308 --- Q200604250004
Scientific Notebook No. 533: Corrosion of Alloy 22 in Salt Environment at Elevated Temperatures (07/25/2002 through 09/16/2005)

CENTER FOR NUCLEAR WASTE REGULATORY ANALYSES

Notebook
#533
Salt #2.

No
#

CNWRA
CONTROLLED
COPY 533

① · 11-10-2002 up to 533737

Copy 212

712 Title

up to
2006-01-11
①

Notebooks
533737

Initial Entries for Under-salt Corrosion Tests: Project # 06002.01.322 06002.01.212

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 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.

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).

Required level of accuracy:
Temperature: ±3 oC, Currents: ±10 nA. ; Relative Humidity ± 5% L.Y. 4/10/06

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

L. Yang 2/14/06

Special personnel training or qualification requirements:
None

Material/chemical:
Varies (see in-progress entries).

Continued from Notebook # 464

Corrosion of Carbon Steel and Stainless Steel under salt deposits in Humidity Controlled environment.

Liet ai Yang. L. Yang. L.Y.

7/25/02.

Justin Landry Justin Sandy JPL

Brian K. Dealy - BKD

Roger J Bykstra · RJB - RJD

All electronic Data are stored in NoteBooks/NoteBook#533_Salt Folder.

L. Y

Steve Young - Steve Young - SY SBY 5/6/05 11/17/03

Continued from Note book # 464, page 200.

7-25-02

16:57 II-2 connected

7-26-02

8:02 II-3 connected
II-5 Connected

9:29 Data# 2697
SS: -54.428 - +12.397
CS -754.344 - +176.484
T_d/T_w = 51/43 - 51/44 RH(n) = 85.82 - 86.61% T(n) = 47.89°C

9:42 II-2, II-3, & II-5 Removed, and connected to MIC Test

16:58 T_d/T_w = 51/43. too low.
Water Tank does not have H_2O

16:59. water added.
Connectors II-2 connected

17:04 set T_d/T_w = 51/45 (previously 51/43.5)

7-29-02

7:38 connector II-2 Removed

8:25 II-2, II-3, and II-5 ~~Rema~~ JPL 7-29-02 Returned

Justin Sandy 8-1-02

8:37 T_d/T_w = 51/44 - 50/44 RH(n) = 89.07 - 89.56% T(n) = 48.06°C
Data# 3425
SS: -43.051 - +8.364 μV
CS: -1113.694 - + 166.654 μV

JPL 7-29-02
~~8:40~~

T_d/T_w = 51/44 RH(n) = 89.47 - 90.00% T(n) = 48.11°C
16:34 SS: -41.439 - +5.938 μV
Data # 3520 CS: -1081.506 - +294.085 μV
II-2, II-3 II-5 Removed

16:55 II-2 Returned

7-30-02
7:22 II-2 Removed

7:55 All connections Returned

8:20 T_d/T_w = 51/45 RH(n) = ~~89.~~ JPL 7-30-02 93.36 - 93.87 T(n) = 48.10°C
Data# 3711 SS -54.273 - + 30.004 μV
CS -1850.619 - + 306.056 μV

15:15 T_d/T_w = 51/45 RH(n) 94.14 - 94.42 T(n) = 48.25°C
Data# 3794 SS -52.003 - + 20.086 μV
JPL 7-30-02 CS -2193.205 - + 529.971 μV
16:00
~~17:00~~ ~~II-2~~, II-3, II-5 Removed
JPL 7-30-02 JPL 7-30-02

Justin Sandy 7-31-02

7-31-02

7:33 II-2 Removed

8:55 II-2, II-3, II-5 Returned

Data# 4054 T_d/T_w = 51/44 RH(m) = 90.43 - 90.95 % T(m) = 48.16°C

13:13 SS: ~~CS:~~ JPL 7-31-02 ~~SS:~~ JPL 7-31-02 -3645.999 - +1592.677 μV

CS: ~~SS:~~ JPL 7-31-02 ~~CS:~~ 7-31-02 -547.116 - +154.108 μV

JPL Noted that connections were on wrong.

7-31-02 ~~Connections are supposed to be SS connected to II-2 and II-3~~ JPL 7-31-02

15:14 T_d/T_w = 51/44 RH(m) = 90.35 - 90.80 % T(m) = 48.16°C

Data# 4077 SS: -4158.768 - +2453.582 μV

CS: -581.532 - +135.358 μV

II-2, II-3, and II-5 Removed

15:48 II-3 Returned

8-1-02

8:05 II-3 Removed

8:40 II-2, II-3, and II-5 Returned

9:39 T_d/T_w = 51/45 - 51/46 RH(m) = 96.71 - 97.14 % T(m) = 48.33°C

Data# 4296 SS -4059.192 - +857.246 JPL 8-1-02 μV

CS -1287.403 - +395.339 JPL 8-1-02 μV

Justin Sandry 8-7-02

16:06 Data # 4373

T_d/T_w = 51/44 RH(m) = 93.11 - 93.59 % T(m) = 48.04°C

SS: -4637.434 - +471.04 μV

CS: -1888.807 - +510.541 μV

T_d/T_w set to 51/41

Main Cooling Valve open fully

16:11 II-2, II-3, II-5 Removed

16:20 Program Restarted / result see pages 37-39

New File Name 02-0801a

16:43 II-3 ? Retrieved (removed from Mic Test) to chamber sort test yes J.G. 8/07/02

16:48 T_d/T_w = 51/41 RH(m) = 82.30 - 82.34 % T(m) = 47.39°C

8-2-02

8:26 T_d/T_w = 50/41 RH(m) = 75.63 - 76.94 % T(m) = 47.61°C

II-3 Removed

9:30 II-2, II-3, II-5 Returned

Data #200 T_d/T_w = 51/41 RH(m) = 75.94 - 77.20 T(m) = 47.74°C

10:13 Data #222

T_d/T_w = 51/41 - 51/42 RH(m) 76.16 - 77.52 % T(m) = 47.74°C

SS: -254.867 - +114.225 μV

CS: -278.811 - +75.449 μV

16:49 ~~CS~~ JPL 8-2-02 SS: -240.863 - +135.438 μV

~~SS~~ JPL 8-2-02 CS: -333.359 - +82.652 μV

T_d/T_w = 51/41 RH(m) = 76.32 - 77.71 % T(m) = 47.73°C

Data # 305

Justin Sandry 8-7-02

$T_d/T_w = 41/51$ 2

8/03/02 15:13 # 590 RH(m) = 74.64% — 76.42% (75.1%), T(m) 47.75°C

SS: −179 — +114 μV (II-2, II-3) 100kΩ

CS: −302 — +77 μV (II-4, II-5) 1kΩ

II-3, II-5 Removed for Mic test.

15:31 program restarted 0803a — results see page 37

15:39 set T_d/T_w = 31

T_d/T_w = 51.5/39.5 (from 51.5/41 2)

8-5-02

8:26 II-2 Removed For Micro Test

RH(m) = 66.80 — 68.18% (67.49%) T_d/T_w = 50/40 — 51/40 T(m) = 47.69°C

8:47 All Connections Returned

9:28 Data # 501

RH(m) = 66.95% — 66.30% T_d/T_w = 51/39 T(m) = 47.70°C

SS: (II-2+II-3) −90.066 — +58.665 μV

CS: (II-4+II-5) −74.638 — +26.633 μV

Target Humidity 40% Chiller set to T = 25°C

10:01 RH(m) = 59.95 — 60.61 T_d/T_w = 51/37 T(m) = ~~47.7~~ 47.55°C 50L 8-5-02

T_d/T_w set to T_d/T_w = 51/32

10:09 T_d/T_w = 50/35 RH(m) = 54.97 — 56.15% (55.56%) T(m) = 47.52°C

Justin Sandy 8-7-02

15:15 Data # 567 (49.5%)

T_d/T_w = 50/35 — 51/35 RH(m) 49.09 — 50.13% T(m) = 47.59°C

SS (II-2+II-3) −18.801 — +7.733 μV

CS (II-4+II-5) −7.279 — +10.9 μV

II-2, II-3, II-5 Removed For Mic Test

17:01 Program Restarted: File: 02_0805a

17:31 II-2 Returned

8-6-02

7:27 II-2 Removed for Mic Test

8:21 II-2, II-3, II-5 Returned

T_d/T_w = 50/33 RH(m) = 38.51 — 39.31% (38.91%) T(m) = 47.56°C

9:25 Data # 212

SS: −7.858 — −3.951 μV

CS: −1.795 — +5.107 μV

T_d/T_w = 51/33 RH(m) = 38.87 — 39.58% T(m) = 47.6°C

13:50 Program Restarted c806a

II-4, II-5 changed from 1kΩ to 100kΩ

16:18 T_d/T_w = 51/33 RH(m) = 38.40 — 39.11% (38.76%) T(m) = 47.60°C

Data # 30 SS (II-2+II-3) −14.029 — −2.546 μV

CS (II-4+II-5) −127.831 — +369.112 μV

II-2, II-3, II-5 Removed For Mic test

16:55 II-2 Returned

Justin Sandy 8-7-02

8-7-02

7:25 It was noted that the Return on II-4 was not connected therefore the Data for II-4 from 16:18 8-6-02 Data# 30 to 7:30 8-7-02 Data# 200 might not be good.

II-4 connection corrected

II-2 Removed for MIC Test

7:50 II-2, II-3, II-5 Returned

9:33 T_d/T_w = 51/33 RH(m) = 37.96 – 38.72% (~38.34%) T(m) = 47.62°C

Data #226 SS(II-2 + II-3) -6.041 – +0.098 μV

CS(II-4 + II-5) -109.139 – +268.541 μV

12:50 II-3 Removed For Salt Solution Test

14:00 II-5 Removed For Salt Solution Test

15:15 II-2 Removed For Salt Solution Test

J.y. 8/7/02

15:44. Noticed program halted at ~~3:po~~ 3:13 p.m !

17:19. program Restarted 02-0807a

17:19. water in Tank low, DI. water added.

17:20. Humidity increased !! to T_w/T_d = 43/41 !! has been 51/33 37.2 – 38.7% = 37.95%

chiller to 20°C from 25°C.

17:37 Back to 50/37, R(m) = 49.47%, reached 51.92% the highest point by Meter.

17:49 T_d/T_w = 51/34. R(m) = 43.78%

J.y. 9/30/02

8/08/02

9:22 T_d/T_w = 51/33.2, RH(m) = 38.09 – 38.89% (~38.49%), T(m) = 47.71

10:12 II-2, II-3, II-5 Returned from MIC test

13:41 II-2, II-3, II-5 removed for Bottle salt test

Data Entry @ 13:50 Restarted Program for Bottle Salt Testing

17:07 II-2, II-3, II-5 Returned

Data # 43 RH(m) = 30.20 – 30.95% (~30.56%) T(m) = 47.73°C T_d/T_w = ~~51/49~~ 51/31 – 32 J.y. 8/8/02

17:15 SS(II-2 + II-3) -7.773 – -5.358 μV

CS(II-4 + II-5) -321.847 – +478.18 μV

8/9/02

8:08 T_d/T_w = 51/31 RH(m) = 29.37 – 30.15% (~29.8%) T(m) = 47.59°C

Data #235 SS(II-2 + II-3) ~~-4.535 – +3.444 μV~~ JDL 8-9-02 -6.223 – -1.536 μV

CS(II-4 + II-5) -184.134 – +271.626 μV

II-2, II-3, II-5 Removed for MIC Test

11:34 Computer shutdown when Zip Drive was Accessed

11:42 Data Restarted Program File # 02-0809b

MIC J.y. 9/4/02

13:00 ~~Returned~~ To Test from Salt Bottles To MIC test File # 02-0809c

8/11/02

17:19 T_d/T_w = 51/30, RH(m) = 28.77 – 29.70%.

18:40 T_d/T_w = 51/31 RH(m) = 30.55 – 31.37% (~30.96%)

II-2, II-3, II-5 Returned from Bottle test.

J.y. 9/30/02

J.y. 8/14/02

18:45 Chiller turned to ~~10°C~~ 12°C from 20°C.

18:50 Td/Tw = 51/29°C RH(m) = (30.5 — 31.3 %)

18:52 Noticed Connection of II-2 was bad, corrected.

19:07 Td/Tw = 51/29°C RH (m) = 26.42 – 27.00% = 26.7%

Chiller turned to 13.9°C from 12°C.

8/12/02

7:25 Removed All except II-4 Connections from chamber

13:42 Td/Tw = 51/29°C RH (m) = 25.03% – 25.22% = 25.12% T (m) = 47.42°C

14:40 Removed All Connections from Salt Bottle Testing Except II-4

Reconnected Mic Tests

Restarted with File Data # 02_0812 @ 15:04

17:09 Td/Tw = 51/30 RH (m) = 26.09 – 26.38% = 26.23%

8/13/02

Data # 232 @ 9:08

Returned Connection II-2, II-3 And II-5

16:12 II-2, II-3, II-5 removed for Bottle test.

Td/Tw = 51/30, RH (m) = 25.0 – 25.3% = 25.15%

8/14/02 @ 7:30

Removed All Connections from Salt Bottle Tests

Returned connection to Mic Test

17:24 II-2, II-3, II-5 Returned from Mic test.

Td/Tw = 51/30°C, RH (m) = 24.78%

8/20/02

8/15/02 @ 9:06 Data # 818

Removed All connections from Chamber Except II-4

Return To salt Bottle 8/15/02

Data # 876 @ 2:06 pm / 14:06

Removed All connection from Bottle Tests

Reconnected Mic Test.

8/15/02

8/16/02 @ 7:18 Data # 1081

Removed Connections from ~~Bottle~~ Salt Bottle Test Mic Test

Reconnected II-2, II-3 And II-5

To Chamber

Reconnected @ 7:29 Data # 1083 8/16/02

8:56 II-5 -15.6 — +82 μV still corrosion.

Td/Tw = 51/30, RH(m) = 26.75 – 26.92%, Trm = 24°C (Room)

T (m) = 47.55°C.

Chiller set to 7.5°C from 13.9°C.

Disconnected All Connections Except II 4 from chamber @ 10:03 Data # 1113

Td/Tw = 51/29. still high.

Chiller set To ~~min 7.5%~~ 8/14/02 minimum from 7.5%

~~Td/Tw = 25.4 – 25.6%~~ J.y. 8/16/02

14:10 Td/Tw = 51/29°C, (Td/Tw) set to 51/20°C RH(m) = 25.27 – 25.38% = 25.32%

from 51/30 J.y. 8/14/02 Aug. 8/20/02

15:34. Noticed II-4, II-5 not coupled together.
II-2, II-3, II-5 Returned from Bottle test.
Td/Tw = 51/28°C. RH(m) = 24.38 – 24.56%

8/16/02
16:28 New File. #1187 File Name: 0816a. ← lost j.y 9/4/02

8/15/02 Disconnected chamber connections Except for II-4
Time: 9:55 Data: 781

8/19/02. 10:38 Td/Tw = 50 – 51/28°C, RH(m) = 26.0 – 26.5%! Why high
T(m) = 46.4°C

8/20/02 8:48, Td/Tw = 50/28 (51/29°C), RH(m) = 27.50 – 27.62% (=27.55%)
II-2, II-3, II-5 Returned. T(m) = 46.27°C
chiller set 1min (0.0°C), but indicated 8.6°C!

SS316 II-2 / II-3 > -7.7 – -3.5 μV ΔI = 37.3E-25 = 62.6E-11 A
STD = 62.6E-11 * 2.14 * 0.1 = 1.33E-10 A
CS1010 II-4 / II-5 > -37.3 – +25.3 μV. (Still corroding. See page 53)

Set Td/Tw = 51.8/10°C from 51.8/20°C.

Td/Tw = 51/27, RH(m) = 23.98% – 23.83%, T(m) 46.18°C

II-4/II-5, -30.2 – +20.5 μV. ΔI = 50.7E-11 A
STD = 50.7E-11 * 0.214 = 1.08E-10 A

J.yang 9/30/02

J.y. 8/20/02

17:24, Td/Tw = 51/27°C, RH(m) = ~~23.25%~~ 23.01 – 23.98% (=23.5%) T(m) = 46.47 – 46.32

II-4 / II-5 > -28 – +19.37 μV ΔI = 47.37E-11 A
Estim. STD = 47.37 * 2.14 * 0.1 = 1.01E-9 A = 1.01E-10 A
See page 53.

8/21/02 Disconnected chamber Except for II-4
Time: 7:30 Data = 1311

10:10 Td/Tw = 51/27°C RH(m) = 23.01 – 24.0%, T(m) = 46.32
16:32 Td/Tw = 51/27°C RH(m) = 23.9 – 24.3% T(m) =
16:32 II-2, II-3, II-5, Back. J.y. 8/21/02
16:46 II-2 + II-3 → -5.04 – ~~-19.~~ -1.9 μV ΔI = 43.5E-11 A
II-4 + II-5 → -26.79 – +16.742 μV. Still corrosion!

16:46 Set Td/Tw → 51.8/0°C from 51.8/10°C

17:05 Td/Tw = 51/27°C. no change. STD = 43.5 * 0.214 = 0.93E-10 A

8/22/02 Time 7:18
Data: #1587
II-2 + II-3 = -5.062 ~~-4.545~~ 8/22/02 – -4.521
II-4 + II-5 = -20.301 – +14.045
ΔI = 44.3E-11 A

Removed Connection Returned To Mic Test STD = 2.14 * 44.3E-11 = 9.48E-10 A
See page 53.

11:43 Td/Tw = 51/27°C, RH(m) = 24.0 – 24.2% 8/22/02
Data #1638 ~~II-4, II-2, II~~ J.y. 8/22/02
II-5 returned.
Set chiller to 20°C,

J.yang 9/30/02

11:53 Set Chiller → 10°C, Td/Tw = 51.8/29°C.

11:57 51/31 = Td/Tw too high. Set Td/Tw = 51.8/26°C
Chiller to 10°C

Noticed battery of Hygrometer is gone.
replaced with new one.

13:45 Td/Tw = 51/30. RH(M) = 22.82 ~ 23.02
ΔI = 58.0 E-11 A
Estimat. STD = 1.24 E-10 A
II-4 + II-5. − 30.74 ~ + 27.3. increased!

15:24 Td/Tw = 51/30 RH(M) = 23.27 ~ 23.35%.
− 35.307 ~ + 30.04 !

16:41 Td/Tw = 51/30-31, Set (Td/Tw) = 51/25.5, RH(M) = 23.5 - 23.8%

18:14 Td/Tw = 51/30, RH = 22.92 ~ 23.58%
II-4 + II-5 − 45 ~ 34.5 ~~pA~~ ΔI = 79 E-11 A
II-2, II-3 back from MIC Test.

8/23/02
Estimated STD = 79E-11 * 2.14
= 1.69E-10 A

Time = 7:26
Data = 1863

See page 53
J.y. 10/8/02

Disconnected chamber connections
II-2 II-3 II-5
Returned then to MIC Tests

Data # 1813
11:56. II-2, II-3, II-5 returned.
Td/Tw = 51/30, RH(M) = 23.75 ~ 23.84% T(M) = 47.67°C
J.yor 9/30/02

12:00 chiller set to 10°C from 10°C.
II-4 + II-5, −47.13 ~ + 38.66 μV
Td/Tw set ~~to~~ from 51.8/25.5°C to 51.8/27.0°C
J.y. 8/23/02
ΔI = 85.7 E-11 A

Estimated STD = 85.7 * 2.14 * 0.1
= 1.83 E-10 A

13:44 Disconnected II-2, II-3 And II-5 from
Data 1934 chamber Returned to MIC Test

18:00 Td/Tw = 51/31. RH(M) = 25.8 ~ 26.1%

II-2, II-5 returned.

8/25/02
20:52. Td/Tw = 51/31, RH(M) = 25.53% ~ 25.82% T(M) = 47.67°C

Set Td/Tw = 51.8/29.0°C.

8/26/02 Disconnected II-5 + II-2 from chamber
Time = 7:11 Data = 2660

8:33 Td/Tw = 51/32, RH(M) = 28.50
8:35 RH(M) = 28.80 ~ 29.04, RH(M) = 47.7°C
15:38 Td/Tw = 51/32°C RH(M) = 28.7 ~ 29.01, RH(M) = 47.7°C
Found program stopped
Chamber opened.
J.yor 9/30/02

16:52. Deliquescence measurement started, File: 0826A.

cells: ① MgCl₂·6H₂O. Lot # A5-0024

|Z|=500 Ω, ② Corrosion product, see page 144, Bk #464

has been on cell I (MgCl₂·6H₂O). NaCl + product

17:06 to cell II (Corrosion product).

The Multicell program Failed, computer failed, computer can't be started!

|Z| = 3706, About 10 days data lost!! 9/4/02

Deliquescence cell see page 28, Bk. #464.

program: Auto Z plot. See pages 6 to 26, Bk #464.

The cells are inside the same Beaker (see page 178 Bk #464) as the corrosion sensor, to smooth the R. Humidity and the avoidance of drop condensates.

This time the beaker is 4L one, previously 600 mL

8/27/02 Computer crashes last night

8:47. |Z| = 6E6 Ω. very high. (has been on cell II), ~~MgCl₂ cell~~ 8.9. 9/6/02

to cell I,

Td/Tw = 50 – 51/32 – 31, RH(m) = 26.3 – 26.42%

|Z| of cell I = 1.2E6 Ω. T(m) = 48.70°C

also very high.

Liyan 9/30/02

11:31. Td/Tw = 51/32°C, |Z|₁ RH(m) = 1.2E6 Ω. 24.62 – 24.76%

9/02/03

14:58. Data # 4880.

program terminated.

15:07

Multicell measurement started using another computer.

File 02_0902a.txt

only II-4 is with chamber test.

the rest connections are with MIC test.

9/3/02 9:16 a.m.

II-4: –10.1 — –8.0 (from 12:27, 9/05/02, II-5 not measured but coupled).

100 hr 9/4/02 02-0904a started. but did not go.

9/5/02 program restarted. 02-0905a

9/6/02 14:10. old computer fixed.

Auto_Z-plot Restarted File 02_0906a Zview. with MgCl cell Cell I

14:20 program stopped for installing VB 6.0 pro.

14:34 program (Auto Z plot restarted file 02-0906b Zview. with MgCl cell, cell I

14:34 File: 02_0906b for Multicell also started.

Cell I, |Z| = 1.8E5 Ω

14:53 to cell II, |Z| = 5E6 Ω. RH(m) = 26.12%, T(m) = 47.99°C

15:07 Td/Tw = 50/32°C, |Z|_II = 5E6 Ω, RH(m) = 25.9 – 26.2% = 26.06%

Liyan 9/30/02

14:38 II-2, II-3, II-5 to Chamber test.

17:14 T_d/T_w = 51/32, RH(m) = 25.9 ~ 26.2% ≈25.05%

Z_{II} = 8E6 Ω, (II-2 + II-3) = -7.6 ~ ~~-4.9 μV~~

~~II-4 + II-5 = -22 ~ -1.1 μV.~~

set (T_d/T_w) = 51.8/31°C has been 51.8/29

9/8/02. 13:50 T_d/T_w = 50/32 RH(m) = 27.76 ~ 27.96% ≈27.86%

Z_{II} = 5.4E6 Ω, to Z_I (cell I).

(II-2 + II-3) = -6.4 ~ + -4.8 μV

(II-4 + II-5) = -10 ~ ~~+4.7~~ -4.7 μV. J.Y. 9/8/02

Z_I = ~~837760~~ = 8.377E4

Set (T_d/T_w) = 51.8/32.6°C, from 51.8/31°C

14:14 T_d/T_w = 51/33°C RH(m) = 30.3 ~ 30.4%

Z_I = 13038 Ω declining! To Cell II

9/9/02 T_d/T_w = 50/33 RH(m) : 49.14 / 48.66 % ≈48.9%

Time 7:33 am (II-2 + II-3) : -5.804 ~ -4.82 μV

Data : 669 (II-4 + II-5) : -5.663 ~ -2.052 μV

T_d/T_w = 51/34 RH(m) : 32.19 / 27.04 = 29.615%

Time 3:43 pm (II-2 + II-3) = -8.245 ~ -4.571 μV

Data 742 (II-4 + II-5) : -10.326 ~ -5.448 μV

J.Y. 9/10/02

9/10/02 T_D/T_W = 51/34 RH(m) = 32.59 / 27.20 % ≈29.90%

Time = 9:10 am

Data = 891 (II-2 + II-3) = -5.784 ~ -4.699 μV

(II-4 + II-5) = -9.44 ~ -2.73 μV

T_D/T_W = 51/34 RH(m) = 33.19 / 27.20 %

Time = 3:45 pm (II-2 + II-3) = -6.047 ~ -4.672 μV

Data 944 (II-4 + II-5) = -8.597 ~ -1.586 μV

(50-51)/34°C RH(m) = 33.4 ~ 33.6% 33.5%

17:44 Z_{II} = 3.6E6 ohm.

to cell I

~~Z_I = 602 ohm~~

17:48 set (T_d/T_w) = 51.8/~~32°C~~ 34°C J.Y. 9/10/02

to Cell II.

9/11/02 33.3% No change.

8:48 T_d/T_w = 51/34°C RH(m) = 33.24 ~ 33.39.

Z_{II} = 3.5 E6, (II-2 + II-3) = -5.5 ~ + -3.3 μV

(II-4 + II-5) = -10.64 ~ -3.2 μV.

to cell I

9:13 Z_I = 643 Ω.

Set $T_{chiller}$ = 18°C (from 15°C) J.Y. 9/10/02

9:50 To cell II, T_d/T_w = 51/34°C, RH(m) = 33.92% not much!

Z_{II} = 4.8 E6.

9:50 set (T_d/T_w) = 51.8/~~34°C~~ ; 10:59 set (T_d/T_w) = 51.8/36°C

Set chiller to 20°C from 18°C.

T_d/T_w = 51/35°C, RH(m) = 35.5 ~36.6%, Z_{II} = 4E6 Ω

17:20 T_d/T_w = 51/35°C, RH(m) = 35.7 ~37.8%.

= 36.5%

9/12/02 Time 7:30 T_d/T_w 50/35 RH(m) 35.1 ~ 36.87%

Data 1248 (II-2 + II-3) = -6.726 ~ -4.706

(II-4 + II-5) = -9.149 ~ -1.581

9:06 Z_{II} = 4E6 Ω

To Cell I. Z_I = 553 Ω.

Set (T_d/T_w) = 51.8/38°C

9:16 To Cell II.

9:38 T_d/T_w = 51/37, set chiller T = 23°C from 20°C

10:36 Z_{II} = 4E6, T_d/T_w = 51/36, RH(m) = 40 ~ 40.16%

13:59 T_d/T_w = 50~51/36, RH(m) = 40.01 ~ 40.16%

Z_{II} = 3.7E6 (at 1kHz) (II-2 + II-3) = -9.3 ~ -3.11 μV

(II-4 + II-5) = -18.8 ~ +8.2 μV

9:23/09/13/02 T_d/T_w = 51/36 RH(m) = 40.2 ~ 40.4%

Z_{II} = 8.2E6 (II-2 + II-3) = -10 ~ -4.6 μV

(II-4 + II-5) = -15.6 ~ +2.9 μV

set chiller T = 26°C from 23°C,

set (T_d/T_w) = 51.8/38.5°C.

II-2, II-3, II-5 to MIC Test.

11:22 T_d/T_w = 51/38 RH(m) = 45.66%

Z_{II} = 6E6 Ω!

Continued on page 40.

J.Y. 9/30/02

7/26/02.

Continued from Notebook # 464 Page 143.

Deliquescence Point measurement

Set up same as the one shown in Page 137 of Note Book ~~#463~~ #464

J.Y. 7/26/02.

J.Y. 7/25/02

Bottle #1 NaCl, ~~100g~~, 50g lot # 020814

7.95g DI. water.

JPL 7-26-02

Bottle #2 $MgCl_2 \cdot 6H_2O$, 50.05g, Lot#950024

Bottle #3 $FeCl_2 \cdot 4H_2O$, 50.06g, Lot#976620

JPL 7-26-02

8.136 g ~~DI~~ DI H_2O

7-26-02 JPL

Bottle #4 $FeCl_3 \cdot 6H_2O$, 50.40g, Lot# 005437

5.24g DI H_2O

Bottle #5 $NiCl_2 \cdot 6H_2O$, 50.63g, Lot# 961903,

6.24g DI

Bottle #6 $Ni(NO_3)_2 \cdot 6H_2O$, 50.12g, Lot# 015299

5.423g DI H_2O

Justin Sardy 7-26-02

Bottle #7 $Fe(NO_3)_3 \cdot 9H_2O$, 50.24g, Lot # 015321

3.049 g DI H_2O

Bottle #8 $CuCl_2 \cdot 2H_2O$, Lot # 897713, 50.074g

JPL 7-24-02

~~3.244 g DI H_2O~~ 6.781g DI H_2O

7-29-02

:00 Hg Thermometer SN: 183304 Cal: July 11, 2002

Due Cal: Jan 11, 2003

Hg Thermometer Placed in Oven

Hydrometer #1 is SN: 21330180 Cal: June 27, 2002

Cal Due: June 27, 2003

Hydrometer #1 placed in Bottle #1 NaCl

Hydrometer #2 is SN: 21334995 Cal June 27, 2002

Cal Due: June 27, 2002

Hydrometer #2 Placed in Bottle #2 $MgCl_2 \cdot 6H_2O$

9:30 Hg Thermometer: T = JPL 7-29-02 21.3°C

Hydrometer #1 in Bottle #1 NaCl RH = 92.87% T(m) = 20.94°C

Hydrometer #2 in Bottle #2 $MgCl_2 \cdot 6H_2O$ RH = 61.19-61.21% T(m) = 20.96°C

9:50 Hg Thermometer T = 21.5°C

Hydrometer #1 in Bottle #1 NaCl RH = 92.91-92.92% T(m) = 20.89°C

Hydrometer #2 in Bottle #2 $MgCl_2 \cdot 6H_2O$ RH = 59.80-59.70% T(m) = 20.90°C

Justin Sandy 7-29-02

9:55 Hydrometer #1 Placed in Bottle #2 $MgCl_2 \cdot 6H_2O$

Hydrometer #2 Placed in Bottle #1 NaCl

7-30-02

8:05 Hg Thermometer: T = 20.8°C

Hydrometer #1 in Bottle #2 $MgCl_2 \cdot 6H_2O$ RH(m) ~~44.98~~ JPL 7-30-02 45.09% T(m) = 19.99°C

Hydrometer #2 in Bottle #1 NaCl RH(m) = 95.00% T(m) = 20.02°C

Hydrometer #1 Placed in Bottle #3 $FeCl_2 \cdot 4H_2O$

Hydrometer #2 Placed in Bottle #4 $FeCl_3 \cdot 6H_2O$

9:47

Hydrometer #1 in Bottle ~~#2~~ 3 JPL 7-30-02 $FeCl_2 \cdot 4H_2O$ RH(m) = 60.89% T(m) = 20.12°C

Hydrometer #2 in Bottle #4 $FeCl_3 \cdot 6H_2O$ RH(m) = 67.25% T(m) = 20.14°C

Hydrometer #1 Placed in Bottle #5 $NiCl_2 \cdot 6H_2O$

Hydrometer #2 Placed in Bottle #6 $Ni(NO_3)_2 \cdot 6H_2O$

Hg thermometer T = 20.8°C

11:39

Hydrometer #1 in Bottle #5 $NiCl_2 \cdot 6H_2O$ RH(m) = 66.78% T(m) = 20.45°C

Hydrometer #2 in Bottle #6 $Ni(NO_3)_2 \cdot 6H_2O$ RH(m) = 71.70% T(m) = 20.46°C

Hydrometer #1 Placed in Bottle #7 $Fe(NO_3)_3 \cdot 9H_2O$

Hydrometer #2 Placed in Bottle #8 $CuCl_2 \cdot 2H_2O$

Hg thermometer T = 21.0°C

Justin Sandy 7-30-02

14:25

Hydrometer #1 in Bottle #7 $Fe(NO_3)_3 \cdot 9H_2O$ RH(m) = 70.82% T(m) = 21.17°C

Hydrometer #2 in Bottle #8 $CuCl_2 \cdot 2H_2O$ RH(m) = 85.45% T(m) = 21.19°C

Hg Thermometer T = 21.7°C

14:30

Temperature Raised to 35°C

Hydrometer #1 Placed in Bottle #1 NaCl

Hydrometer #2 JPL 7-30-02 Placed in Bottle #2 $MgCl_2 \cdot 6H_2O$

7-31-02

9:00

Hydrometer #1 in Bottle #1 NaCl RH(m) = 92.11% T(m) = 33.03°C

Hydrometer #2 in Bottle #2 $MgCl_2 \cdot 6H_2O$ RH(m) = 44.40% T(m) = 33.06°C

Hydrometer #1 Placed in Bottle #2 $MgCl_2 \cdot 6H_2O$

Hydrometer #2 Placed in Bottle #1 NaCl

Hg Thermometer T = JPL 7-31-02 34.1°C

8-1-02

8:17 Hg Thermometer T = 34.0°C

Hydrometer #1 in Bottle #2 $MgCl_2 \cdot 6H_2O$ RH(m) = 42.28% T(m) = 33.06°C

Hydrometer #2 in Bottle #1 NaCl RH(m) = 94.00% T(m) = 33.14°C

Hydrometer #1 Placed in Bottle #3 $FeCl_2 \cdot 4H_2O$

Hydrometer #2 Placed in Bottle #4 $FeCl_3 \cdot 6H_2O$

Justin Sandy 8-1-02

9:50 Hg Thermometer T = 34.0°C

Hydrometer #1 in Bottle #3 $FeCl_2 \cdot 4H_2O$ RH(m) = 62.35% T(m) = 33.03°C

Hydrometer #2 in Bottle #4 $FeCl_3 \cdot 6H_2O$ RH(m) = 58.55-58.53% T(m) = 33.05°C

Hydrometer #1 Placed in Bottle #5 $NiCl_2 \cdot 6H_2O$

Hydrometer #2 Placed in Bottle #6 $Ni(NO_3)_2 \cdot 6H_2O$

11:23

Hydrometer #1 in Bottle #5 $NiCl_2 \cdot 6H_2O$ RH(m) = 63.80% T(m) = 33.05°C

Hydrometer #2 in Bottle #6 $Ni(NO_3)_2 \cdot 6H_2O$ RH(m) = 61.82% T(m) = 33.14°C

Hydrometer #1 Placed in Bottle #7 $Fe(NO_3)_3 \cdot 9H_2O$

Hydrometer #2 Placed in Bottle #8 $CuCl_2 \cdot 2H_2O$

13:00

Hydrometer #1 in Bottle #7 $Fe(NO_3)_3 \cdot 9H_2O$ RH(m) = 92.74% T(m) = 33.04°C

Hydrometer #2 in Bottle #8 $CuCl_2 \cdot 2H_2O$ RH(m) = 83.43% T(m) = 33.12°C

Hg Thermometer T = 33.9°C

Temperature Raised to 45°C

Hydrometer #1 Placed in Bottle #1 NaCl

Hydrometer #2 Placed in Bottle #2 $MgCl_2 \cdot 6H_2O$

15:02

Hydrometer #1 in Bottle #1 NaCl RH(m) = JPL 8-1-02 ~~42.~~ 93.02% T(m) = 43.84°C

Hydrometer #2 in Bottle #2 $MgCl_2 \cdot 6H_2O$ RH(m) = 46.09-46.13 T(m) = 43.92°C

Hg Thermometer T = 43.9°C

Justin Sandy 8-1-02

Hydrometer #1 Placed in Bottle # 2 $MgCl_2 \cdot 6H_2O$
Hydrometer #2 Placed in Bottle # 1 NaCl

16:42
Hydrometer #1 in Bottle #2 $MgCl_2 \cdot 6H_2O$ RH(m) = 49.14% T(m) = 43.85°C
Hydrometer #2 in Bottle #1 NaCl RH(m) = 89.37% T(m) = 43.90°C
Hg Thermometer T = 44.0°C

8-2-02
8:30
Hydrometer #1 Placed in Bottle #3 $FeCl_2 \cdot 4H_2O$
Hydrometer #2 Placed in Bottle #4 $FeCl_3 \cdot 6H_2O$
Hg Thermometer T = 44°C

10:00
Hydrometer #1 in Bottle #3 $FeCl_2 \cdot 4H_2O$ RH(m) 59.93-59.95% T(m) = 43.91°C
Hydrometer #2 in Bottle #4 $FeCl_3 \cdot 6H_2O$ RH(m) = 43.85-43.89% T(m) = 43.97°C

Hydrometer #1 Placed in Bottle #5 $NiCl_2 \cdot 6H_2O$
Hydrometer #2 placed in Bottle #6 $Ni(NO_3)_2 \cdot 6H_2O$
Hg Thermometer T = 44.0°C

11:28
Hydrometer #1 in Bottle #5 $NiCl_2 \cdot 6H_2O$ RH(m) = 59.28-59.30% T(m) = 43.88°C
Hydrometer #2 in Bottle #6 $Ni(NO_3)_2 \cdot 6H_2O$ RH(m) = 42.55% T(m) = 43.92°C

Justin Sandy 8-2-01

Hydrometer #1 Placed in Bottle #7 $Fe(NO_3)_3 \cdot 9H_2O$
Hydrometer #2 Placed in Bottle #8 $CuCl_2 \cdot 2H_2O$
Hg Thermometer T = 44.0°C

13:00
Hydrometer #1 in Bottle #7 $Fe(NO_3)_3 \cdot 9H_2O$ RH(m) = 100.0% T(m) = 43.85°C
Hydrometer #2 in Bottle #8 $CuCl_2 \cdot 2H_2O$ RH(m) = 74.46% T(m) = 43.94°C

Temperature Raised to 55°C
Hydrometer #1 Placed in Beaker #1 NaCl
Hydrometer #2 Placed in Bottle # 2 $MgCl_2 \cdot 6H_2O$

14:30
JAL 8-2-02
Hg Thermometer T = ~~44°C~~ 54°C
Hydrometer #1 in Bottle #1 NaCl RH(m) = 100%
Hydrometer #1 will no longer be used due to two consecutive 100% Humidity Readings
Noticed #6 Bottle, Bottle #4, Bottle #7 are only one phase, liquid

4.15 g DI H_2O added to Bottle #1 NaCl

15:45
Hydrometer # 2 in Bottle #2 $MgCl_2 \cdot 6H_2O$ RH(m) = 37.38% T(m) = 52.84

Hydrometer # 2 Placed in Bottle #1 NaCl
Hg Thermometer T = 54.0°C

9/30/02

16:53

Hydrometer #2 in Bottle #1 RH(m) = 84.59% T(m) = 52.90°C

Hg Thermometer T = 54.0°C

8-5-02

35 Hydrometer #2 Placed in Bottle # 3 $FeCl_2 \cdot 4H_2O$

JPL 8-5-02
~~8~~

10:04

Hydrometer #2 in Bottle #3 $FeCl_2 \cdot 4H_2O$ T(m) = 52.92°C RH(m) = 64.27%

Hydrometer #2 Placed in Bottle #4 $FeCl_3 \cdot 6H_2O$

Hg Thermometer T = 54°C

11:30

Hydrometer #2 in Bottle #4 $FeCl_3 \cdot 6H_2O$ RH(m) = 53.70% T(m) = 52.96°C

Hydrometer #2 Placed in Bottle #5 $NiCl_2 \cdot 6H_2O$

Hg Thermometer T = 54°C

JPL 8-5-02
~~13:05~~ 13:05

Hydrometer #2 in Bottle #5 $NiCl_2 \cdot 6H_2O$ RH(m) = 62.36% T(m) = 52.85°C

Hydrometer #2 Placed in Bottle #6 $Ni(NO_3)_2 \cdot 6H_2O$

Hg Thermometer T = 54.1°C

9/30/02

8-6-02

8:25 Hydrometer #2 in Bottle #6 $Ni(NO_3)_2 \cdot 6H_2O$ RH(m) = 41.62% T(m) = 52.92°C

Hydrometer #2 Placed in Bottle #7 $Fe(NO_3)_3 \cdot 9H_2O$

Hg Thermometer T = JPL 8-6-02 ~~4~~ 54°C

10:26

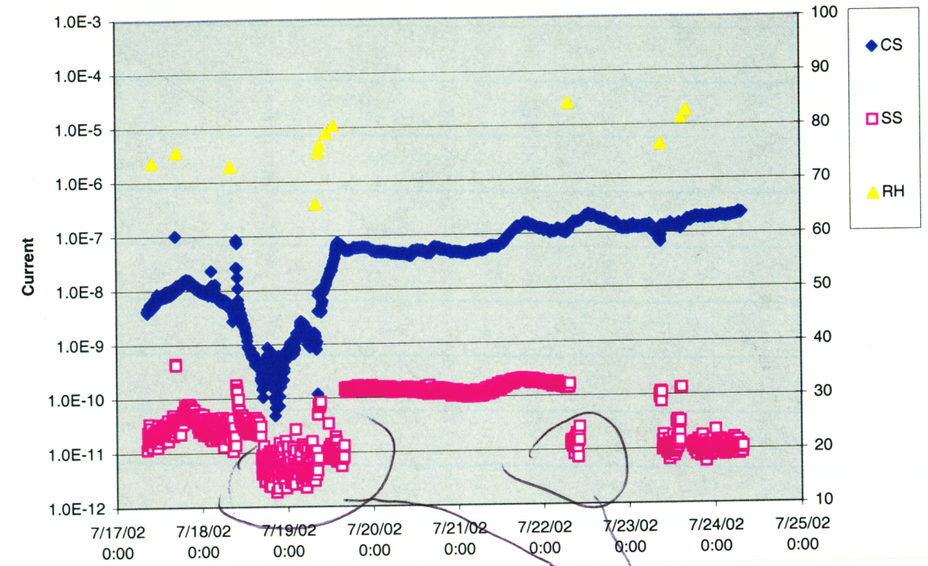
Hydrometer #2 in Bottle #7 $Fe(NO_3)_3 \cdot 9H_2O$ RH(m) = 100.00%

Test stopped because of the 100% Humidity reading.

9/30/02

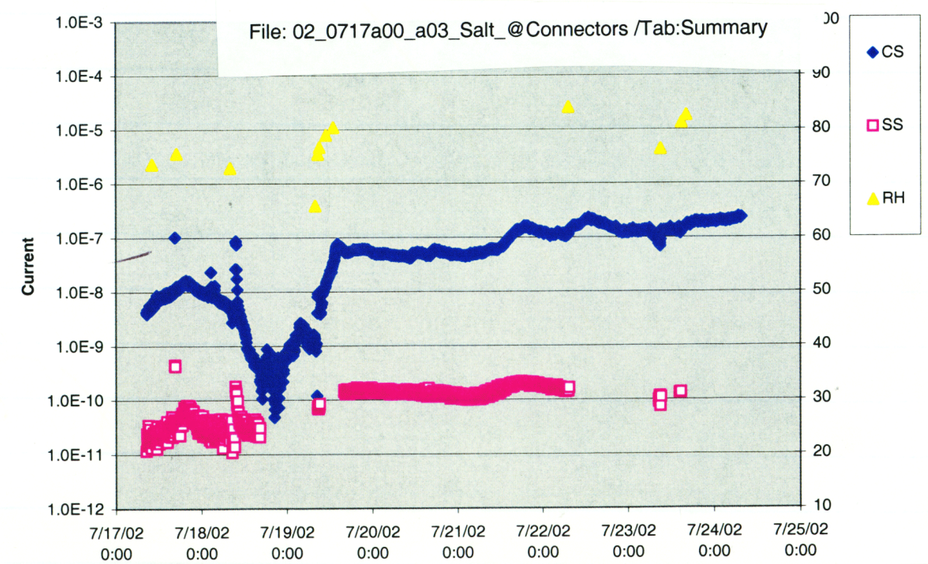
	STD CS	STD SS	RH(M) RH
7/17/2002 8:36	4.29045E-09	1.17845E-11	0
7/17/2002 8:43	3.99669E-09	2.45053E-11	
7/17/2002 8:48	4.46555E-09	1.60433E-11	
7/17/2002 8:54	4.82245E-09	1.92514E-11	0

File: 02_0717a00_a03_Salt /Tab:Summary



Due to the use of only one connector. see below.

	STD CS	STD SS	RH(M) RH
7/17/2002 8:36	4.29045E-09	1.17845E-11	0
7/17/2002 8:43	3.99669E-09	2.45053E-11	0
7/17/2002 8:48	4.46555E-09	1.60433E-11	0
7/17/2002 8:54	4.82245E-09	1.92514E-11	0

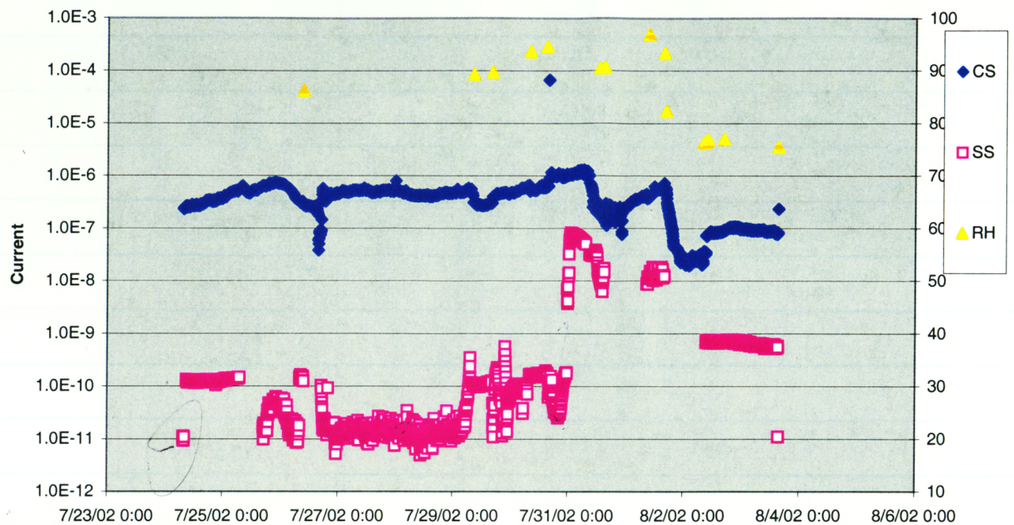


9/30/02

File: 02_0717a04-02_0801a01_Salt_2Connectors / Tab: Summary

	STD CS	STD SS	RH(M) RH	
7/24/2002 7:45	2.34E-07	1.06E-11		0
7/24/2002 7:50	2.32E-07	9.46E-12		0

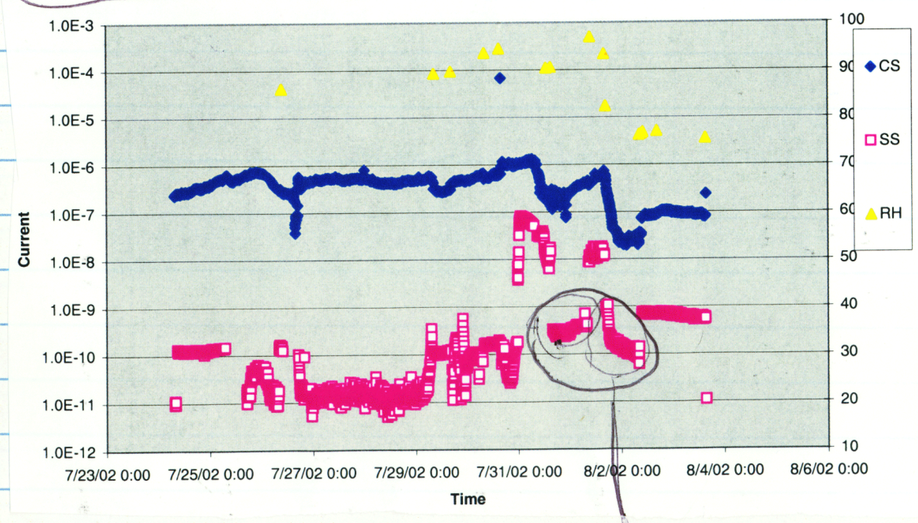
example content in file. J.y. 10/7/02



example content in file. J.y. 10/7/02

	STD CS	STD SS	RH(M) RH	
7/24/2002 7:45	2.34E-07	1.06E-11		0
7/24/2002 7:50	2.32E-07	9.46E-12		0
7/24/2002 7:55	2.39E-07	1.14E-11		0

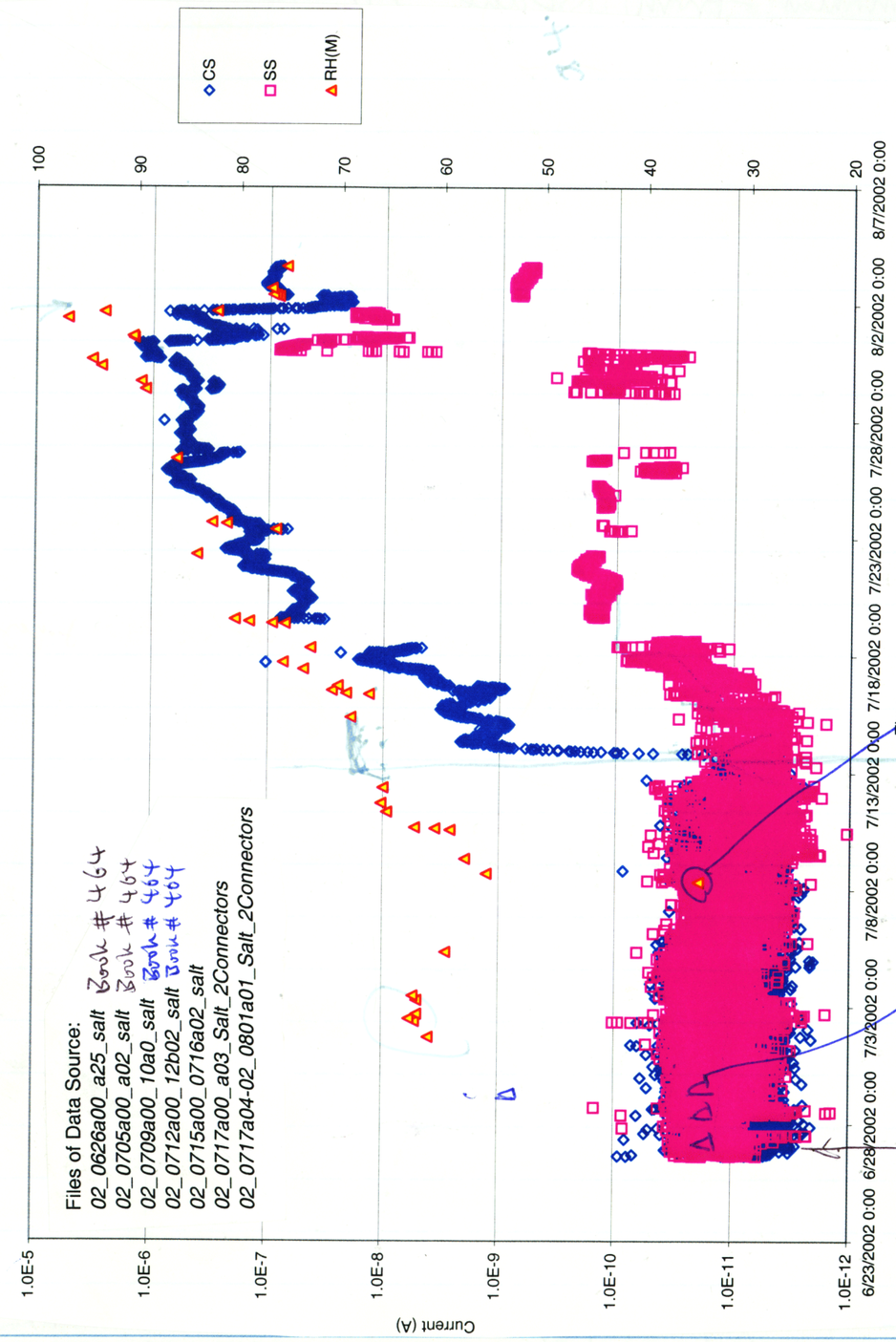
File: 02_0717a04-02_0801a01_Salt /Tab:Summary



J.y. 9/30/02

Due to the use of only one connector.

File: 02_0626a00_020801a01_Salt_Summary / Tab: Chart1



Few RH Data which here

Water was gone in the Pers Tank.

9/27/02 2:12

J.y. 9/30/02

9/16 continued from page 20.

8:40 T_d/T_w = 51/37–38°C, RH(m) = 47.1 – 47.24 %

Z_{II} = 3E6 Ω. T(m) = 48.93 °C

II-2, II-3, II-5 back to chamber.

9:22 (II-2 + II-3) : -3.5 – -3.8 μV

(II-4 + II-5) : -24 – +12 μV.

II-2 II-3, II-5 back to MIC Test

13:40 Set Cooling system T = 30°C from 26°C.

14:59 program restarted. 02-0916a

9/17

9:16 ~~II-2, II-3, II-5 to chamber~~

T_d/T_w = 50/39°C, RH(m) = 52.12 %

Z_{II} = 3.9 E6.

14:53 (II-2 + II-3) : -6.3 – -2.7

(II-4 + II-5) -274 – 225 μV

T_d/T_w = 51/39°C RH(m) = 53.13

Set (T_d/T_w) = 51.8/40°C.

II-2, II-3, II-5 removed for MIC test

16:47 Set (T_d/T_w) = 51.8/42°C

17:00 T_d/T_w = 39. shut down chiller.

T_d/T_w = 50/47 too high, RH(m) 69 %

17:09 Start chiller, set chiller T = 33°C.

17:10 Z_{II} = 3151 Ω, II-4: -2762 – +1653 RH(m) = 72 %

9/30/02

17:24. T_d/T_w = 51/42, RH(m) = 65.7 %.

Z_{II} = 177650 Ω. increased!

9/18/02 T_d/T_w = 51/40 – 51/41 II-4: -1492 – +1405 μV

8:11 Z_{II} = 1.3 E6. RH(m) = 61.5 %,

to cell I.

8:19. II-2, II-3, II-4 back to chamber test

Z_I = 367 Ω., back to Z of cell II.

8:57 RH(m) = 62.1 % T_d/T_w = 51/41

Set Chiller Temp to Maximum. (from 32°C).

10:56 No change in T_d/T_w. RH(m) = 62.7 %.

Set (T_d/T_w) = 51/44°C

11:06 Set Flow of chiller to 3/8 open, to 1/2 again.

II-2, II-3, II-5 back to MIC test.

11:29. T_d/T_w = 51/43°C, RH(m) = 68.02 %, Z_{II} = 514081

12:30 T_d/T_w = 51/43°C, RH(m) = 70.30 %, Z_{II} = 421618

16:14 T_d/T_w = 51/43°C RH(m) = 72.3 %, Z_{II}

Z_{II} = 392751 Ω II-4 = -2762 – +1656 μV

9/19/02 T_d/T_w = 51/43 % (m) RH = 75.09 %

Time 9:05 II-4 = -3075.931 – +1182.255

Data 677

12:47 Z_{II} = 259390 Ω., RH(m) = 76.2 9/30/02

12:49 chiller water valve to $\frac{3}{8}$ open (from $\frac{1}{2}$ open).

17:07 $Z_{II} = 171020\ \Omega$.
$T_d/T_w = 51/44$ RH(m) = 79.22 → 79.60 %

20/09/02 (9/20/02).
8:23 $Z_{II} = 67080$, $T_d/T_w = 49/44$ → 50 = 51/44, RH(m) = 81.90 %
II-4 = −15407 ~ +16860 μV; T(M) = 48.73 %
II-2, II-3, II-5 to chamber.

9:51. Set chiller cooling water to $\frac{1}{2}$ flow.
Set $(T_d/T_w) = 51.8/45$ from 51.8/44.

11:21 $T_d/T_w = 51/45$ RH(m) = 86.98 % $Z_{II} = 6500\ \Omega$.
(II-4 + II-5) = −33713 ~ +22349 μV.
~~II-2, II-3, II-5 to Water.~~ J.Y. 9/20/02.

14:35 $Z_{II} = 1118\ \Omega$; $T_d/T_w = 51/46$°; RH(m) = 90.48 %.
(II-4 + II-5) = −33889 ~ +26771 μV
Set $(T_d/T_w) = 51.8/44$°.

17:00 $T_d/T_w = 51/45$ RH(m) = 88.49 %, $Z_{II} = 1105\ \Omega$
Set $(T_d/T_w) = 51.8/42$°
J.Y. 9/20/02

9/23/02 $T_d/T_w = 51/36$ RH(m): 43.10 %

(II-2 + II-3) = −5.228 ~ +4.662 μV
(II-4 + II-5) = −26.791 ~ +38.148 μV

Time: 7:58
Data: 1391 J.Y.

8:57 $T_d/T_w = 51/36$ ~ 37°. RH(m) = 49.27 %, T(m) = 47.59°.
$Z_{II} = 466$, Z_I, (II-4 + II-5) = −38 ~ +29 μV
to I. Water in chamber Res. is gone.
8:59 $Z_I = 859\ \Omega$. Water added to the Tank.

9:47 to II. $T_d/T_w = 51/43$° RH(m) = 63.91 %, T(m) 49.7°
(II-4 + II-5) = −11522 ~ +11668 μV
$Z_{II} = 496274\ \Omega$
$Z_{II} = 64600\ \Omega$. $T_d/T_w = 51/43$°, RH(m) = 70.43 %.

15:09. $T_d/T_w = 51/43$°. $Z_{II} = 332938$ RH(m) = 72.64 %
System opened and Z_{II} taken out.
J.Y. 9/30/02

Cell II ~~replaced~~ replaced with KCl corrosion product
produced using the set up in Page 193, Book 464
see also page 194, Book 464. J.Y. 9/30/02

15:20 Set $(T_d/T_w) = 51.8/38.5°C$, chiller T = 26°C
Fully open.
See page 20.

17:21. $Z_{II} = 2266\,\Omega$ $T_d = 51/41$ $RH^{(m)} = 65.0\%$
already started to gump!

9/24/02 $Z_{II} = 6E6$. $T_d/T_w = 51/37 \sim 38°C$, $RH^{(m)} = 49.54\%$, $T(m) = 48.85$
9:28
$(II\text{-}4 + II\text{-}5) = -87 \sim +50\,\mu V$

To cell I., $Z_I = 929\,\Omega$.
set chiller to Max Temp and fully open
set $(T_d/T_w) = 51.8/44°C$

9:36 To cell II
10:28 $T_d/T_w = 51/40°C$ $RH(m) = 59.66\%$, $Z_{II} = 6.9E6$
$(II\text{-}4 + II\text{-}5) = -815 \sim +776\,\mu V$.

13:30 $T_d/T_w = 51/41$ $RH(m) = 61.42$ $Z_{II} = 6.8E6$
R: $(II\text{-}4 + II\text{-}5) = -463$
$= -763 \sim +640\,\mu V$

set $T_d/T_w = 51.8/44.2$, (same), chiller Flow to 50% open of 1 turn.

14:50 $T_d/T_w = 51/43$ $RH(m) = 69.86\%$ $Z_{II} = 1.6E6$

17:13 $RH(m) = 72.62\%$, $Z_{II} = 1.6E6\,\Omega$

9/25/02 $T_d/T_w = 51/43$ $RH(m) = 72.3\%$
8:51
9/30/02

8:55. Chamber opened. $Dp(NaNO_3, 48°C) = 69.5°C$.
change cell one to $NaNO_3$ salt
lot 961772A. Fisher, for calibration of Hygrometer.
9:01 to cell I, chamber closed and
heating started.
9:03 To cell II.

10:15 $T_d/T_w = 51/43$, $RH(m) = 75.21\%$
$Z_{II} = 5E6\,\Omega$, $(II\text{-}4 + II\text{-}5) = -8969 \sim +9120\,\mu V$.
To cell I, $Z_I = 486\,\Omega$.

Set chiller flow to fully open (7 turns)

11:20 $T_d/T_w = 51/41$, $RH(m) = 67.16\%$. $Z_I = 5824\,\Omega$.

16:20 $T_d/T_w = 51/40$ $RH(m) = 64.5\%$. $Z_I = 5\times10^5\,\Omega$.
set chiller to 1.5 turn.
16:30 $T_d/T_w = 51/42$, set chiller to 2.5 turn. $RH(m) = 68.53\%$.

$T_d/T_w = 51/43$ set chiller to 3.0 turn. $RH(m) = 68.7\%$.
9/26/02 II-2, II-3, II-5 to Mic test.
8:41 $T_d/T_w = 51/43$, Z_{II} $RH(m) = 75.1$
$Z_I = 11236\,\Omega$ decreasing $T(m) = 49°C$

10:43, II-2, II-3, II-5 to chamber.
14:47 $T_d/T_w = 51/43 \sim 44$, $Z_I = 3558\,\Omega$. $RH(m) = 77.38\%$ J.Yo. 9/30/02
to II, $Z_{II} = 6.5E6.1$
set chiller to 5 turn open!, New File: 0926a.

16:14. Td/Tw = 50/43 ; RH(m) = 76.02 ., To cell I.

17:49 RH(m) = 77 %.

Set chiller to 30°C from Tmax.

16:51 Set chiller to 29°C.

17:36 Td/Tw = 50/43 RH(m) = 73.2%. started to go up

9/27/02.

8:36 Td/Tw = 50/40.4 RH(m) = 64.26% T(m) = 48.9°C.

Z_I = 1127.50 Ω. ∴ Dp = ~~64.26 ~ 73.2%~~ ≈ 77 ~ 73.2 ! J.Y. 11/19/02

Channel 73 – 80 not logged (II-4 !), configure file wrong.

program stopped.

8:46 program restarted. 02_0927a.

(II-4 + II-5) = −791 ~ +709 μV.

To 32°C (Set chiller to 32°C from 29°C)

14:32 Td/Tw = 50/40 RH(m) = 61.63 % ! still too low.

Set Chiller to max Temp. from 32°C.

18:14. Td/Tw = 50/41, RH(m) = 64.44%, Z_I = 365.

J.Y.
9/30/02

9/30/02.

8:52. Td/Tw = 51/36 ; T(m) = 49.03 ; RH(m) = 46.95%.

Z_{II} Z_I = 5.575 Ω to cell II.

J.Y. 9/30/02

Z_{II} = 666.

water in tank gone.

8:53. water added!

8:59 to cell I.

17:47 Z_I = 665 Ω . RH = 64.2% Td/Tw = 51/41°C.

10/2/02.

8:30 Z_I = 665 Ω, RH(m) = 65.2% , Td/Tw = 51/41

Set (Td/Tw = 51.8/47°C) from 51.8/44°C.

11:30 Td/Tw = 51/41, RH(m) = 65.7% No change!

set chiller flow to 4 full turn.

from 8 full turn.

11:37 adding water to tank, caused RH ↑

11:42 Td/Tw = 50/48 RH(m) = 79.81. Z_I = 3104 Ω!

11:45 to cell II. RH(m) = 83 % Z_{II} = 266 Ω.

11:50. Td/Tw = 50/43, RH(m) = 74.18%. Came back.

to cell I.

13:17 Td/Tw = 51/42, RH(m) = 77.44%. Z_I = 5731 Ω rising.

J.Y. 9/30/02

Pages 1 – 48 copied for QA Records

J. Yang 10/3/02

J. Yang 10/4/02

10/4/02

8:12 Td/Tw = 51/42°, RH(m) = 64.51 %, $Z_I = 10^{+5}$ Ω

Set Chiller to 3 turn Flow.

11:22 Td/Tw = 51/43° RH(m) = 71.86 %, Z_I = 7.5E4 Ω

14:00 Td/Tw = 51/43° RH(m) = 71.94 %, Z_I = 6.0E4 Ω

Set Chiller to 2 turns Flow.

10/07/02

8:40 Td/Tw = 51/37°, RH(m) = 44.46

Water Tank is dry.

9:45. Water Tank refilled.

10/08/02 Td/Tw = 51/42°. RH(m) = 72.52, Z_I = 7.5E4 Ω.

10:50 T(m) = 48.02

Set Chiller Flow to 1 turn. from 2 turns

10/8/02

13:23 Td/Tw = 51/42° RH(m) = 76.5 % Z_I = 6.2E4 Ω

16:00 Td/Tw = 51/42° RH(m) = 68.84 % Z_I = 6.E4 Ω.

New Battery.

Set (Td/Tw) = 51.8/42°, from 51.8/41°

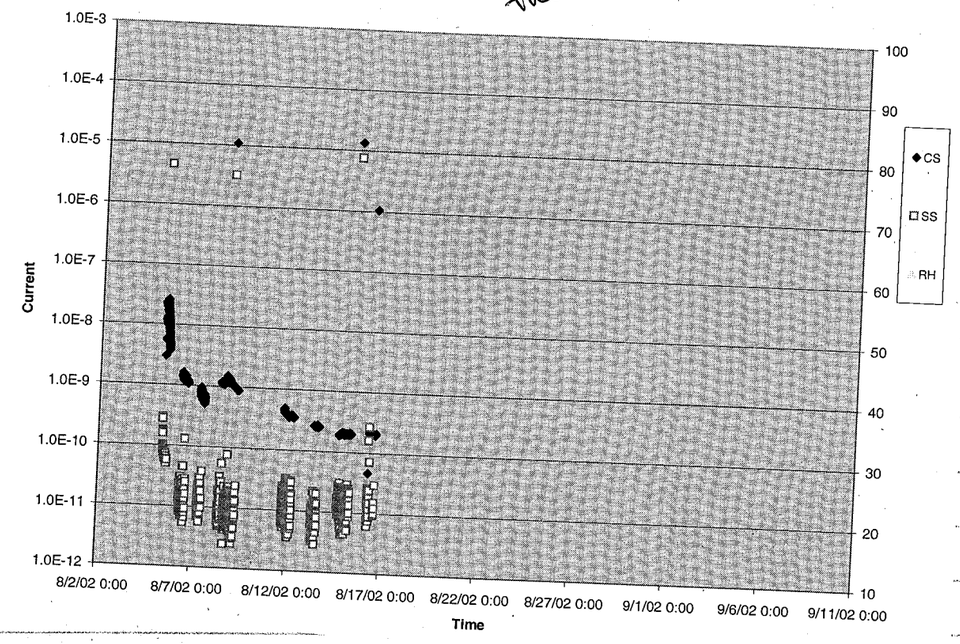
16:20 Td/Tw = 51/43°, RH(m) = 79.8 %, Z_I = 5.2E4 Ω.

Continued at page 57

J. Yang 10/8/02

File: 02_0803a00-02_0902a00_Salt /Tab:Summary

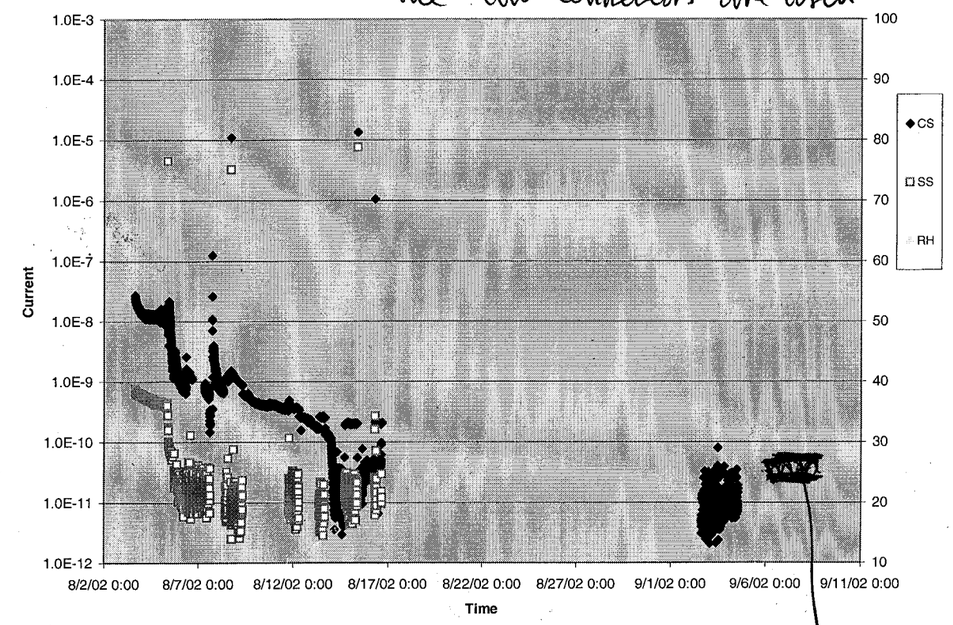
Signals used only when there are two connectors.



L. Yang
10/8/02

File: 02_0803a00-02_0902a00_Salt_2Connectors /Tab:Summary

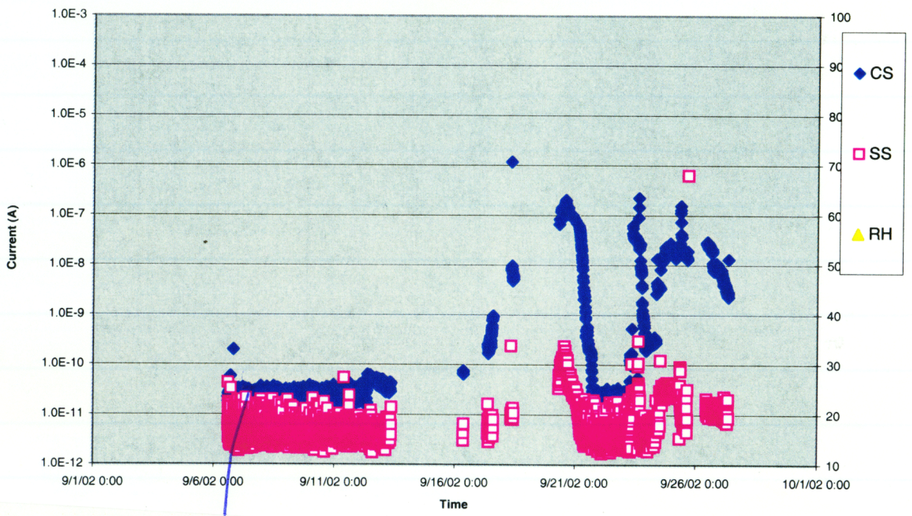
Signals used when one of the two connectors are used.



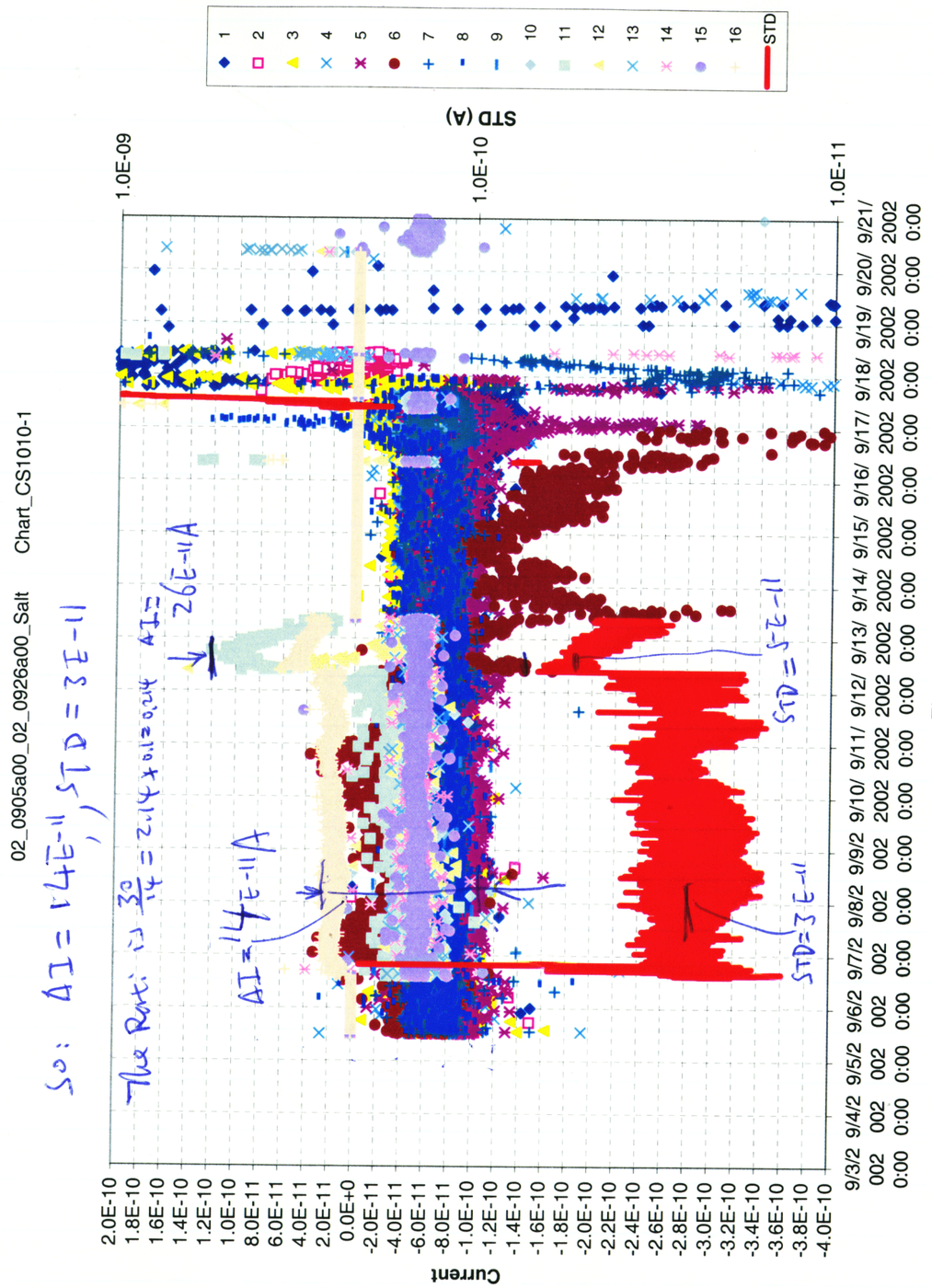
Two connectors are used.

L. Yang
10/8/02

File: 02_0905a00_02_0926a00_Salt



10/8/02



So: $\Delta I = 1.4E-11$, $STD = 3E-11$

The Ratio is $\frac{30}{1.4} = 21.4 \approx 20$ $\Delta I = 26E-11A$

$\Delta I = 14E-11A$

$STD = 5E-11$

$STD = 3E-11$

10/8/02

J.Y.
10/8/02

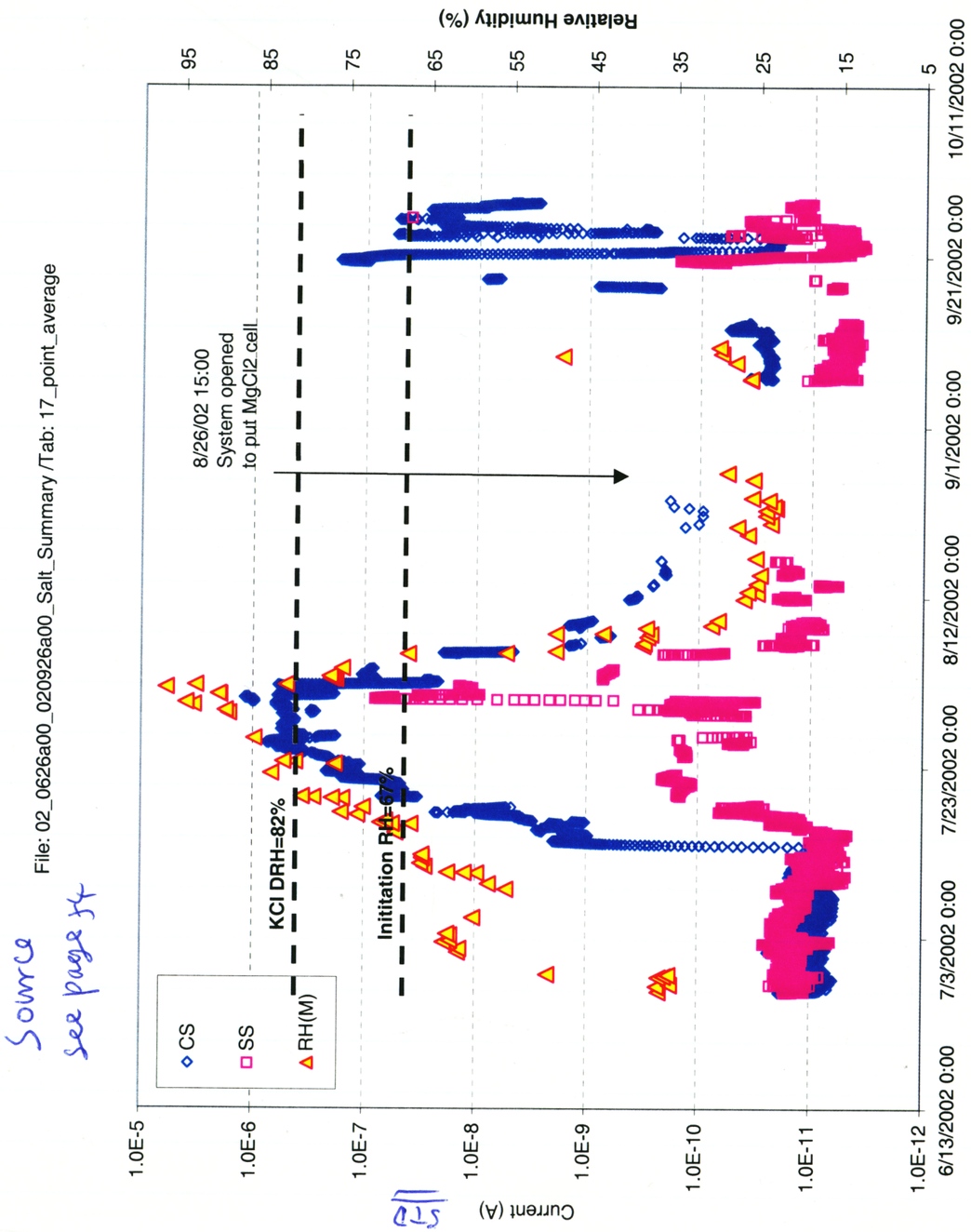
File: 02_0626a00_020926a00_Salt_Summary / Tab: Data

Files of Data Source:
02_0626a00_a25_salt
02_0705a00_a02_salt
02_0709a00_10a0_salt
02_0712a00_12b02_salt
02_0715a00_0716a02_salt
02_0717a00_a03_Salt_2Connectors
02_0717a04-02_0801a01_Salt_2Connectors
02_0803a00-02_0902a00_Salt
02_0905a00_02_0926a00_Salt

The following STD are extimated, see Notebook entries for the date

8/20/2002 8:48	1.33E-10
8/20/2002 17:24	1.01E-10
8/21/2002 16:46	9.30E-11
8/22/2002 7:18	9.30E-11
8/22/2002 13:45	1.24E-10
8/22/2002 18:14	1.69E-10
8/23/2002 12:00	1.83E-10

J. Y. 10/8/02



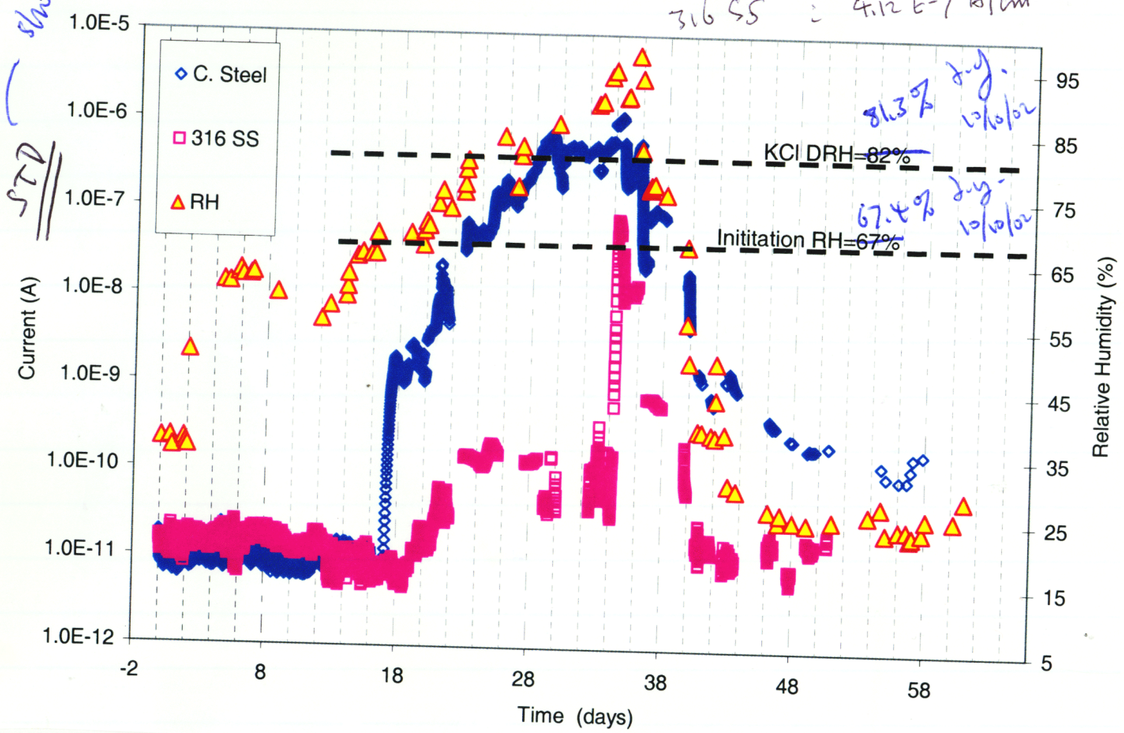
Source
see page 54

J. Y. 10/8/02

(should use 3x STD) J.y. 10/10/02

File: 02_0626a00_020926a00_Salt_Summary / Tab: Chart_#1

Average current density over 40 days (0 to 40 days)
C. steel: 5.10 E-7 A/cm²
316 SS : 4.12 E-7 A/cm²



File: 02_0626a00_020926a00_Salt_Summary / Tab: Data

Files of Data Source:
02_0626a00_a25_salt
02_0705a00_a02_salt
02_0709a00_10a0_salt
02_0712a00_12b02_salt
02_0715a00_0716a02_salt
02_0717a00_a03_Salt_2Connectors
02_0717a04-02_0801a01_Salt_2Connectors
02_0803a00-02_0902a00_Salt
02_0905a00_02_0926a00_Salt

The following STD are extimated, see Notebook entries for the date

8/20/2002 8:48	1.33E-10
8/20/2002 17:24	1.01E-10
8/21/2002 16:46	9.30E-11
8/22/2002 7:18	9.30E-11
8/22/2002 13:45	1.24E-10
8/22/2002 18:14	1.69E-10
8/23/2002 12:00	1.83E-10

J. yar 10/8/02

Continued from page 49.

10/08/02

4:52 T_d/T_w = 51/43, RH(m) = 70.5%. Z_I = 4.9E4 Ω

17:27 T_d/T_w = 51/43, RH(m) = 71.09% Z_I = 4.6E4 Ω.

10/09/02

8:58 T_d/T_w = 51/43, RH(m) = 70.9% Z_I = 1.2E4 Ω.

Set (T_d/T_w) = 51.8/42.5°C.

11:34 T_d/T_w = 51/43 RH(m) = 72.81% Z_I = 1E4 Ω.

16:30 T_d/T_w = 51/43 → 50/43, RH(m) = 73.2% Z_I = 3E4 Ω.

Set (T_d/T_w) = 51.8/43°C.

17:30 Set (T_d/T_w) = 51.8/43.5°C. J.y. 10/10/02

10/10/02

9:26 T_d/T_w = 50/43°C RH(m) = ~~74.33~~ 73.82% Z_I = 2.4E4 Ω

to cell II. Z_{II} = 2E6 Ω.

9:34 Back to cell I.

Set T_d/T_w = 51.8/46°C.

10:01 T_d/T_w = 51/43, RH(m) = 75.23%

11:32 T_d/T_w = 50/43, RH(m) = 75.28%, Z_I = 2.5E4 Ω

Set (T_d/T_w) = 51.8/44.5, and Flow of chiller to ½ turn open.

13:30 T_d/T_w = 50/43 RH(m) = 77.78°C, Z_I = 4.4E3 Ω

16:24 T_d/T_w = 51/44 RH(m) = 78.73°C, Z_I = 1.5E3 Ω

~~Continued on page 65~~

J.y. 10/10/02

J. yar 10/10/02

10/11/02
8:14 Td/Tw = 51/43°C ~ 51/44 RH(m) = 77.00% Z_I = 3000 Ω

To cell II.

Z_{II} = 3.5E6 Ω. still high.

8:20 set (Td/Tw) = 51.8/41, Chiller Flow to 25% open.

To cell I

8:23 Td/Tw = 51/44 ~ 50/44°C RH(m) = 78.40%

8:27 Td/Tw = 50/44°C RH(m) = 79.36% Z_I = 2418 Ω (1K)

9:32 Td/Tw = 51/44 RH(m) = 80.77%, Z_I = 413 Ω

12:09 Td/Tw = 51/44°C, 81.72%, Z_I = 453 Ω.

13:37 Td/Tw = 51/45°C RH(m) = 82.44% Z_I = 473 Ω.

to cell II. Z_{II} = 2.6 E6 Ω.

14:31 Td/Tw = 51/45 RH(m) = 82.44%

set (Td/Tw) = 51/48°C.

15:46 Td/Tw = 50/44 ~ 45°C, RH(m) = 82.99%.

10/13/02 18:06 Td/Tw = 51/47°C RH(m) = 96.94% Z_{II} = 2.2E4 Ω.

to cell I. Z_I = 380

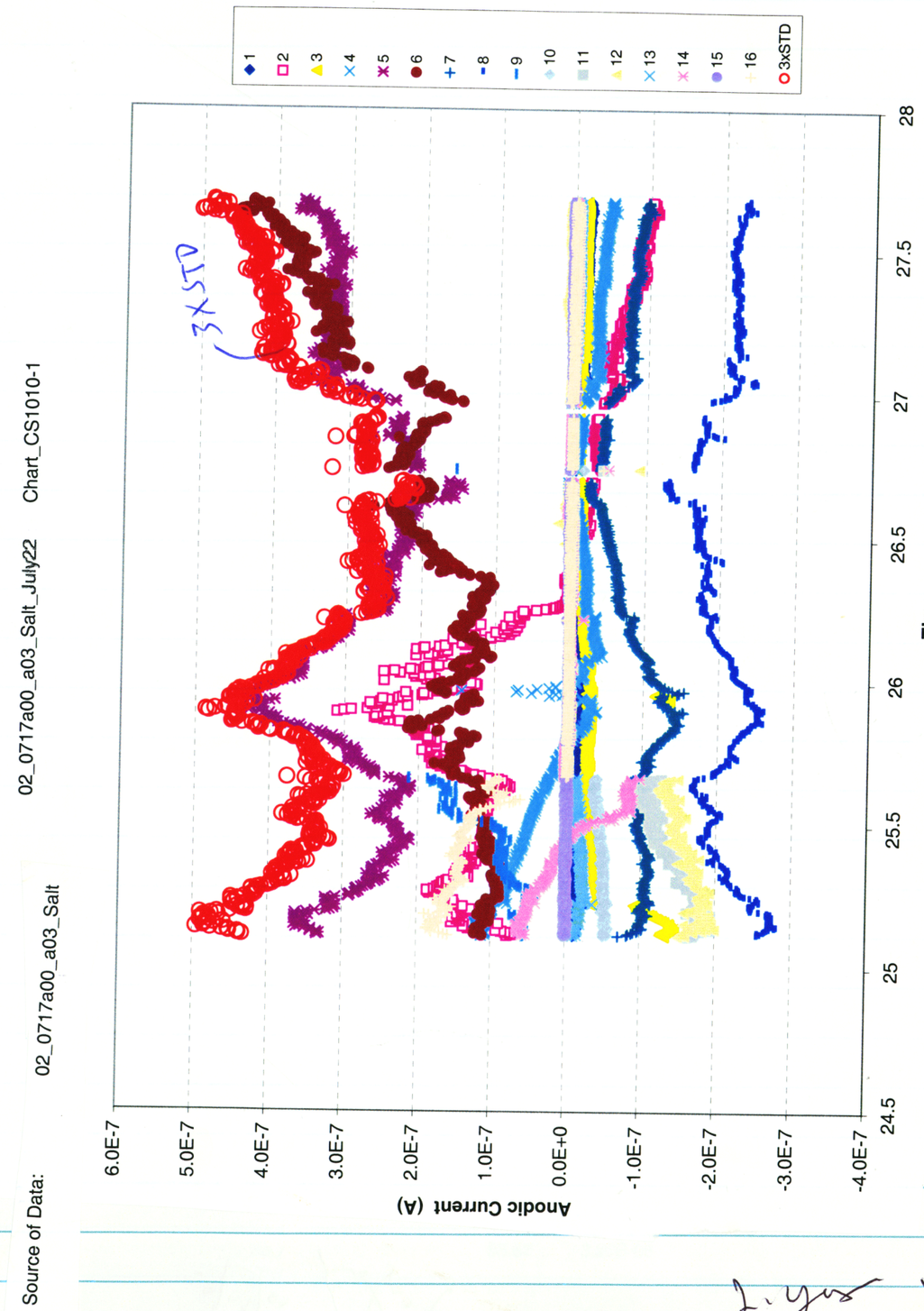
set (Td/Tw) = 51.8/50°C.

10/14/02

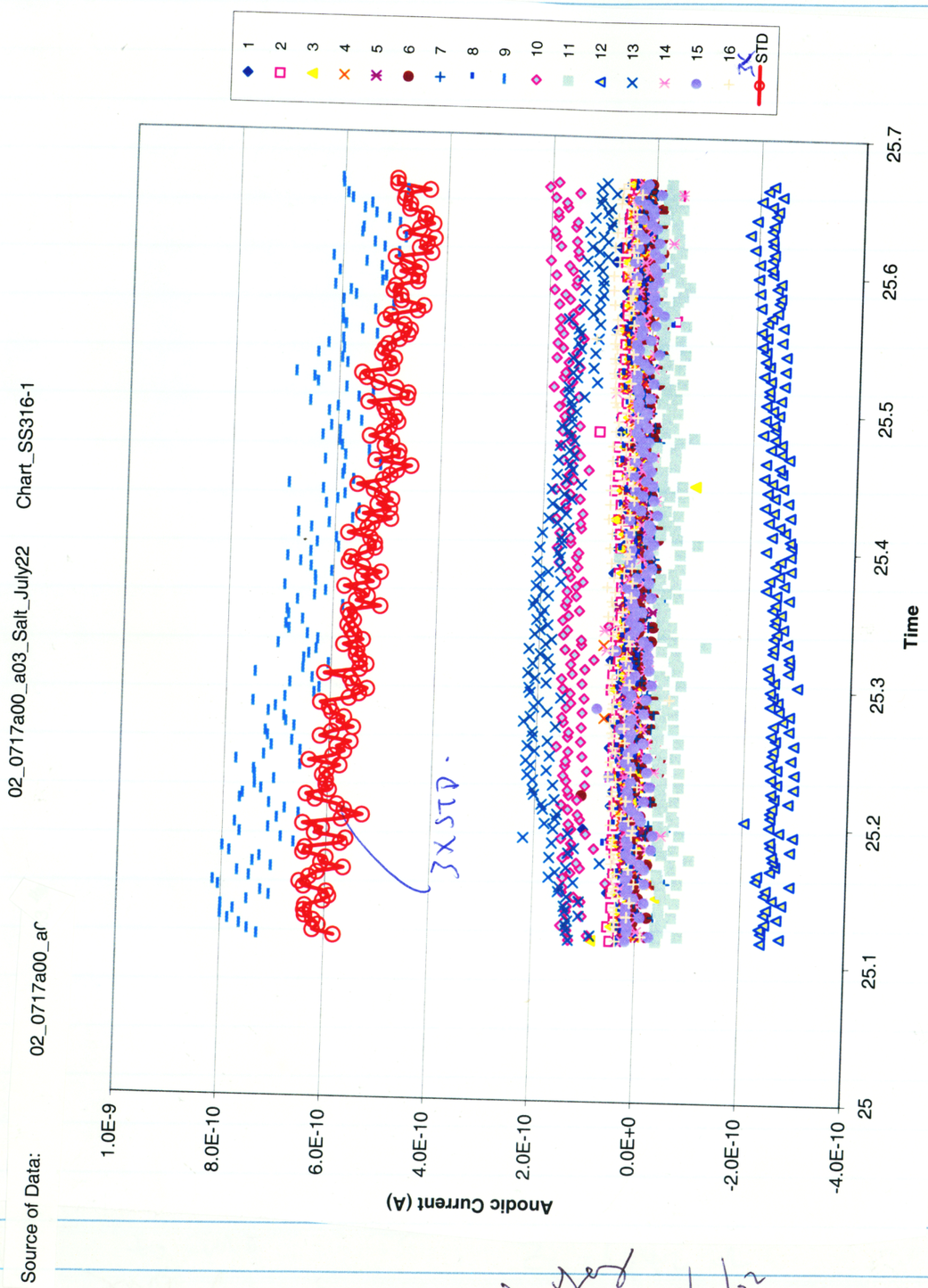
10:20 Td/Tw = 51.8/47, RH(m) = 97.48 ~~Z_{II} = 97.~~ J.Y. 10/14/02

to cell II Z_{II} = 6942 Ω. J.Y. 10/21/02

set chiller flow to 1/8 open.



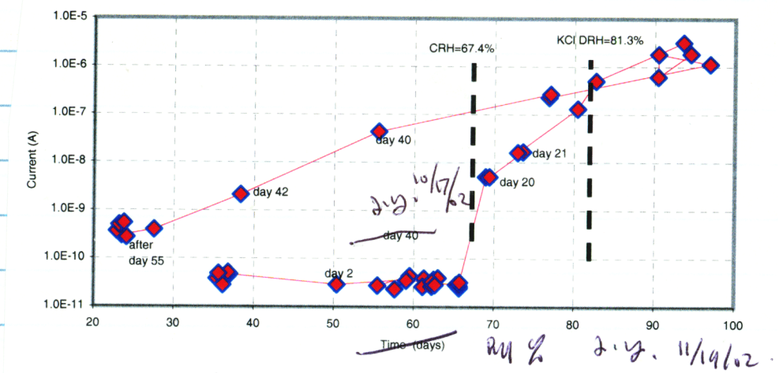
J. Yus 10/10/02



J. Yang 10/10/02

File: 02_0626a00_020926a00_Salt_Summary_RH / Tab: Data

File: 02_0626a00_020926a00_Salt_Summary_RH
Data From: *02_0626a00_a25_salt*

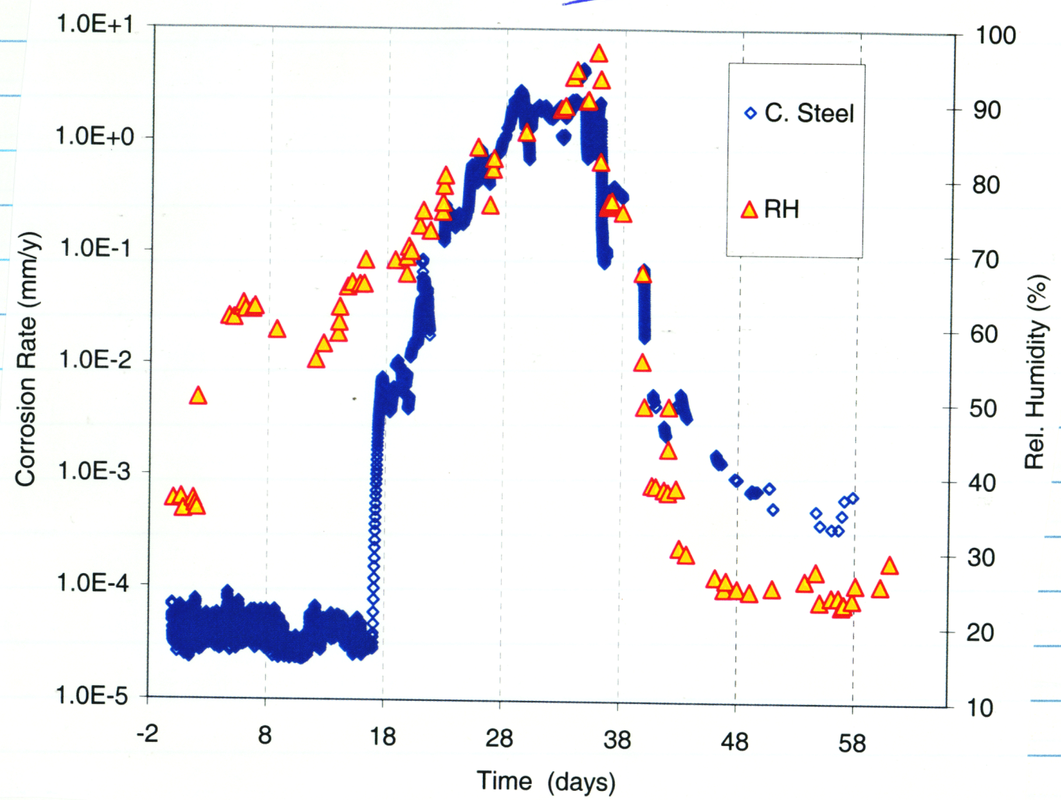


Days	RH	17-point average of 3xSTD C. Steel	316 SS
0			
0.05625	36.78	4.29334E-11	4.36556E-11
0.719444444	37	4.76965E-11	3.32183E-11
0.888194444	35.4	3.89635E-11	3.32183E-11
1.750694444	36.8	5.19723E-11	5.78571E-11
1.902777778	36.14	2.87272E-11	2.77764E-11
2.053472222	35.6	4.97384E-11	5.09458E-11
2.094444444	50.4	2.94086E-11	4.93123E-11
4.668055556	61.31	4.01195E-11	4.36E-11
5.082638889	61.16	2.66805E-11	4.19732E-11
5.752083333	62.52	3.73515E-11	
5.863888889	63.06	4.03364E-11	4.71535E-11
6.063194444	62.29	2.69247E-11	2.77512E-11
6.661805556	62.29	3.38431E-11	5.11193E-11
6.847222222	62.67	2.89567E-11	5.02685E-11
8.713194444	59.5	4.44323E-11	
12.05922454	55.49	2.79284E-11	
12.69487269	57.63	2.3794E-11	3.80943E-11
13.93086806	59.09	3.57509E-11	2.21991E-11
14.69549769	65.34	2.95966E-11	2.25515E-11
15.72641204	65.71	2.51681E-11	3.37585E-11
15.73503472	65.71	2.72587E-11	3.36624E-11
16.09824074	65.75	3.28288E-11	2.42577E-11
	68.94	5.05882E-09	6.98E-11
19.75087963	69.39	5.05882E-09	6.98E-11
20.78631944	73.62	1.69139E-08	7.01E-11
21.0709838	75.63		1.01053E-10
21.69677083	72.95	1.63245E-08	8.71566E-11
22.90643519	80.39	1.3268E-07	4.95083E-10
27.03844907	82.67	5.05172E-07	4.95083E-10
33.7	93.62	3.25E-06	

J. Yang 10/10/02

File: 02_0626a00_020926a00_Salt_Summary / Tab: Chart_Rate_CS

Source: Same as Page 56.



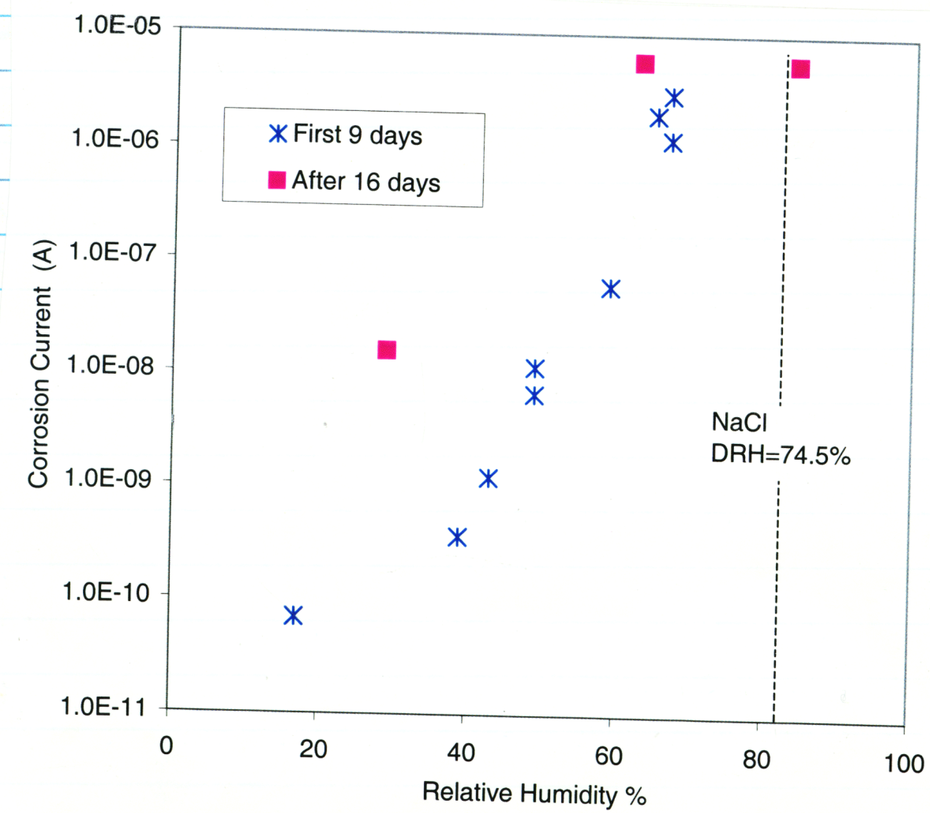
J. Yost 10/10/02

RH_Humidity_Plot_Humidity_Sensor_Test_CS

Data Source: 0820_1314_0910_1310_Sensor_extracted_CS_SS
See Notebook # 464, page 167

RH		Standard Deviation	
	Days after exposure	First 9 days	After 16 days
67	1	4.00E-07	
59	2	2.00E-08	
49	3	2.20E-09	
17	5	2.30E-11	
39	5	1.20E-10	
43	6	4.00E-10	
49	7	3.80E-09	
65	8	6.60E-07	
67	9	1.00E-06	
84	16		1.90E-06
63	18		1.95E-06
29	20		5.19E-09

3 Times Standard Deviation		
First 9 days	After 16 days	Imped
1.20E-06		
6.00E-08		
6.60E-09		
6.90E-11		
3.60E-10		
1.20E-09		
1.14E-08		
1.98E-06		
3.00E-06		
	5.70E-06	
	5.85E-06	
	1.56E-08	



J. Yost 10/10/02

11:11 T/d $Z_I = 922\,\Omega$

$T_d/T_w = 51.0/50°C$ RH(m) = 100%

14:38 $T_d/T_w = 50/48°C$ RH(m) = 100% $Z_I = 900\,\Omega$

Set chiller Flow to $\frac{5}{16}$ open.

15:53 $T_d/T_w = 51/47$ RH(m) = 100%, $Z_I = 214\,\Omega$, T(m) = 49.8°C

16:41 $T_d/T_w = 51/46°C$, RH(m) = 99.47%, $Z_I = 386\,\Omega$, T(m) = 49.4°C

10/15/02

8:44 $T_d/T_w = 51/46°C$ RH(m) = 100.0% ~ 99.8% $Z_I = 104\,\Omega$ T(m) = 49.4°

Set $(T_d/T_w) = 51.8/46°C$

10:57 $T_d/T_w = 51/47°C$ RH(m) = 97.28% $Z_I = 200\,\Omega$,

14:33 $T_d/T_w = 51/47°C$ RH(m) = 95.58% $Z_I = 10^{2.2}\,\Omega$

16:

17:12 $T_d/T_w = 51/46°C$, RH(m) = 95.22%, $Z_I = 10^4\,\Omega$

10/16/02

9:27 $T_d/T_w = 51/47°C$ RH(m) = 100% $Z_I = 5.5E4\,\Omega$.

Why. dropping.

Set (T_d/T_w) to $51.8/44°C$

10:58 $T_d/T_w = 51/46°C$, RH(m) = 97.91% $Z_I = 9E4\,\Omega$.

to cell I. $Z_I = 600\,\Omega$.

11:09 Set $(T_d/T_w) = 51.8/44.5°C$, Chiller Flow = 50% turn.

same as 11:32 on 10/10. J.Y. 10/16/02

14:55 $T_d/T_w = 51.8/49°C$, RH = 92.39%, $Z_I = \cancel{920.0°C}$ $920\,\Omega$

17:20 T_d/T_w RH(m) 90.27%, $Z_I = 950\,\Omega$.

10/17/02

8:24 $T_d/T_w = 51/38°C$. RH(m) = 56.28%, $Z_I = 9\times10^5\,\Omega$

Water in Tank is Gone! refilled!

9:55 $T_d/T_w = 51/43°C$ RH(m) = 74.64%, Z_I 4.9E4, T(m) = 49.04°C

dropped!

13:30 $T_d/T_w = 50/43°C$, 50/44°C RH(m) = 83.93% $Z_I = 3612\,\Omega$.

~~Set chiller Flow to slightly < 50% open.~~

J.Y. 10/17/02 ~~45% open.~~

Set chiller Flow to 75% open.

13:46 RH(m) = 83.95%.

Set chiller Flow to 100% of one turn. open.

14:44 $T_d/T_w = 50/43$ 48/43 RH(m) = 82.48%

water found on Td tip

~~Set~~ Cl

$(T_d/T_w) = 51.8/44°C$

16: $T_d/T_w = 50/44$, RH(m) = 84.60%, $Z_I = 1900\,\Omega$.

Set $(T_d/T_w) = 51.8/43°C$.

10/18/02

8:37: $T_d/T_w = 48/43°C$ RH(m) = 77.78, $Z_I = 3200\,\Omega$

Td has water drops

J.Y. 10/18/02