = 114°, T/C4 = 111°, T/C5 = 86°, Tair = 22°

12:36 (cyc. 6416) ch.39 = 2.62mV, ch40 = 3.73mV, T/C con = 116°, T/C4 = 112°, T/C5 = 89°, Tair = 23°

16:15 (cyc. 6442) ch39 = 2.52mV, ch40 = 3.68mV, T/C con = 116°, T/C4 = 113°, T/C5 = 89°, Tair = 24°

7/14/5 7:53 (cyc. 6557) ch39 = 2.64mV, ch40 = 3.70mV, T/C con = 113°, T/C4 = 112°, T/C5 = 88°, Tair = 21°

11:04 (cyc. 6580) ch39 = 2.61mV, ch40 = 3.61mV, T/C con = 117°, T/C4 = 114°, T/C5 = 90°, Tair = 23°

14:41 (cyc. 6605) ch39 = 2.55mV, ch40 = 3.62mV, T/C con = 116°, T/C4 = 113°, T/C5 = 89°, Tair = 24°

15:51 (cyc. 6613) ch39 = 2.60mV, ch40 = 3.65mV, T/C con = 116°, T/C4 = 113°, T/C5 = 86°, Tair = 24°

7/15/5 8:23 (cyc. 6733) ch39 = 2.69mV, ch40 = 3.77mV, T/C con = 114°, T/C4 = 112°, T/C5 = 87°, Tair = 21°

8:52 (cyc. 6736) * Briefly disconnected I-3 / 2005-07-08-2 A

10:08 (cyc. 6745) ch39 = 2.70mV, ch40 = 3.76mV, T/C con = 115°, T/C4 = 112°, T/C5 = 89°, Tair = 22°, ph = 5.8, 7.4 mls (Bubbler)

24 hr.
115° – Stop, reduced controler temp to 90°C

13:30 90°C – Start – stablized

(cyc. 6768) ch39 = 1.79mV, ch40 = 2.67mV, T/C con = 92°, T/C4 = 89°, T/C5 = 69°, Tair = 23°

15:38 (cyc. 6783) ch39 = 1.71mV, ch40 = 2.68mV, T/C con = 91°, T/C4 = 88°, T/C5 = 65°, Tair = 23°

7/18/05 7:51 (cyc. 7245) ch39 = 1.95mV, ch40 = 2.84mV, T/C con = 90°, T/C4 = 88°, T/C5 = 66°, Tair = 21°

24 hr.
90°C – Stop reduced control temp. to 70°C

10:23 70°C – Start – stablized

(cyc. 7263) ch39 = 1.02mV, ch40 = 2.00mV, T/C con = 69°, T/C4 = 69°, T/C5 = 46°, Tair = 22°

12:18 (cyc. 7276) ch39 = 1.10 mV, ch40 = 2.00 mV, T/C con = 71°, T/C4 = 70°, T/C5 = 48°, Tair = 23°

3:22 (cyc. 7298) ch39 = ~~2.27~~ SBY 7/19/5 mV, ch40 = ~~3.79~~ SBY mV, T/C con = 71°, T/C4 = 70.1°, T/C5 = 47.6°, Tair = 24°

7/19/05 7:43 (cyc. 7416) ch39 = 1.10 mV, ch40 = 2.08 mV, T/C con = 71°, T/C4 = 70°, T/C5 = 48°, Tair = 21°

10:06 (cyc. 7431) ch39 = 0.97 mV, ch40 = 1.98 mV, T/C con = 69°, T/C5 = 47°, T/C4 = 68°, Tair = 22°

13:52 (cyc. 7458) ch39 = 0.97 mV, ch40 = 1.95 mV, T/C con = 69°, T/C4 = 69°, T/C5 = 47°, T/C, Tair = 24°

15:59 (cyc. 7473) ch39 = 0.97 mV, ch40 = 1.96 mV, T/C con = 71°, T/C4 = 70°, T/C5 = 48°, Tair = 24°

7/20

SBY 10/4/05

9/16/05

7/19/05 10:18

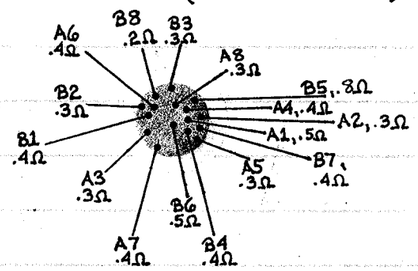
Used: Fluke 87 III

SN: 73980497

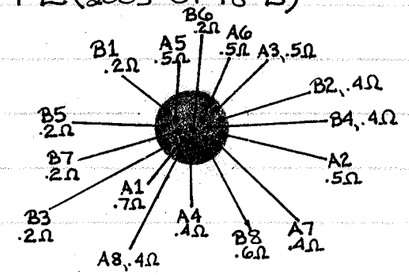
Cal: 12/7/05

Due: 12/7/06

P1 (2005-~~08~~ 07-18-1) SBY 7/19/15



P2 (2005-07-18-2)



* These probes were built of the same materials and the same parameters as those on page 190 & 189.

3:18 p.m. 7/19/05 Noise Noticed since start of test on July 13!

① Fume hood Fan/Light stopped! → to see effect.

② moved cable of 4 lines away from bottom of side of hood.

7/20/05 7:46 (cyc. 7587) ch39=1.12 mV, ch40=2.05 mV, T/Ccon=71°, T/C4=70°, T/Cs=49°, Tair=22°

9:23 (cyc. 7598) ch39=1.09 mV, ch40=2.05 mV, T/Ccon=71°, T/C4=71°, T/Cs=48°, Tair=22°

9:24 – Turned heater off to check for noise source.

9:24 70°C – Stop

10:57 (7607) Still had noise, wrapped probe leads w/foil, connected foil to shielding of cables.

ch39=0.78 mV, ch40=1.72 mV, T/Ccon=62°, T/C4=62°, T/Cs=42°, Tair=22°

turned on heater. still set T_{cont}=71°.

12:27 (7618) connected foil wrapper to shell of heater.

1:45 (7625) Tcont raised to 80°C. see heating effect

14:50 (cyc. 7633) ch39=1.53 mV, ch40=2.41 mV, T/Ccon=82°, T/C4=80°, T/Cs=60°, Tair=24°

15:04 (cyc 7635)

14:52 – Covered glass cell w/grounding shield (foil) – completed @ 15:04

Pulled cell to be covered

16:29 (7644) Tcont=80°C, Set Tcont=115°C to see heating effect SBY 10/4/05 J.V.T. 9/16/05

16:57. Tcont = 128°C, (Set was 115°C).

Change ~~set~~ of Tcont ~~to~~ 130°C.

17:5

17:20 Tcont = 127°C, T/C 4 = 126.0, T/C 5 = 103.2°C

7/21/05 9:06 (cyc. 7762) ch39=3.21 mV, ch40=4.19 mV, T/Ccon=128°, T/C4=127°, T/Cs=108°, Tair=24°

14:29 (cyc. 7800) ch39=3.12 mV, ch40=4.29 mV, T/Ccon=129°, T/C4=128°, T/Cs=112°, Tair=24°

16:15 (cyc. 7808) ch39=3.24 mV, ch40=4.34 mV, T/Ccon=128°, T/C4=128°, T/Cs=110°, Tair=24°

7/22/05 7:48 (cyc. 7921) ch39=3.26 mV, ch40=4.38 mV, T/Ccon=129°, T/C4=~~111°~~ 128° SBY 7/22/15, T/Cs=111°, Tair=22°

→ added foil to isolate entire cell from noise.

10:21 (cyc 0020) ch39=3.18 mV, ch40=4.35 mV, T/Ccon=129°, T/C4=128°, T/Cs=110°, Tair=22°

Bubbler: 10 mls, 4.3 ph

13:04 (cyc. 51) ch39=4.01 mV, ch40=4.43 mV, T/Ccon=129°, T/C4=130°, T/Cs=123°, Tair=22°

13:18 – Removed (cyc. 54) foil shielding and grounding, then plugged controler into isolation X-former.

15:00 – No improvements with isolations X-former. Began to set up area

7/25/05 for additional test cell (Test cell B) using new probe sensors * placed in solution at 9:00 7/26/5

P1 (2005-07-18-1) and P2 (2005-07-18-2). Starting solution is

7M NaCl (409g NaCl + 1L D.I.) Lot: 045904. Test cell-B is arranged exactly as

Cell-A (P1, 2005-07-08-1, P2, 2005-07-08-2), with ch.37 to location #5 (vapor)

and ch.38 to location #4 (fluid).

7/26/05 Test cells A & B will be using different Watlow temp. controllers Model #93

9:00 Cell-B sensors were placed in NaCl solution.

9:44 Making final connections, adjustments and bringing test cells up to temp..

(cyc. 1078) Cell A – ch39=3.66 mV, ch40=4.43 mV, T/Ccon=132°, T/C4=134°, T/Cs=151°, Tair=21°

Cell B – ch37=265 μV, ch38=273 μV, T/Ccon=48°, T/C4=56°, T/Cs=58°, Tair=21°

12:42 (cyc. 1106) – Start 70°C (cell B) 24hr and 150°C (cell A) 24hr both are stabilized

	ch.37	ch.38	ch.39	ch.40	T/Ccon	T/C4	T/Cs	Tair
A=B= SBY 7/26/15	2.12 mV,	2.12 mV,			71°	72°	72°	21°
B=A=			3.14 mV,	5.25 mV	149°	146°	106°	21°

J.V.T. 9/16/05

SBY 10/4/05

/26/05 14:42 (cyc. 1124) Cell A - ch39 = 3.20 mV, ch40 = 5.25 mV, T/Ccon = 152°, T/C4 = 145°, T/Cs = 107°, Tair = 21°

Cell B - ch37 = 2.05 mV, ch38 = 2.06 mV, T/Ccon = 69°, T/C4 = 71°, T/Cs = 71°, Tair = 21°

16:00 (cyc. 1135) Cell A - ch39 = 3.43 mV, ch40 = 5.09 mV, T/Ccon = 151°, T/C4 = 146°, T/Cs = 106°, Tair = 21

Cell B - ch37 = 2.03 mV, ch38 = 2.04 mV, T/Ccon = 70°, T/C4 = 71°, T/Cs = 71°, Tair = 21

/27/05 7:47 (cyc. 1276) A - ch39 = 3.22 mV, ch40 = 5.08 mV, T/Ccon = 149°, T/C4 = 142°, T/Cs = 105°, Tair = 21°

B - ch37 = 2.09 mV, ch38 = 2.10 mV, T/Ccon = 70°, T/C4 = 70°, T/Cs = 70°,

11:01 (cyc. 1313) A - ch39 = 3.19 mV, ch40 = 5.06 mV, T/Ccon = 148°, T/C4 = 145°, T/Cs = 108°, Tair = 20°

B - ch37 = 2.14 mV, ch38 = 2.15 mV, T/Ccon = 71°, T/C4 = 72°, T/Cs = 72°

14:07 (cyc. 1345) A - ch39 = 3.25 mV, ch40 = 5.20 mV, T/Ccon = 149°, T/C4 = 145°, T/Cs = 108°, Tair = 21°

B - ch37 = 2.09 mV, ch38 = 2.10 mV, T/Ccon = 71°, T/C4 = 72°, T/Cs = 71°

16:00 (cyc. 1370) A - ch39 = 3.23 mV, ch~~38~~ 40 = 5.22 mV, T/Ccon = 152°, T/C4 = 147°, T/Cs = 109°, Tair = 21°
SBY 7/27/05

B - ch37 = 2.08 mV, ch38 = 2.09 mV, T/Ccon = 71°, T/C4 = 72°, T/Cs = 72°

/28/5 8:00 (cyc. 1506) A - ch39 = 3.29 mV, ch40 = 5.23 mV, T/Ccon = 150, T/C4 = 144°, T/Cs = 107°, Tair = 20°

B - ch37 = 2.18 mV, ch38 = 2.18 mV, T/Ccon = 71°, T/C4 = 72°, T/Cs = 72°

11:02 (cyc. 1541) A - ch39 = 3.31 mV, T/ch40 = 5.12 mV, T/Ccon = 149°, T/C4 = 147°, T/Cs = 109°, Tair = 20°

B - ch37 = 2.16 mV, ch38 = 2.17 mV, T/Ccon = 71°, T/C4 = 72°, T/Cs = 72°

13:17 (cyc. 1562) A - ch39 = 3.25 mV, ch40 = 5.11 mV, T/Ccon = 149°, T/C4 = 146°, T/Cs = 110°, Tair = 21°
Bubbler: ph: 4.0 3.2 mls

B - ch37 = 2.11 mV, ch38 = 2.12 mV, T/Ccon = 71°, T/C4 = 72°, T/Cs = 72°
Bubbler: ph = 6.4 11 mls.

Finished 48 hr test - cells A & B, reset temps. to 115°C cell A, and 90°C cell B. Waiting for stabilization.

14:58 (cyc. 1581) A - ch39 = 2.17 mV, ch40 = 3.69 mV, T/Ccon = 115°, T/C4 = 105°, T/Cs = 72, Tair = 21°

B - ch37 = 2.90 mV, ch38 = 2.91 mV, T/Ccon = 90°, T/C4 = 91°, T/Cs = 91°

Start - 48 hr, cell A @ 115°C and cell B @ 90°C

15:14 (1584) — * noticed open connection to T/C (ch.39). - Reconnected

16:05 (cyc. ~~19~~ 1593) A - ch39 = 2.36 mV, ch40 = 3.69 mV, T/Ccon = 115°, T/C4 = 110°, T/Cs = 78°, Tair = 21°
SBY 7/28/5

B - ch37 = 2.88 mV, ch38 = 2.89 mV, T/Ccon = 90°, T/C4 = 91°, T/Cs = 91°

/29/05 8:32 (cyc. 1729) A - ch39 = 2.44 mV, ch40 = 3.85 mV, T/Ccon = 115°, T/C4 = 109°, T/Cs = 77°, Tair = 21°

B - ch37 = 2.97 mV, ch38 = 2.98 mV, T/Ccon = 90°, T/C4 = 91°, T/Cs = 91°

SBY 10/4/05 J. [illegible] 9/16/05

7/29/05 11:05 (cyc. 1750) A - ch39 = 2.07 mV, ch40 = 3.80 mV, T/Ccon = 115°, T/C4 = 110°, T/Cs = 78°, Tair = 20°

B - ch37 = 2.96 mV, ch38 = 2.97 mV, T/Ccon = 90°, T/C4 = 91°, T/Cs = 91°

8/1/05 7:45 (cyc. 2281) A - ch39 = 2.26 mV, ch40 = 3.83 mV, T/Ccon = 114°, T/C4 = 109°, T/Cs = 80°, Tair = 21°
Bubbler = 7.0 mls ph = 6.9

B - ch37 = 2.88 mV, ch38 = 2.90 mV, T/Ccon = 90°, T/C4 = 91°, T/Cs = 91°, Bubbler = 11 ml ph = 6.0

Finished - 48 hr(+), cell A @ 115°C and cell B @ 90°C, reset temps. to 70°C cell A and 110°C cell B. Awaiting temp. stabilization.

9:28 (cyc. 2297) Had to vent off moister/vapor to aquire 110°C

14:32 (cyc. 2345) A - ch39 = 1.05 mV, ch40 = 2.12 mV, T/Ccon = 71°, T/C4 = 71°, T/Cs = 50°, Tair = 21°

B - ch37 = 2.38 mV, ch38 = 3.80 mV, T/Ccon = 114°, T/C4 = 118°, T/Cs = 81°

Start - 48 hr., cell A @ 70°C and cell B @ 110°C.

9:28 * Note: Cell-B T/C4 and T/Cs were not in vapor state, but were in liquid. T/C's were changed out w/ new ones to avoid future problems from corrosion pitting which had occured. T/C~~4~~ Ch.37 (#9) and T/Cs (#14) were adjusted to 4½" from top of test cell (aprox. midway) in vapor state.
SBY 8/1/5

16:00 (cyc. 2361) A - ch39 = 1.12 mV, ch40 = 2.03 mV, T/Ccon = 69°, T/C4 = 69°, T/Cs = 49°, Tair = 21°

B - ch37 = 2.27 mV, ch38 = 3.74 mV, T/Ccon = 110°, T/C4 = 112°, T/Cs = 75°

8/2/05 7:49 (cyc. 2475) A - ch39 = 1.01 mV, ch40 = 2.04 mV, T/Ccon = 70°, T/C4 = 69°, T/Cs = 48°, Tair = 20°

B - ch37 = 2.07 mV, ch38 = 3.86 mV, T/Ccon = 112°, T/C4 = 113°, T/Cs = 78°

11:10 (cyc. 2505) A - ch39 = .995 mV, ch40 = 2.03 mV, T/Ccon = 69°, T/C4 = 71°, T/Cs = 47°, Tair = 22°

B - ch37 = 2.27 mV, ch38 = 3.66 mV, T/Ccon = 109°, T/C4 = 112°, T/Cs = 77°

13:35 (cyc. 2521) A - ch39 = .951 mV, ch40 = 1.98 mV, T/Ccon = 69°, T/C4 = 70°, T/Cs = 47°, Tair = 24°

B - ch37 = 2.18 mV, ch38 = 3.60 mV, T/Ccon = 111°, T/C4 = 113°, T/Cs = 77°

16:02 (cyc. 2545) A - ch39 = .931 mV, ch40 = 1.95 mV, T/Ccon = 69°, T/C4 = 70°, T/Cs = 47°, Tair = 24°

B - ch37 = 2.23 mV, ch38 = 3.75 mV, T/Ccon = 112°, T/C4 = 114°, T/Cs = 79°

8/3/05 7:54 (cyc. 2655) A - ch39 = 1.02 mV, ch40 = 2.08 mV, T/Ccon = 69°, T/C4 = 69°, T/Cs = 46°, Tair = 21°

B - ch37 = 2.27 mV, ch38 = 4.09 mV, T/Ccon = 118°, T/C4 = 120°, T/Cs = 78°

11:17 (cyc. 2684) A - ch39 = .970 mV, ch40 = 2.07 mV, T/Ccon = 69°, T/C4 = 69°, T/Cs = 46°, Tair = 21°

B - ch37 = 2.38 mV, ch38 = 3.84 mV, T/Ccon = 108°, T/C4 = 110°, T/Cs = 75°

SBY 10/4/05 J. [illegible] 9/16/05

/3/05

13:17 (cyc. 2699) A-ch39=.976 mV, ch40=2.06 mV, T/Ccon= 70°, T/CA= 70°, T/Cs= 45°, Tair=21°

B-ch37=1.98 mV, ch38=3.73 mV, T/Ccon= 112°, T/CA= 114°, T/Cs= 75°

15:42 (cyc. 2718) A-ch39=.936 mV, ch40=2.01 mV, T/Ccon= 69°, T/CA= 70°, T/Cs= 47°, Tair= 21°

B-ch37= 2.08 mV, ch38= 3.62 mV, T/Ccon= 109°, T/CA= 109°, T/Cs= 76°

14/05

7:46 (cyc. 2939) A-ch39=1.01 mV, ch40=2.07 mV, T/Ccon= 70°, T/CA=70°, T/Cs= 47°, Tair=20°

B-ch37=2.27 mV, ch38=3.96 mV, T/Ccon= 109°, T/CA= 104°, T/Cs = 76°

11:08 (cyc. 2963) A-ch39=1.00 mV, ch40=2.07 mV, T/Ccon= 70°, T/CA= 71°, T/Cs= 47°, Tair=20°

B-ch37=2.18 mV, ch38=3.69 mV, T/Ccon= 109°, T/CA=107°, T/Cs= 76°

8/5/05 9:10 look at cell B. crystal formed at bottom, no liquid.

8/05

7:51 (cyc. 3587) A-ch39=.941 mV, ch40=2.03 mV, T/Ccon= 69°, T/CA= 68°, T/Cs= 45°, Tair= 20°

B-ch37=2.07 mV, ch38=3.60 mV, T/Ccon= 117°, T/CA= 116°, T/Cs= 80°

14:16 (cyc. 3632) A-ch39=.982 mV, 40=1.99 mV, T/Ccon= 70°, T/CA= 67°, T/Cs= 45°, Tair=21°

B-ch37=1.78 mV, 38=3.70 mV, T/Ccon= 113°, T/CA= 111°, T/Cs= 69°

16:08 (cyc. 3656) A-ch39=.943 mV, ch40=1.91 mV, T/Ccon= 69°, T/CA= 67°, T/Cs= 45°, Tair=22°

B-ch37=2.25 mV, ch38=3.70 mV, T/Ccon= 114°, T/CA= 114°, T/Cs= 76°

9/05

7:37 (cyc. 3757) A-ch39=.983 mV, ch40=2.04 mV, T/Ccon= 70°, T/CA= 69°, T/Cs= 46°, Tair= 19°

B-ch37=1.93 mV, ch38=3.82 mV, T/Ccon= 108°, T/CA=106°, T/Cs= 66°

13:13 (cyc. 3801) A-ch39=.952 mV, ch40=1.94 mV, T/Ccon= 69°, T/CA= 67°, T/Cs= 45°, Tair= 21°

B-ch37=2.23 mV, ch38=3.71 mV, T/Ccon=108, T/CA=106°, T/Cs= 73°

Raised A- Temp. to 150°

14:25 - Added 150ml of DI to bring liquid level to aprox. 1" from bottom of Cell-B and lowered temp. to 105°C

10/05

7:58 (cyc. 3922) A-ch39=3.24 mV, ch40=5.01 mV, T/Ccon=151°, T/CA=146°, T/Cs= 107°, Tair= 20°

B-ch37=3.20 mV, ch38=3.59 mV, T/Ccon= 105°, T/CA=105°, T/Cs= 96°

12:47 (cyc. 3949) A-ch39=3.22 mV, ch40=5.09 mV, T/Ccon= 151°, T/CA= ~~103°~~ 143° SBY 8/10/5, T/Cs= 107°, Tair= 20°

B-ch37=3.19 mV, ch38=3.58 mV, T/Ccon= 104°, T/CA=105°, T/Cs=96°

15:58 (cyc. 3969) A-ch39=3.20 mV, ch40=4.92 mV, T/Ccon= 151°, T/CA=143°, T/Cs= 104°, Tair= 20°

B-ch37=3.12 mV, ch38=3.53 mV, T/Ccon= 104°, T/CA=105°, T/Cs=96°

J.Y. 9/16/05 SBY 10/4/05

8/11/05

7:42 (cyc. 4071) A-ch39=3.18 mV, ch40=5.09 mV, T/Ccon= 152°, T/CA= 142°, T/Cs=107°, Tair=20°

B-ch37=3.15 mV, ch38=3.53 mV, T/Ccon=104°, T/CA=106°, T/Cs=97°

12:55 (cyc. 4104) A-ch39=3.60 mV, ch40=5.06 mV, T/Ccon= 153°, T/CA=145°, T/Cs=108°, Tair=21

B-ch37=3.14 mV, ch38=3.58 mV, T/Ccon=105°, T/CA 106°, T/Cs= 98°

15:45 (cyc. 4121) A-ch39=3.44 mV, ch40=4.99 mV, T/Ccon= 153, T/CA=144°, T/Cs=109°, Tair=20

B-ch37=3.10 mV, ch38=3.51 mV, T/Ccon=105, T/CA=107°, T/Cs=98°

8/12/05

8:27 (cyc. 4234) A-ch39=3.09 mV, ch40=5.15 mV, T/Ccon=151°, T/CA=144°, T/Cs=108°, Tair=20°

B-ch37=3.20 mV, ch38=3.59 mV, T/Ccon=105°, T/CA=107°, T/Cs=98°

9:30 - A: Liquid is 1/2" above salt crystals, bubbler ph=3.9, 6.8 mls

B: Liquid is 1/4" above salt crystals, . . . ph=8.4, 11 mls

10:25 - New Test Set up :

Th. Aged ← J.Yang 2/21/06

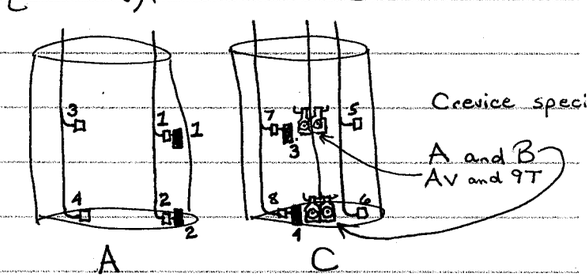
Cell A - Will remove 1/8" from probe sensors, repolish to 600 grit and replace into cell. Will place (2) 1/2" (~~M.A.~~) C22 coupons in vapor, (2) (~~M.A.~~) Th. Aged coupons in liquid, (1) Welded 1"x1/2" coupon in vapor, (1) Welded 1"x1/2" C22 coupon in liquid. Welded 1"x1/2" coupon info. is given in Lab bk. 675 pg. 128.

Material Info: Bk 604, pg 283, 288
~~HT# CM0792~~ 1227713150
SBY 1/5/06

Cell C - Same as cell A but without probe sensors. Both cells will use the solution specified on pg. 190. Cell C will also have (2) crevice specimens (not in cell A) in liquid. Crevice specimen A - C22 (Bk#729 pg. 22) Heat # 2277-3-3266 (M.A.), Initial wt: 22.78815 g. Crevice specimen B - C22 Heat # 2277-3-3292 (Welded S.A. 20 mins. @ 1125°C, water quenched), Filler WN813 (*see NB#579 pg. 38 and 42). Initial wt: 22.56042 g.

Th. Aged ~~M.A.~~ 1/2"x1/2" □) (Welded 1"x1/2" ■ J.Y. 2/21/06

① 1.87192 g	① 3.82509 g
② 1.86434 g	② 3.80024 g
③ 1.85123 g	③ 3.81060 g
④ 1.86664 g	④ 3.78520 g
⑤ 1.95704 g	
⑥ 1.90673 g	
⑦ 1.99675 g	
⑧ 1.99903 g	



*Refer to Bk 737 pg 7 (AV and 9T)

Coupon and crevice specimens are held in position by insullated C22 wire (Alloy 622, Heat: XX1977BG11). Insulation is Kynar tubing and Teflon.

SBY 10/4/05 J.Y. 9/16/05

5/12/05

13:35 (cyc. 4270) A-ch39= 3.18 mV, ch40= 5.09 mV, T/Ccon= 151°, T/CA= 146°, T/Cs= 107°, Tair= 22°

B-ch37= 3.08 mV, ch38= 3.46 mV, T/Ccon= 104°, T/CA= 106°, T/Cs= 97°

* Added 20mls DI to Cell A.

Bubbler =

15:56 (cyc. 4285) A-ch39= 3.26 mV, ch40= 5.07 mV, T/Ccon= 148°, T/CA= 146°, T/Cs= 113°, 7ml, 4.5ph

B-ch37= 3.02 mV, ch38= 3.41 mV, T/Ccon= 104°, T/CA= 106°, T/Cs= 97°, Tair= 23°

/15/05

7:50 (cyc. 4717) A-ch39= 3.31 mV, ch40= 4.99 mV, T/Ccon= 148°, T/CA= 143°, T/Cs= 110°, Tair= 21°

B-ch37= 3.15 mV, ch38= 3.55 mV, T/Ccon= 103°, T/CA= 106°, T/Cs= 97°

13:44 (cyc. 4760) A-ch39= 3.24 mV, ch40= 4.94 mV, T/Ccon= 147°, T/CA= 140°, T/Cs= 110°, Tair= 22°

B-ch37= 3.09 mV, ch38= 3.48 mV, T/Ccon= 104°, T/CA= 106°, T/Cs= 97

* Disconnected probes to cell A (P-2005-07-08-1-2, A+B) to remove aprox. 1/8" for ~~analiz~~ SBY 8/15/5 and repolishing. Increasing temp. of cell C so that solution is no longer crystalized.

16:00 – aprox. placed coupons into cells A & C and probes back into A.

16:30 – reconnected probe leads to wire harness.

18:10 (cyc. 4799) Start Test – with C22 coupons. – temps. stabile (refer pg. 197, 10:25)

* leads were backwards

150° A-ch39= 3.57 mV, ch40= 4.85 mV, T/Ccon= 150°, T/CA= 142°, T/Cs= 100°, Tair= 24°

B-ch37= 3.02 mV, ch38= 3.41 mV, T/Ccon= 105°, T/CA= 106°, T/Cs= 97°

/16/05 180° C- T/Ccon= 176°, TL= 183°, TV= 40°,

8:22 (cyc. 4897) A-ch39= 3.59 mV, ch40= 4.92 mV, T/Ccon= 149°, T/CA= 140°, T/Cs= 100°, Tair= 21°

B-ch37= 3.16 mV, ch38= 3.55 mV, T/Ccon= 104°, T/CA= 106°, T/Cs= 97°

C- T/Ccon= 174°, TL= 184°, TV= 140°

11:08 (cyc. 4924) A-ch39= 3.57 mV, ch40= 4.92 mV, T/Ccon= 150°, T/CA= 139°, T/Cs= 100°, Tair= 21°

B-ch37= 3.09 mV, ch38= 3.51 mV, T/Ccon= 104°, T/CA= 105°, T/Cs= 97°

C- T/Ccon= 171°, TL= 181°, T/V= 130°

15:39 (cyc. 4968) A-ch39= 3.55 mV, ch40= 4.89 mV, T/Ccon= 150°, T/CA= 140°, T/Cs= 100°, Tair= 23°

B-ch37= 3.04 mV, ch38= 3.43 mV, T/Ccon= 104°, T/CA= 105°, T/Cs= 96°

C- T/Ccon= 171°, TL= 179°, TV= 129

J. Y. 9/16/05

SBY 10/4/05

8/17/05

8:44 (cyc. 5084) A-ch39= 3.70 mV, ch40= 4.96 mV, T/Ccon= 149°, T/CA= 140°, T/Cs= 100°, Tair= 20°

B-ch37= 3.15 mV, ch38= 3.54 mV, T/Ccon= 105°, T/CA= 105°, T/Cs= 96°

C- T/Ccon= 171°, TL= 184°, TV= 130°

11:10 (cyc 5099) A-ch39= 3.61 mV, ch40= 4.97 mV, T/Ccon= 149°, T/CA= 139°, T/Cs= 100°, Tair= 21°

B-ch37= 3.12 mV, ch38= 3.52 mV, T/Ccon= 104°, T/CA= 106°, T/Cs= 97°

C- T/Ccon= 171°, TL= 181°, TV= 129°

15:52 (cyc. 5132) A-ch39= 3.49 mV, ch40= 4.89 mV, T/Ccon= 150°, T/CA= 140°, T/Cs= 100°, Tair= 22

B-ch37= 3.07 mV, ch38= 3.46 mV, T/Ccon= 104°, T/CA= 105°, T/Cs= 97°

C- T/Ccon= 169°, TL= 179°, TV= 129°

8/18/05

7:53 (cyc. 5241) A-ch39= 3.65 mV, ch40= 4.87 mV, T/Ccon= 147°, T/CA= 139°, T/Cs= 100°, Tair=

B-ch37= 3.15 mV, ch38= 3.55 mV, T/Ccon= 104°, T/CA= 106°, T/Cs= 97°

C- T/Ccon= 171°, TL= 180°, TV= 128°

11:43 (cyc. 5288) A-ch39= 3.66 mV, ch40= 4.90 mV, T/Ccon= 148°, T/CA= 139°, T/Cs= 100°, Tair= 21°

B-ch37= 3.14 mV, ch38= 3.53 mV, T/Ccon= 104°, T/CA= 107°, T/Cs= 98

C- T/Ccon= 170°, TL= 179°, TV= 129°

16:05 (cyc. 5333) A-ch39= 3.45 mV, ch40= 4.90 mV, T/Ccon= 148°, T/CA= 140°, T/Cs= 100°, Tair= 23°

B-ch37= 3.05 mV, ch38= 3.56 mV, T/Ccon= 104°, T/CA= 106°, T/Cs= 98°

C- T/Ccon= 169°, TL= 177°, TV= 129°

8/19/05

9:02 (cyc. 5556) A-ch39= 3.66 mV, ch40= 4.93 mV, T/Ccon= 148°, T/CA= 141°, T/Cs= 100°, Tair= 21°

B-ch37= 3.12 mV, ch38= 3.50 mV, T/Ccon= 104°, T/CA= 106°, T/Cs= 96°

C- T/Ccon= 172, TL= 182, TV= 129°

13:53 (cyc. 5590) A-ch39= 3.59 mV, ch40= 4.86 mV, T/Ccon= 149°, T/CA= 139°, T/Cs= 100°, Tair= 22°

B-ch37= 3.09 mV, ch38= 3.45 mV, T/Ccon= 104°, T/CA= 105°, T/Cs= 98°

C- T/Ccon= 170°, TL= 178, TV= 128°

16:09 (cyc 5610) A-ch39= 3.58 mV, ch40= 4.91 mV, T/Ccon= 151°, T/CA= 140°, T/Cs= 100°, Tair= 23°

B-ch37= 3.06 mV, ch38= 3.44 mV, T/Ccon= 104°, T/CA= 105°, T/Cs= ~~92°~~ 96° SBY 8/19/5

C- T/Ccon= 172°, TL= 180°, TV= 130°

J. Y. 9/16/05

SBY 10/4/05

 SBY

8/22/05

7:38 (cyc 6061) A-ch39 = 3.78 mV, ch40 = 4.97 mV, T/Ccon = 148°, T/CA = 139°, T/Cs = 100°, Tair = 21°

B-ch37 = 3.18 mV, ch38 = 3.56 mV, T/Ccon = 105°, T/CA = 106°, T/Cs = 98°

C- T/Ccon = 171°, TL = 179°, TV = 130°

10:55 – C- bubber pH = 4.3, 23mls — added 20mls DI into test cell.

11:02 (cyc 6110) A-ch39 = 3.72 mV, ch40 = 5.02 mV, T/Ccon = 148°, T/CA = 143°, T/Cs = 100°, Tair = 21°

B-ch37 = 3.13 mV, ch38 = 3.50 mV, T/Ccon = 104°, T/CA = 106°, T/Cs = 97°

C- T/Ccon = 174°, TL = 188°, TV = 143°

13:54 (cyc. 6135) A-ch39 = 3.66 mV, ch40 = 4.87 mV, T/Ccon = 151°, T/CA = 140°, T/Cs = 100°, Tair = 21°

B-ch37 = 3.06 mV, ch38 = 3.43 mV, T/Ccon = 105°, T/CA = 106°, T/Cs = 97°

C- T/Ccon = 171°, TL = 182°, TV = 135°

16:09 (cyc. 6154) A-ch39 = 3.62 mV, ch40 = 4.88 mV, T/Ccon = 149°, T/CA = 141°, T/Cs = 100°, Tair = 22°

B-ch37 = 3.05 mV, ch38 = 3.42 mV, T/Ccon = 104°, T/CA = 105°, T/Cs = 96°

C- T/Ccon = 169°, TL = 181°, TV = 131°

8/23/05

7:51 (cyc. 6267) A-ch39 = 3.74 mV, ch40 = 4.89 mV, T/Ccon = 148°, T/CA = 141°, T/Cs = 100°, Tair = 20°

B-ch37 = 3.16 mV, ch38 = 3.53 mV, T/Ccon = 105°, T/CA = 106°, T/Cs = 98°

C- T/Ccon = 170°, TL = 180°, TV = 130°

10:48 (cyc. 6301) A-ch39 = 3.66 mV, ch40 = 5.05 mV, T/Ccon = 149°, T/CA = 140°, T/Cs = 100°, Tair = 21°

B-ch37 = 3.15 mV, ch38 = 3.52 mV, T/Ccon = 104°, T/CA = 106°, T/Cs = 98°

C- T/Ccon = 174°, TL = 186°, TV = 130°

16:08 (cyc. 6346) A-ch39 = 3.57 mV, ch40 = 4.77 mV, T/Ccon = 149°, T/CA = 142°, T/Cs = 100°, Tair = 24°

B-ch37 = 3.08 mV, ch38 = 3.43 mV, T/Ccon = 104°, T/CA = 105°, T/Cs = 97°

C- T/Ccon = 169°, TL = 184°, TV = 130°

8/24/05

7:45 (cyc. 6459) A-ch39 = 3.66 mV, ch40 = 5.09 mV, T/Ccon = 146°, T/CA = 144°, T/Cs = 100°, Tair = 21°

B-ch37 = 3.14 mV, ch38 = 3.51 mV, T/Ccon = 104°, T/CA = 106°, T/Cs = 98°

C- T/Ccon = 170°, T/CA = N/A, T/L = 183°, TV = 130°

11:00 (cyc. 6486) A-ch39 = 3.59 mV, ch40 = 4.92 mV, T/Ccon = 148°, T/CA = 144°, T/Cs = 100°, Tair = 24°

B-ch37 = 3.02 mV, ch38 = 3.38 mV, T/Ccon = 105°, T/CA = 105°, T/Cs = 97°

C- T/Ccon = 171°, TL = 184°, TV = 130°

To be continued in Scien. Notebook #737 page 3.

SBY 10/4/05

J. Yang 9/16/05

The following papers/report were published based on the work in this scientific notebook (#533):

Lietai Yang, "Corrosion of Alloy 22 in Concentrated Nitrate and Nitrate and Chloride Sale Environments at Elevated Temperature—Progress Report", CNWRA 2006-02, San Antonio, TX, April 2006

L. Yang, R. T. Pabalan, L. Browning and D.S. Dunn, "Corrosion Behavior of Carbon Steel and Stainless Steel Materials under Salt Deposits in Simulated Dry Repository Environments", in Scientific Basis for Nuclear Waste Management XXVI, R. J. Finch and D. B. Bullen, eds, Warrendale, PA: Materials Research Society, M.R.S. Symposium Proceedings, Vol. 757, pp.791-797, 2003.

Lietai Yang, Roberto T. Pabalan, and Miriam R. Juckett, "Deliquescence Relative Humidity Measurements Using an Electrical Conductivity Method", Submitted to Journal of Solution Chemistry, May, 2005

L. Yang, Miriam Juckett and Roberto T. Pabalan, The conductivity behavior of potential salt deposits on the surface of the engineered barrier materials for the proposed high level nuclear waste repository at yucca mountain", in Scientific Basis for Nuclear Waste Management XXVIII, J. M. Hanchar, S. Stroes-Gascoyne, and L. Browning, eds, Warrendale, PA: Materials Research Society, M.R.S. Symposium Proceedings, Vol. 824, pp.19-26, 2004.

J. Yang 4/20/06

I have reviewed this scientific notebook and find it in compliance with QAP-001. There is sufficient information regarding procedures used for conducting tests, acquiring and analyzing data so that another qualified individual could repeat the activity.

4/24/06

ADDITIONAL INFORMATION FOR SCIENTIFIC NOTEBOOK NO. 533

Document Date:	07/25/2002
Availability:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, Texas 78228
Contact:	Southwest Research Institute® Center for Nuclear Waste Regulatory Analyses 6220 Culebra Road San Antonio, TX 78228-5166 Attn.: Director of Administration 210.522.5054
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File Types: (.exe, .bat, .zip, etc.)	doc, xls, pdf, cor, ppt, jpg, txt
Remarks: (computer runs, etc.)	Media contains: data files and spreadsheets