

303
Scientific Notebook # 291
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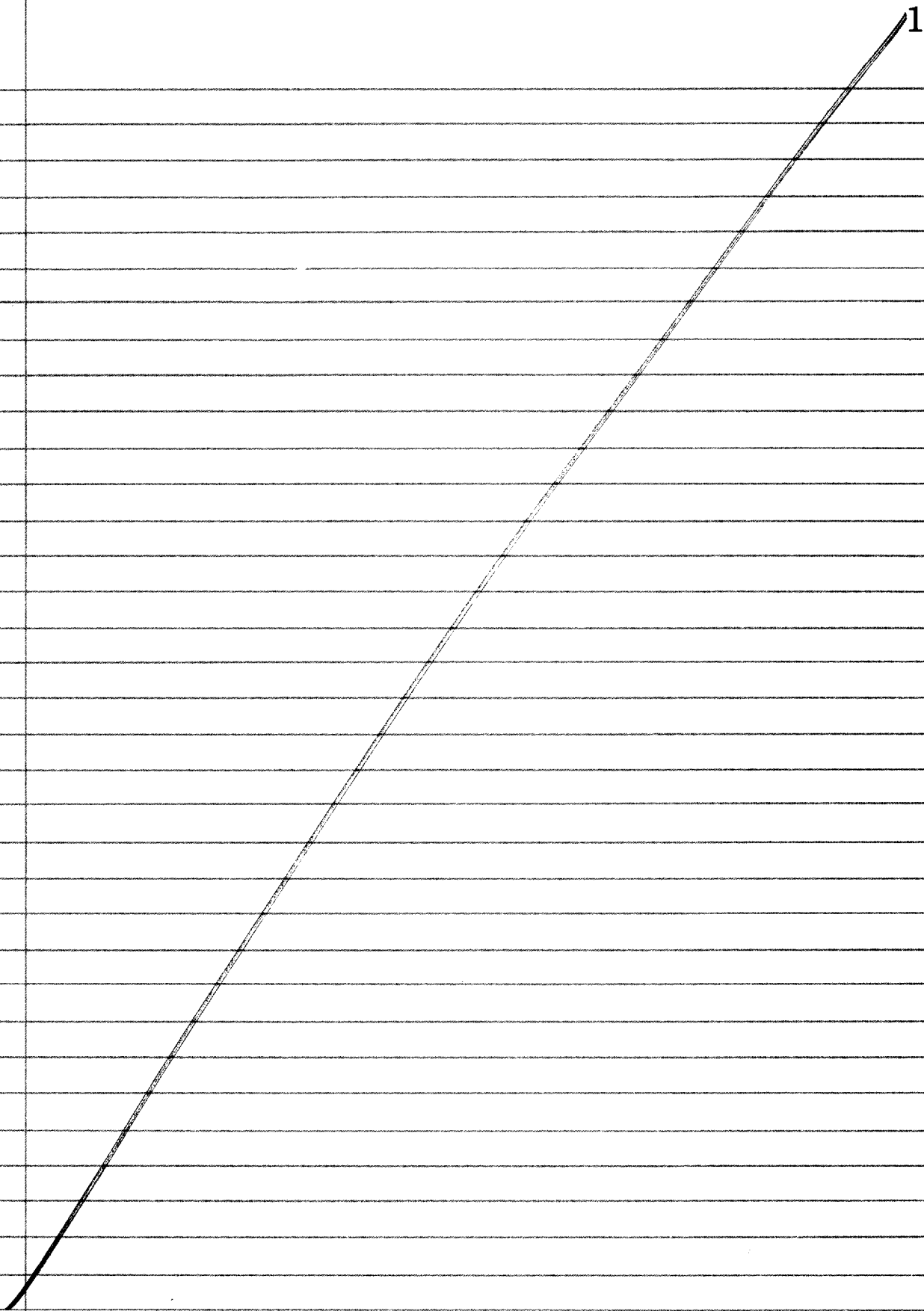
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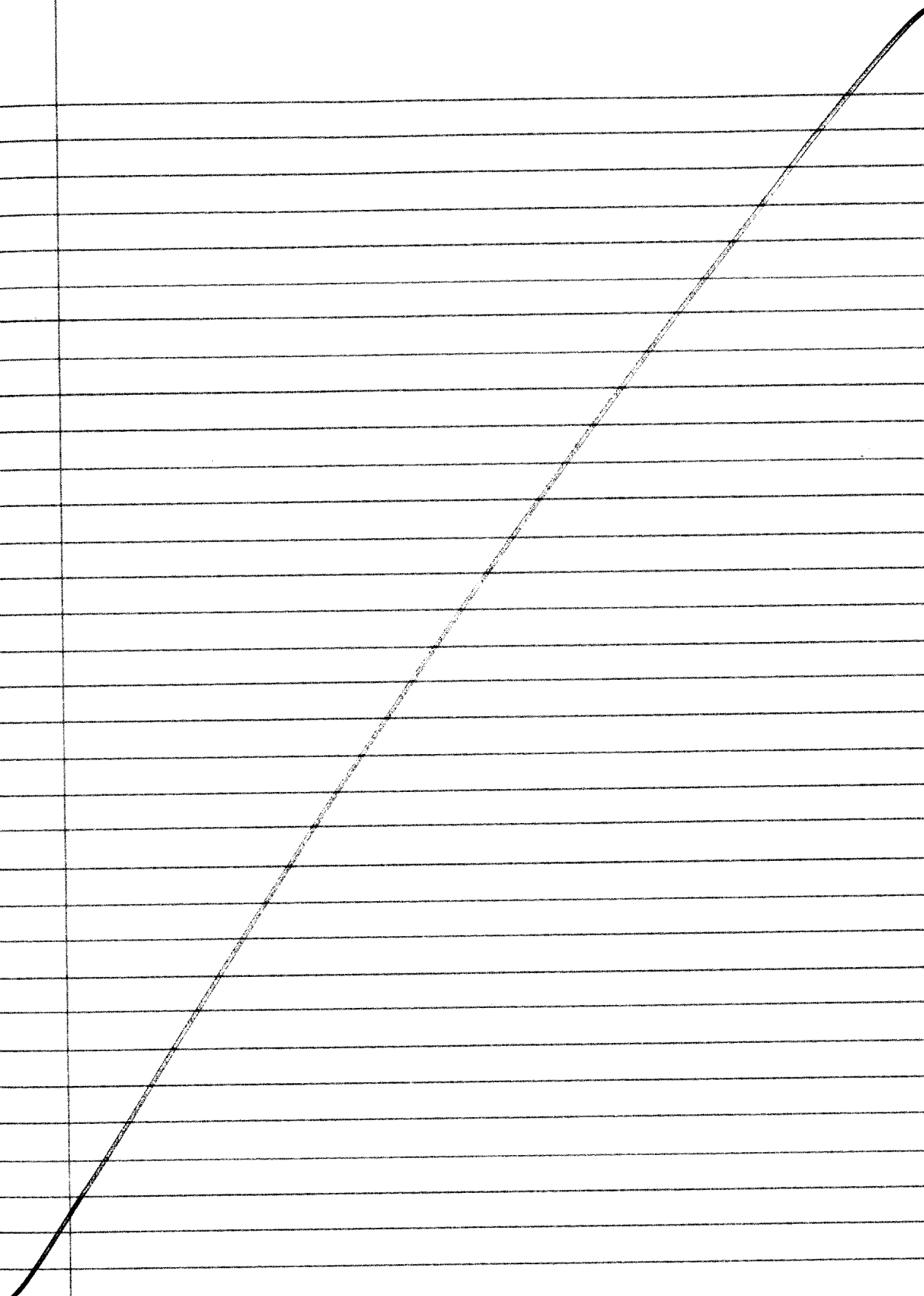
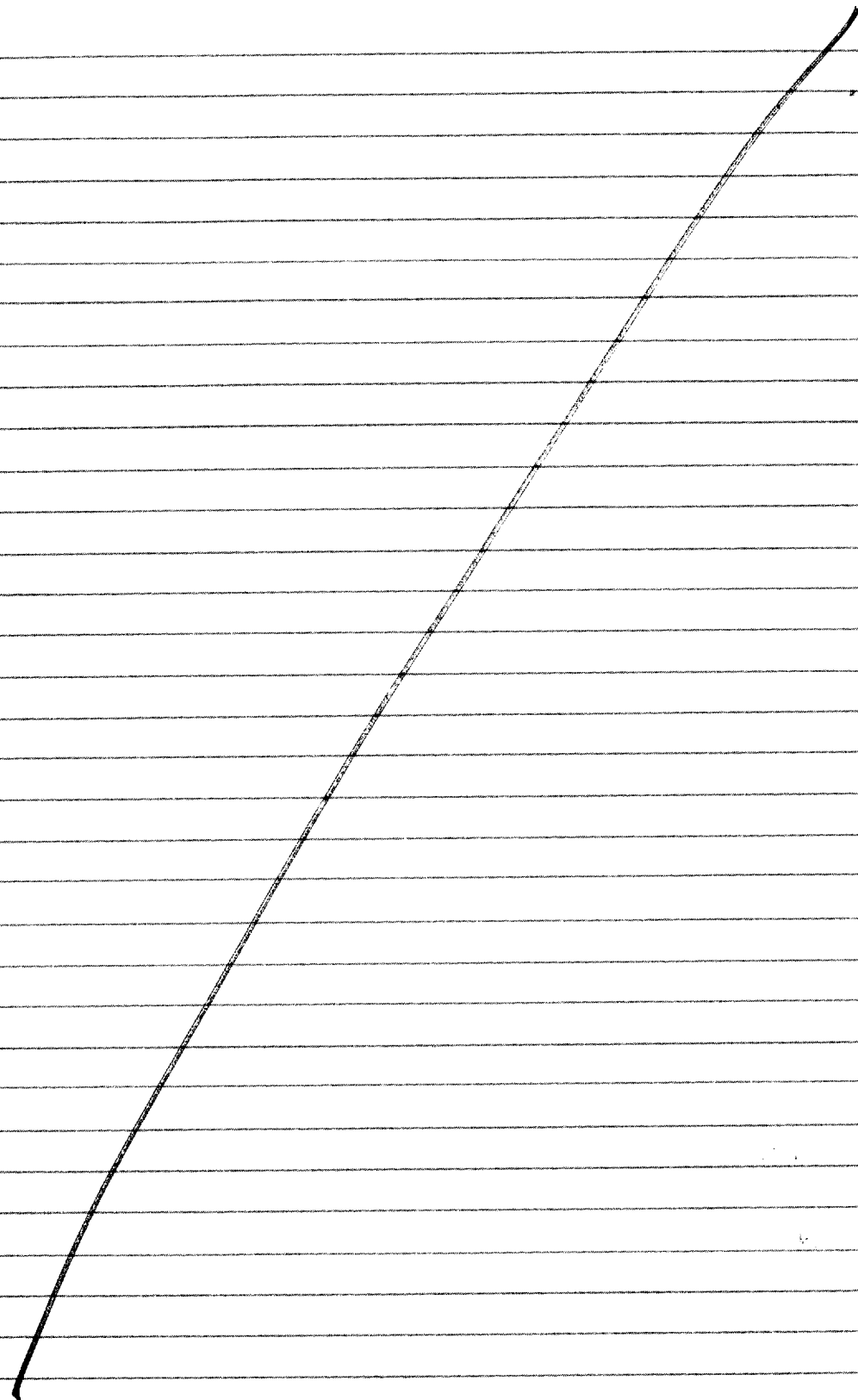
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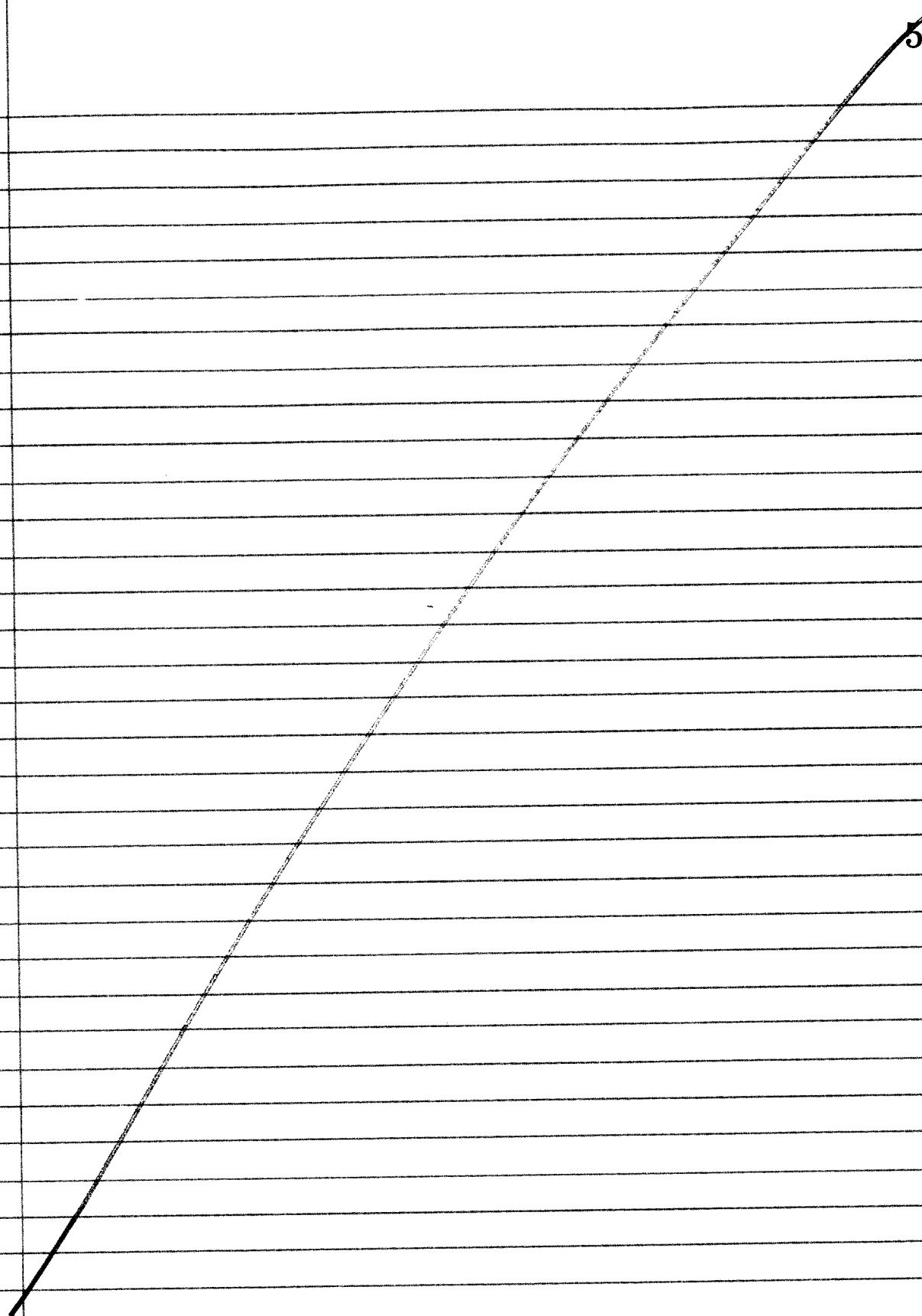
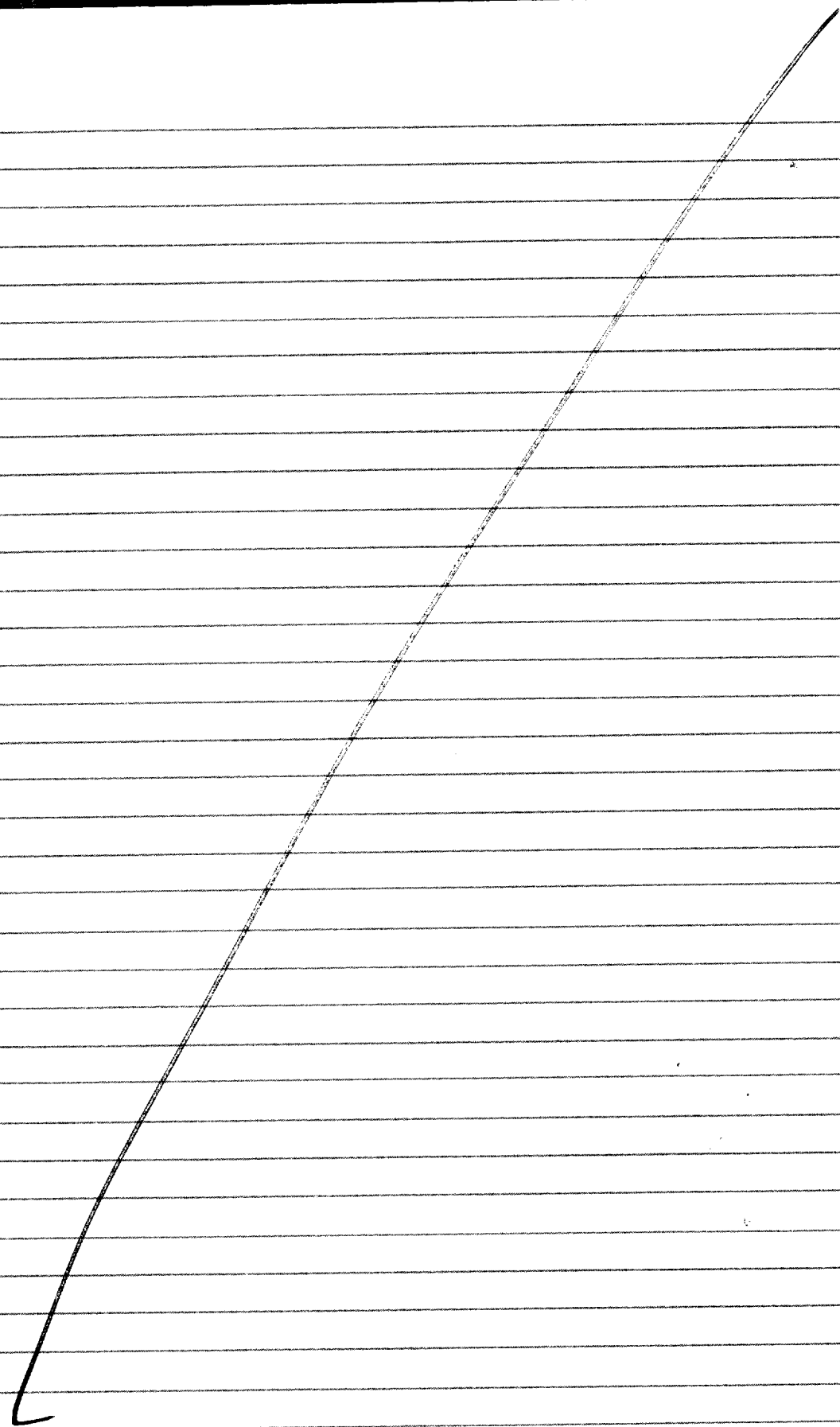
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From page
160 of Book
260

Cell 3 516PS102.1A1
 $T = 95^{\circ}\text{C}$

$E_{\text{set}} = -170\text{ mV}$

Init wt = 28.8617g

Final wt = 28.79948g

Final Soln. pH = 10.525

Observations

Some precipitate + general corrosion

crevice pitting noted around feet but not under

Initial Scientific notebook entry for A516 grade 60 carbon steel pit growth kinetics study.

Title: Pit growth in A516 grade 60

Tests Performed by: Sean Brossia; other personnel will be identified as they begin work on specific tests.

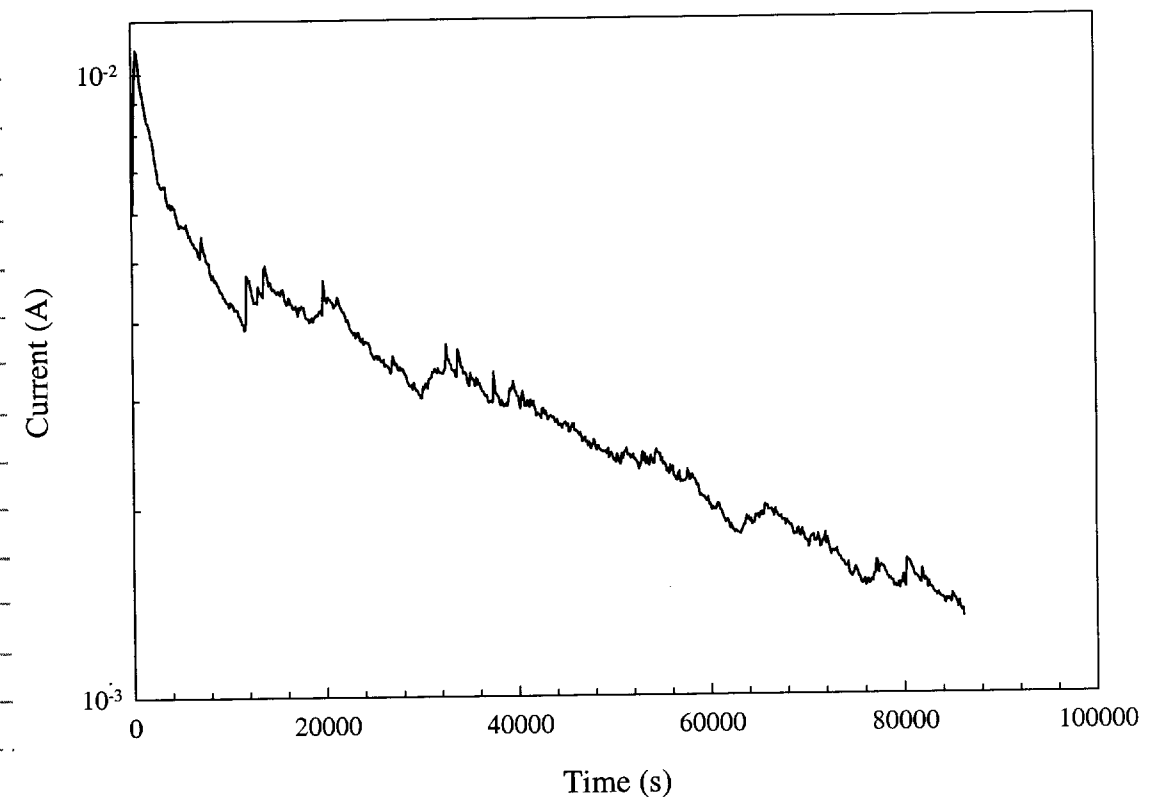
Objectives: Determine growth rate of pits in A516 grade 60 as a function of environmental conditions expected in repository. Evaluate if long-term pit propagation likely to continue and lead to perforation. Ascertain if lateral pit growth and/or development of new pits will dominate the corrosion process such that pit penetration arrest occurs. Detailed test objectives identified in initial entries or individual test entries.

Equipment: Specific equipment lists provided in initial entries or in individual test entries. Equipment will be identified and calibrated prior to testing.

Materials: A516 grade 60 carbon steel (Heat #: D84944; composition: 0.03Cr, 0.01Ni, 0.01Mo, 0.02Cu, 1.00Mn, 0.23Si, 0.009S, 0.18C, 0.014P, 0.021Al, 0.001V, 0.001Nb, bal Fe). Other materials and heats to be added and identified prior to testing.

Continuation of Notebook #260

516PS102



CSB 9/16/98

9-16-98

TO PS8

From pg 7

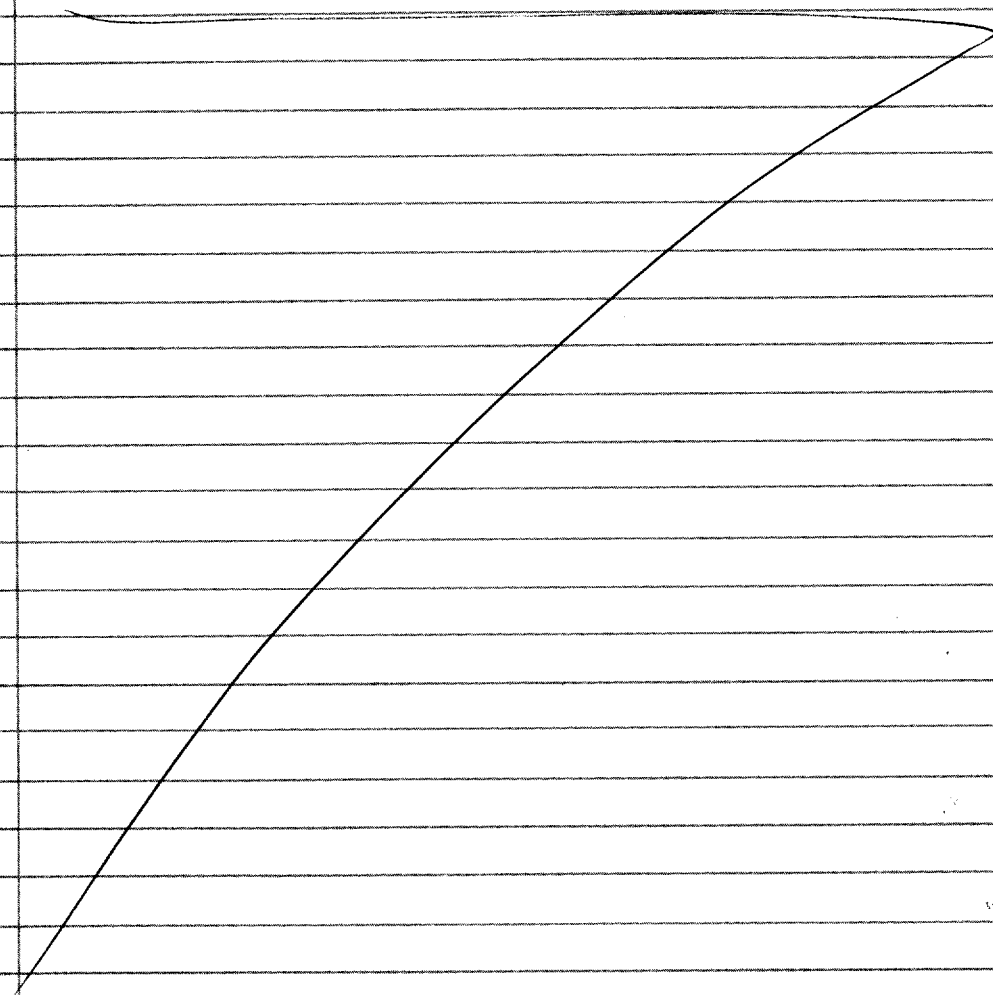
9-17-98

Start Solution

 $\text{Na}_2\text{CO}_3 \rightarrow 3\text{mM} \rightarrow .63594 \text{ g/2L}$ Fish # 960685 $\text{NaHCO}_3 \rightarrow 3\text{mM} \rightarrow .50406 \text{ g/2L}$ " 879789 $\text{NaCl} \rightarrow .12\text{mM} \rightarrow .01403 \text{ g/2L}$ " 972274

PH Initial = 10.163

All specimens polished to 600 grit + ultrasonically cleaned in Acetone
 All crevices ultrasonically cleaned in Methanol



9-17-98

To pg 9

From pg 8

Cell

516PS103.DAT

T = 25°C

Eset = -250mV

Init wt = 28.82723g

Final wt = 28.66056g

9-18-98

Final Solution PH = 11.009

9-18-98

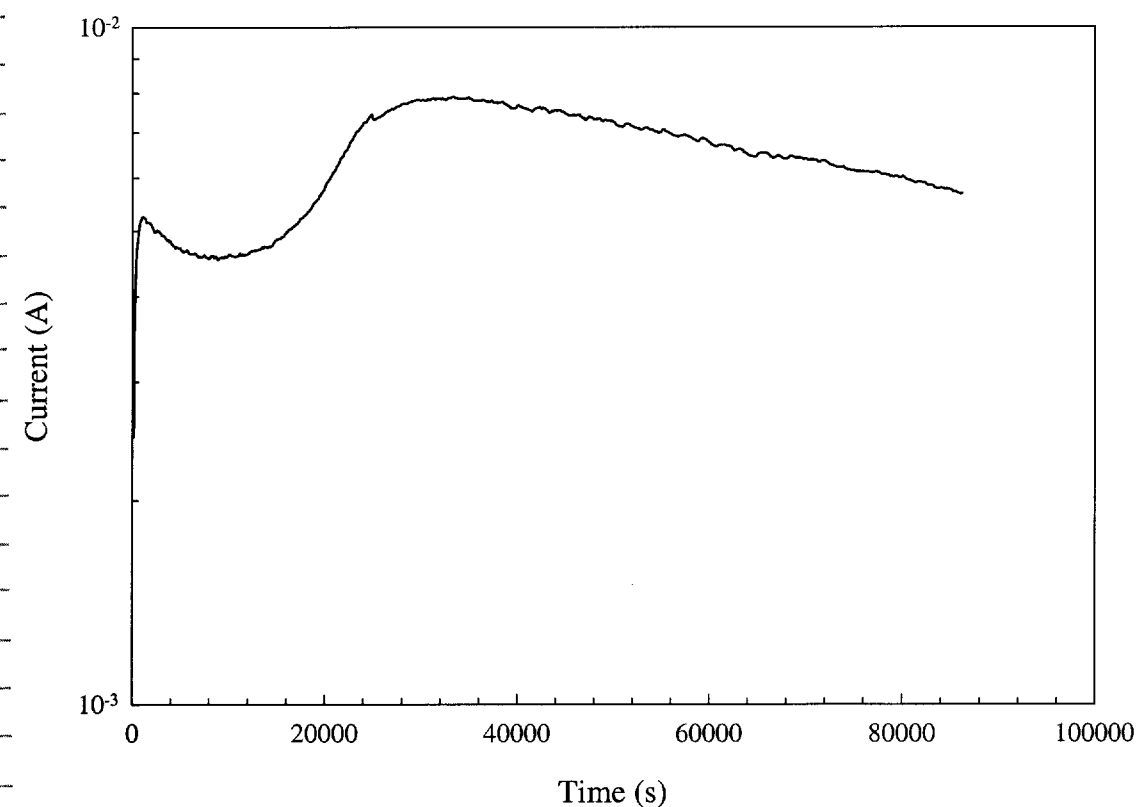
Observations

Heavy precipitate + general corrosion

9-18-98

No crevice pitting

516PS103



9-17-98

To pg 10

From pg 9

Cell 2 516PS104.DAT

T = 65°C

Eset = -220mv

Init wt = 28.92715g

Final wt = 28.85977g 9-18-98

Final Solution pH = 10.365 9-18-98

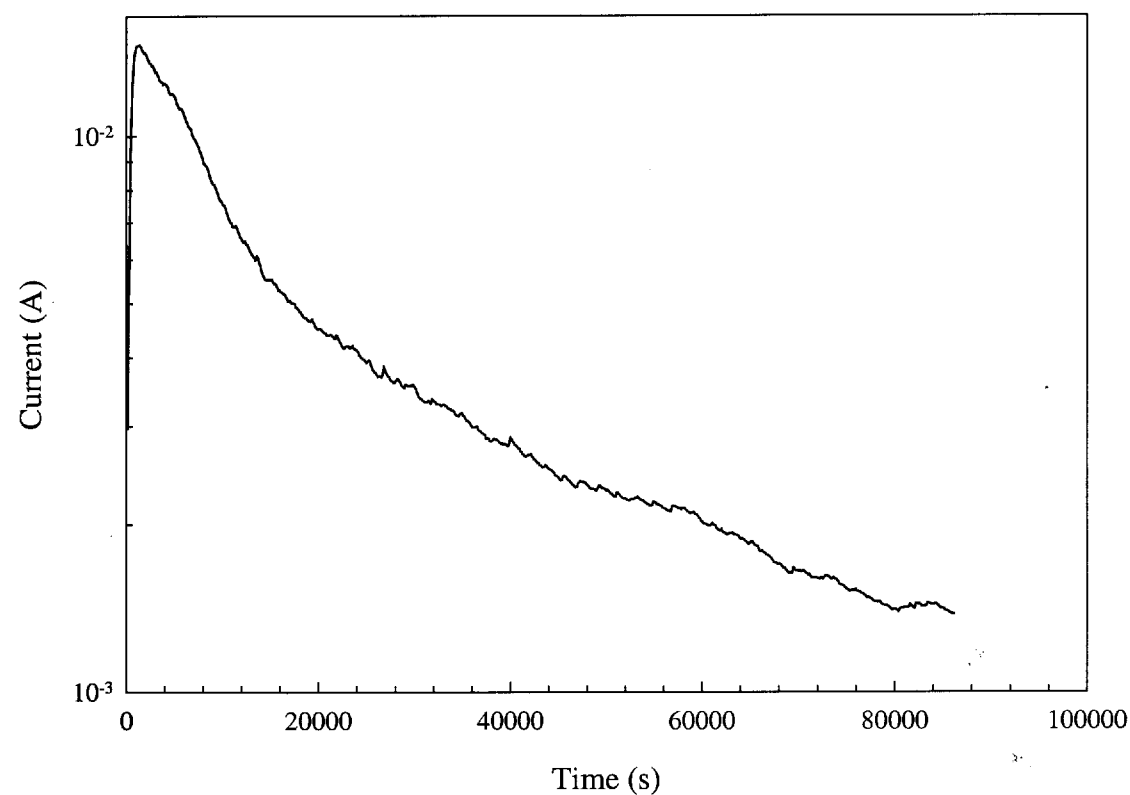
Observations

Heavy precipitate and general corrosion

No crevice pitting

9-18-98

516PS104



9-17-98

To pg 11

From pg 10

Cell 3 516PS105.DAT

T = 95°C

Eset = -150mv

Init wt = 28.76743g

Final wt = 28.75415g 9-18-98

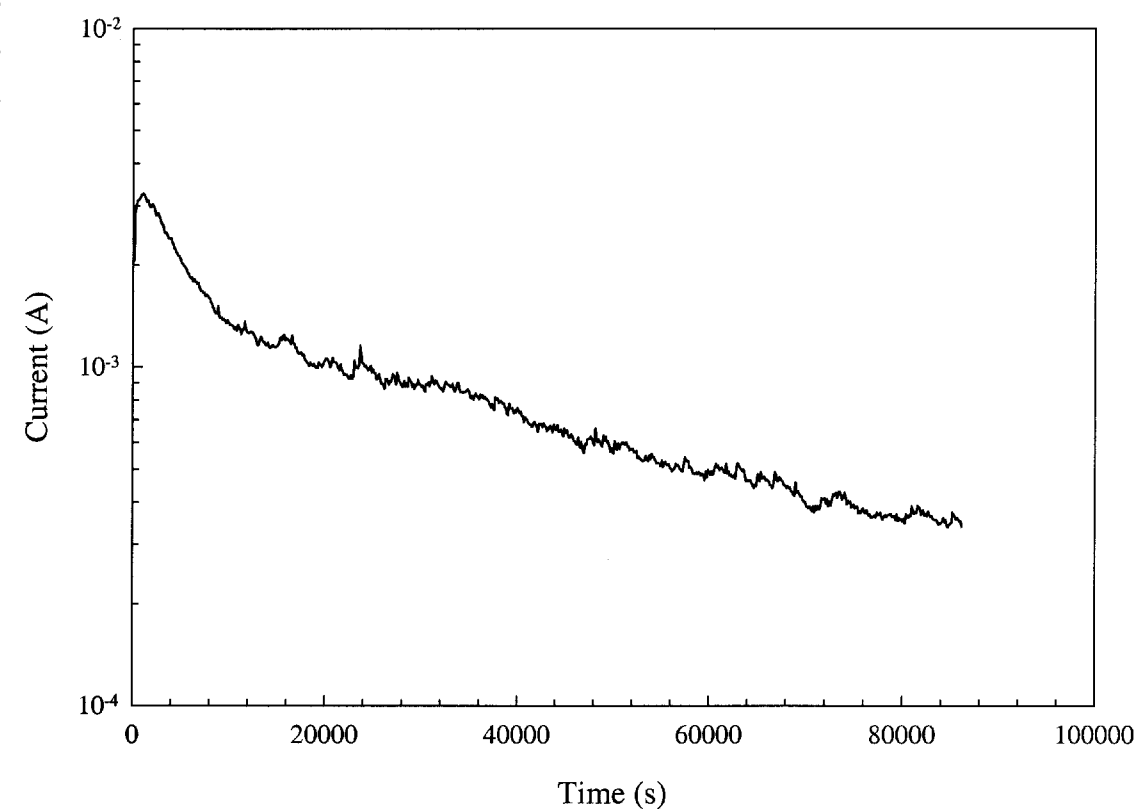
Final Solution pH = 10.667 9-18-98

Observations

Minor precipitate some general corrosion

crevice pitting noted under and around feet 9-18-98

516PS105



9-17-98

9-21-98

Start 9:45 AM

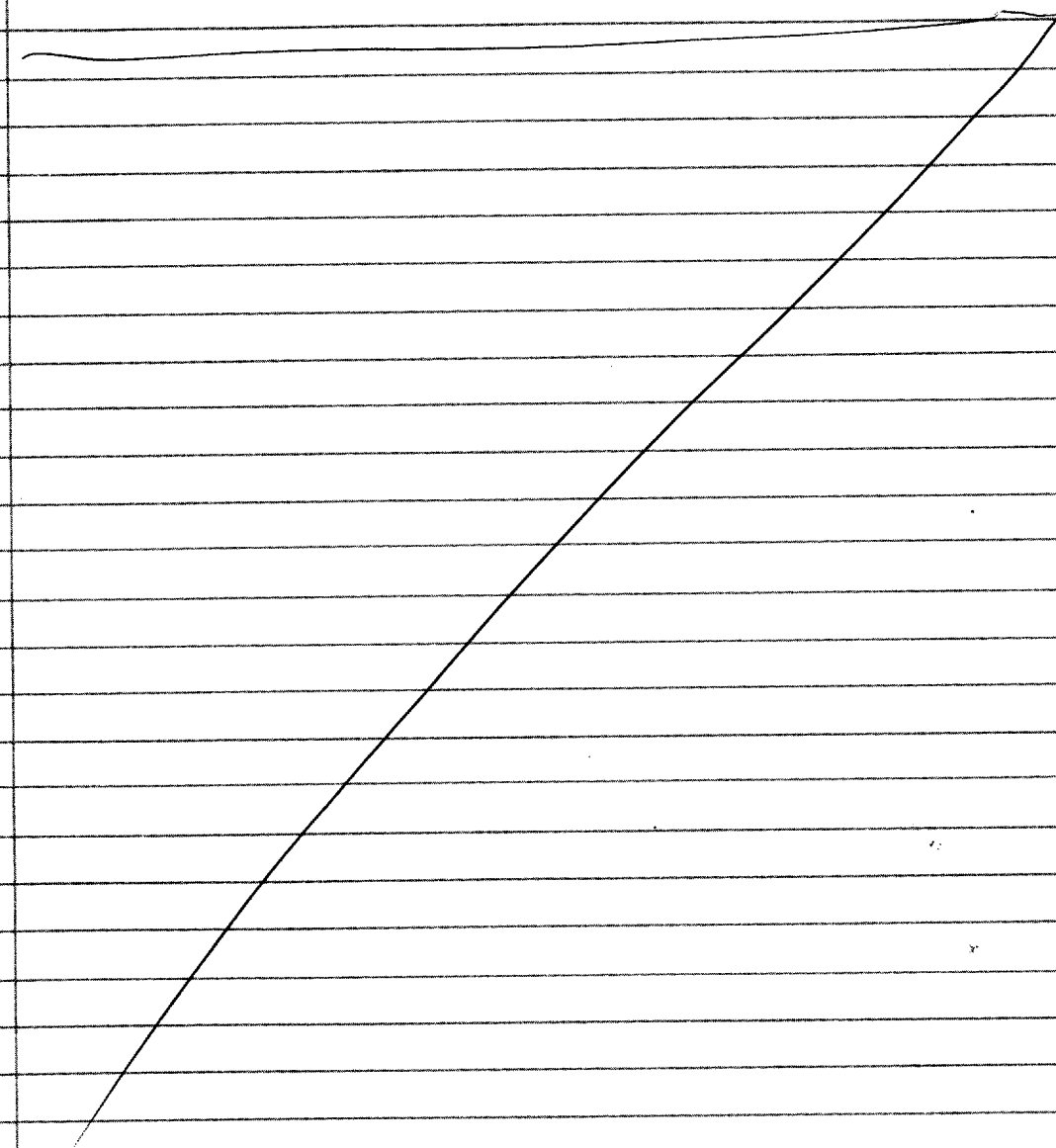
Stock Solution

NaHCO₃ → 120 mM → 20.1624 g/2L Fish # 897789

NaCl → 1.2 mM → 0.1403 g/2L " # 972274

Initial pH = 8.230

All specimens polished to 600 grit + ultrasonically cleaned in Acetone
 All crevices ultrasonically cleaned in Methonal



9-21-98

Cell 1 516PS106-NAT

T = 25°C

E_{set} = -290 mV

Init. wt = 28.94448 g

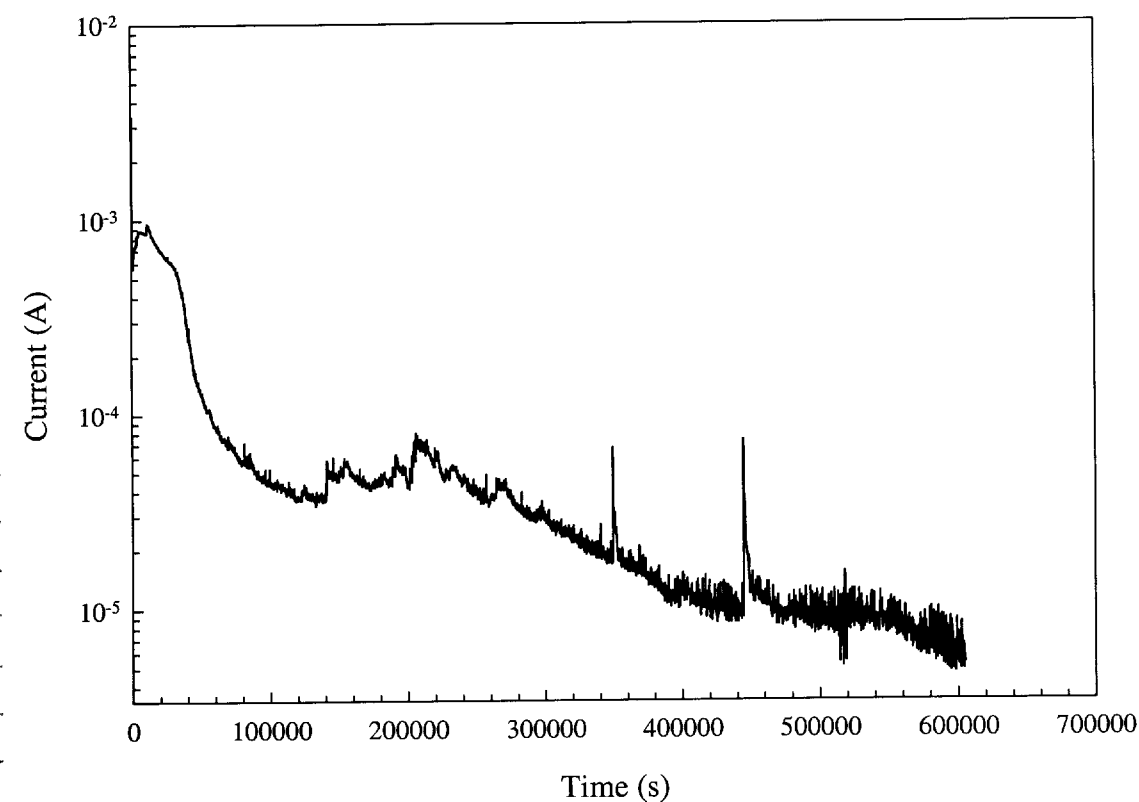
Final wt = 28.93160 g 9-28-98

Final Solution pH = 9.932 9-28-98

Observations

Some general corrosion no local crevice pitting 9-28-98

516PS106



9-21-98

Cell 2 516PS107. DAT

T = 65°C

Eset = -260mv

Init wt = 28.83482g

Final wt = 28.83301g

9-28-98

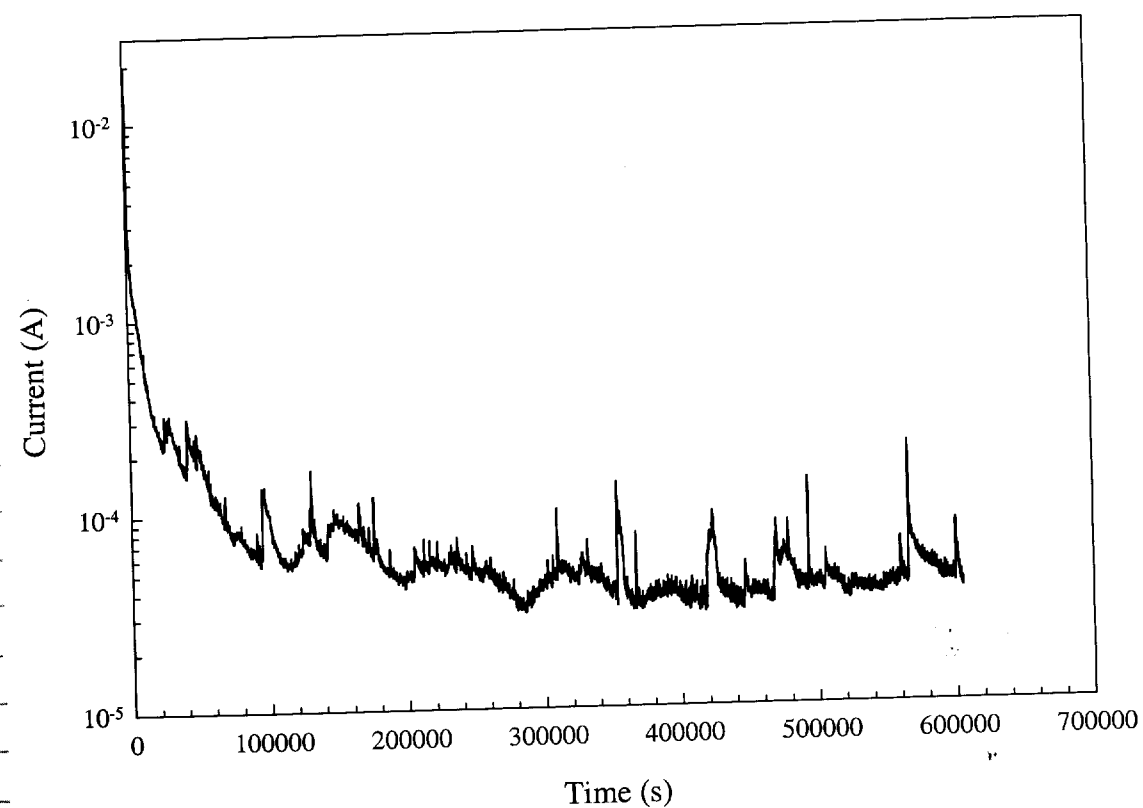
Final Solution pH = 10.36 9-28-98

Observations

General corrosion noted which traveled under crevice feet in some areas

9-28-98

516PS107



9-21-98

Cell 3 516PS108. DAT

T = 95°C

Eset = -190mv

Init wt = 28.76099g

Final wt = 28.76321g

9-28-98

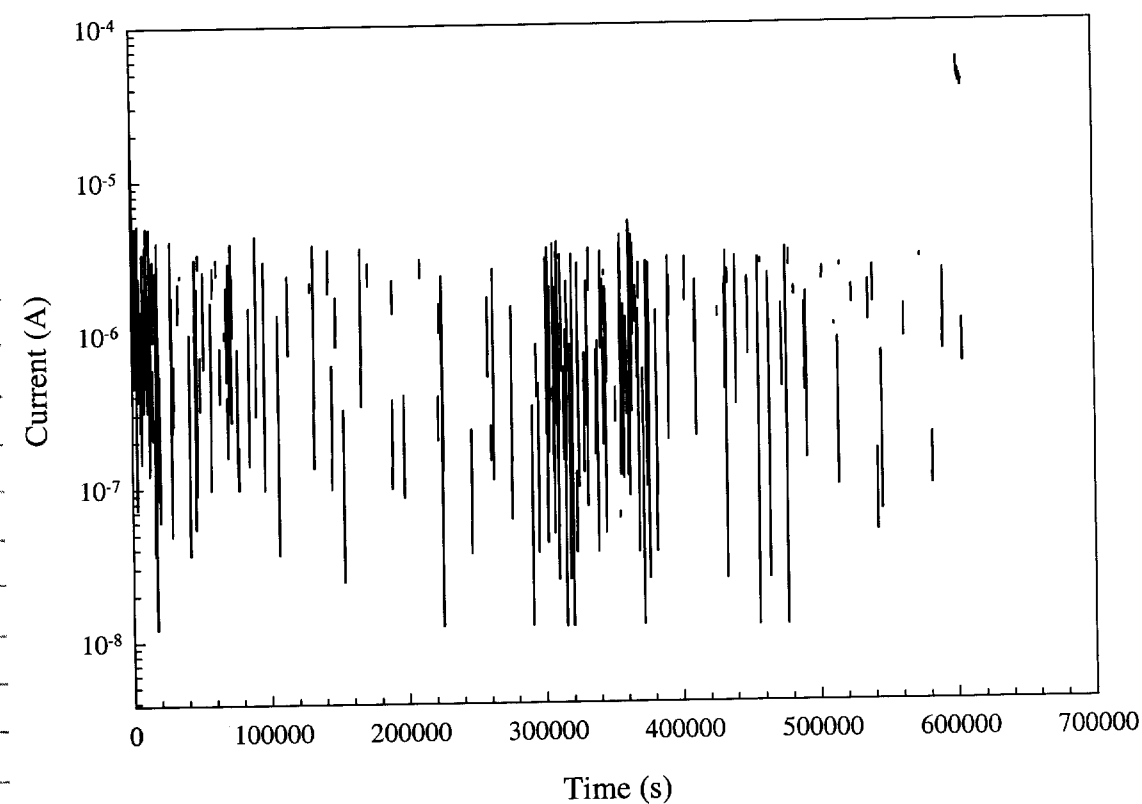
Final Solution pH = 11.047 9-28-98

Observations

No general corrosion some minor crevice pitting noted appears to have film on specimen

9-28-98

516PS108



9-21-98

9-28-98

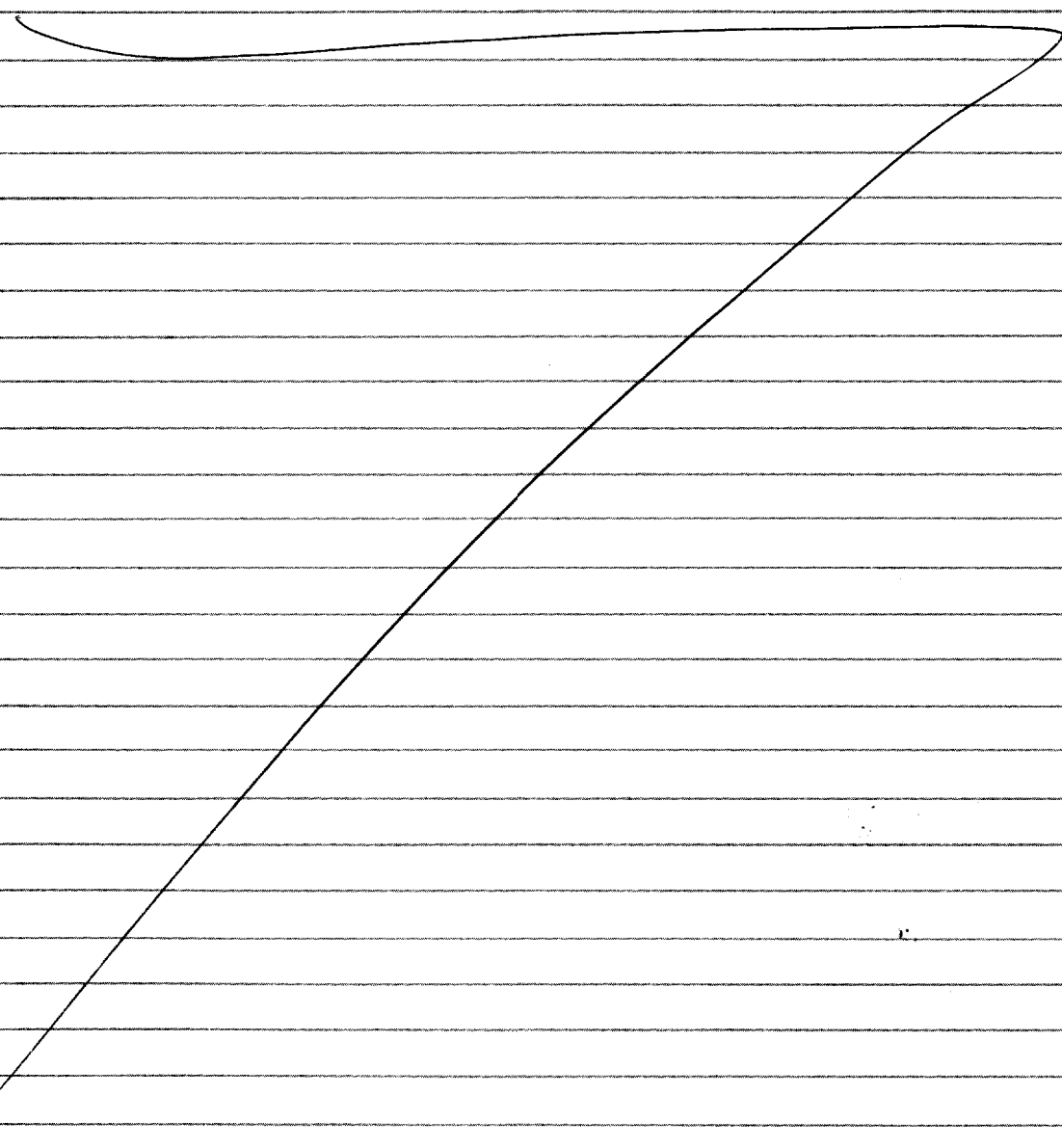
Start 11:20 AM

Start Solution

 $\text{Na}_2\text{CO}_3 \rightarrow 120 \text{ mM} \rightarrow 25.4376 \text{ g/L}$ Fisher Lot 960685 $\text{NaCl} \rightarrow 6 \text{ mM} \rightarrow 0.7013 \text{ g/L}$ " " 972274

PH = 11.353

All specimens polished to 600 grit and ultrasonically cleaned in Acetone
crevices ultrasonically cleaned in Methanol



[Signature] 9-28-98

Cell 1 516PS109.DAT

T = 25°C

Eset = -305 mV

Init wt = 29.03573 g

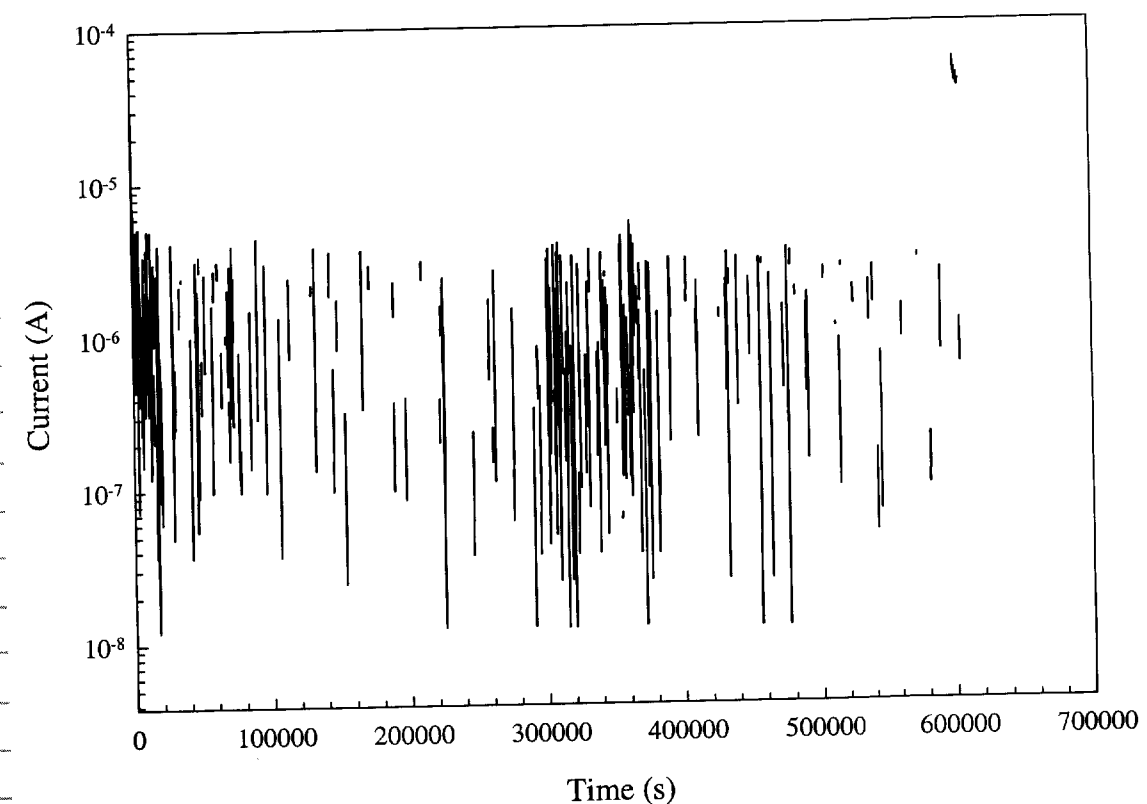
Final wt = 29.03562 g

Final Solution PH = 11.300

Observations

No crevice pitting, some small general corrosion

516PS109



[Signature] 9-28-98

Cell 2 516PS110.DAT

T=65°C

Eset = -310 mV

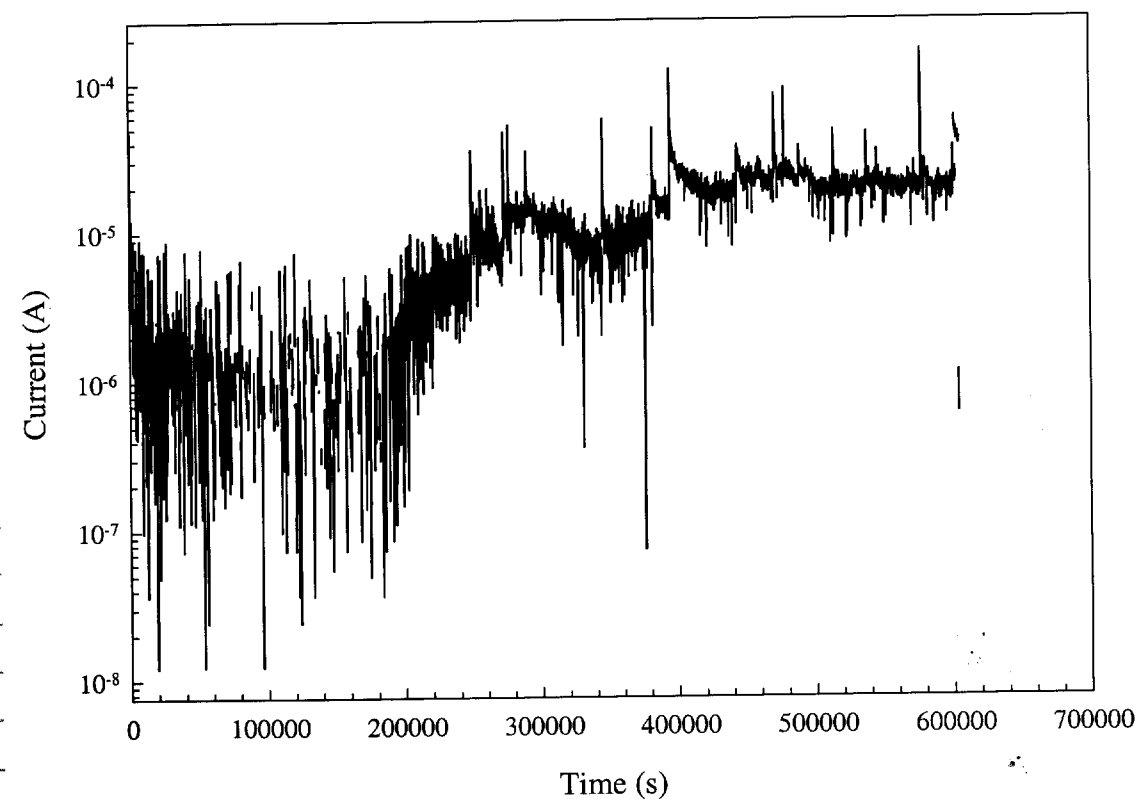
Init wt = 28.81728 g

Final wt = 28.81636 g *ll* 10-5-98Final Solution pH = 11.071 *ll* 10-5-98

Observations

No crevice pitting, one spot of general corrosion
between crevice feet *ll* 10-5-98

516PS110

*ll* 9-28-98

Cell 3 516PS111.DAT

T=95°C

Eset = -260 mV

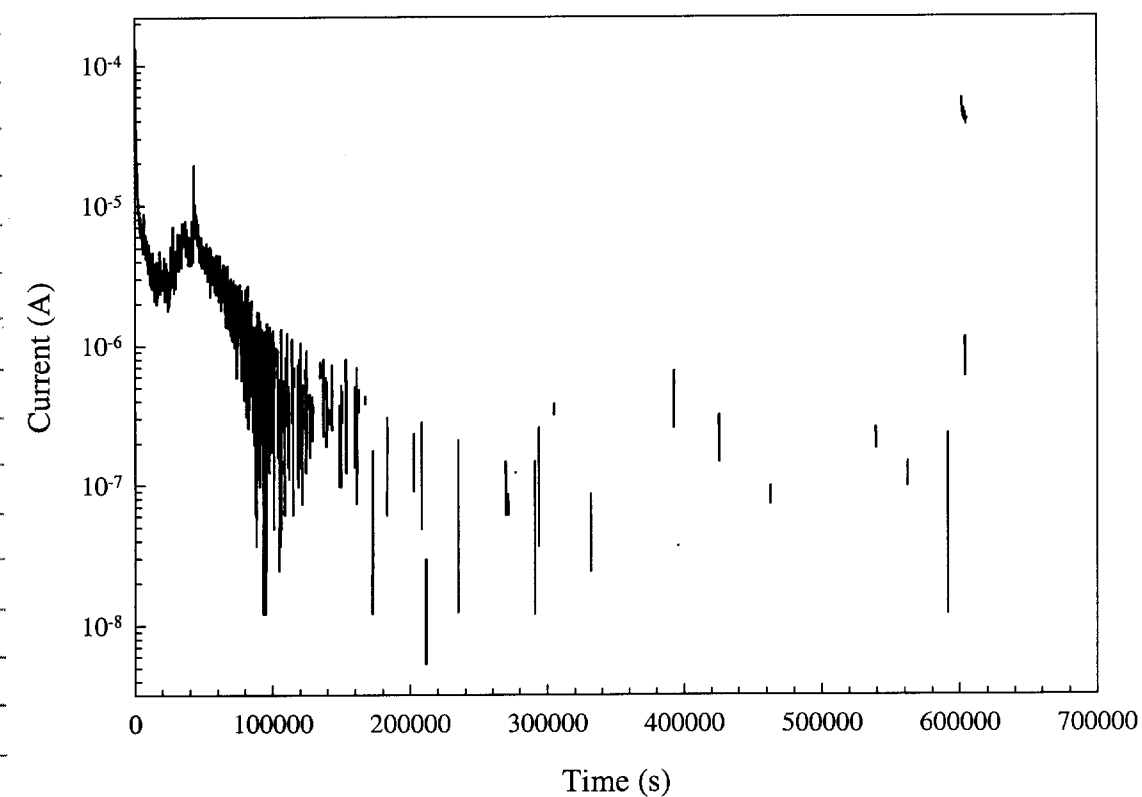
Init wt = 28.79129 g

Final wt = 28.79641 g *ll* 10-5-98Final Solution pH = 11.363 *ll* 10-5-98

Observations

Minor crevice pitting, film growth on specimen
crystal in appearance *ll* 10-5-98

516PS111

*ll* 9-28-98

from 19

10-5-98

Start 2:38

Start Solution

Na₂CO₃ → 12 mM → 2.54376 g / 2LT Fisher # 960685

NaCl → 12 mM → 0.1403 g / 2LT 97227Y

pH = 11.062

All Specimens polished to 600 grit & ultrasonically cleaned in Acetone.

Crevices Ultrasonically cleaned in Methanol

Solution degassed with CO₂ free compressed air

from 20

Cell 1 516PS12 .DAI

T = 25°C

E_{set} = OCP (Open Circuit Potential)

Init wt = 28.56587g

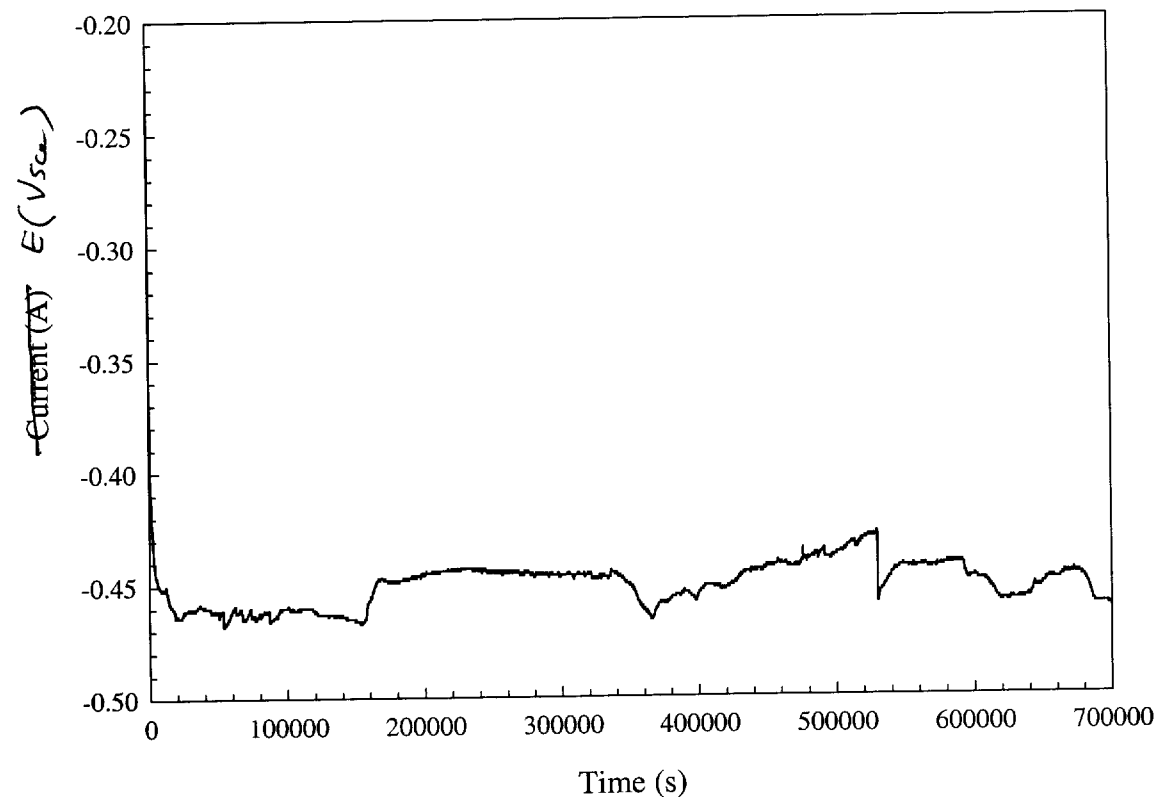
Final wt = 28.55186g 10-15-98

Final Solution pH = 10.927 10-15-98

Observations

Two areas of general corrosion occurrences between crevice (left, some on top of specimen post) 10-15-98

516PS112



10-5-98

10-5-98

To 21

10-5-98

10-5-98

To 22

from 21

Cell 2 516PS13.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = \text{OCP}$

Init wt = 28.6344g

Final wt = 28.63205g

Final Solution pH = 10.717

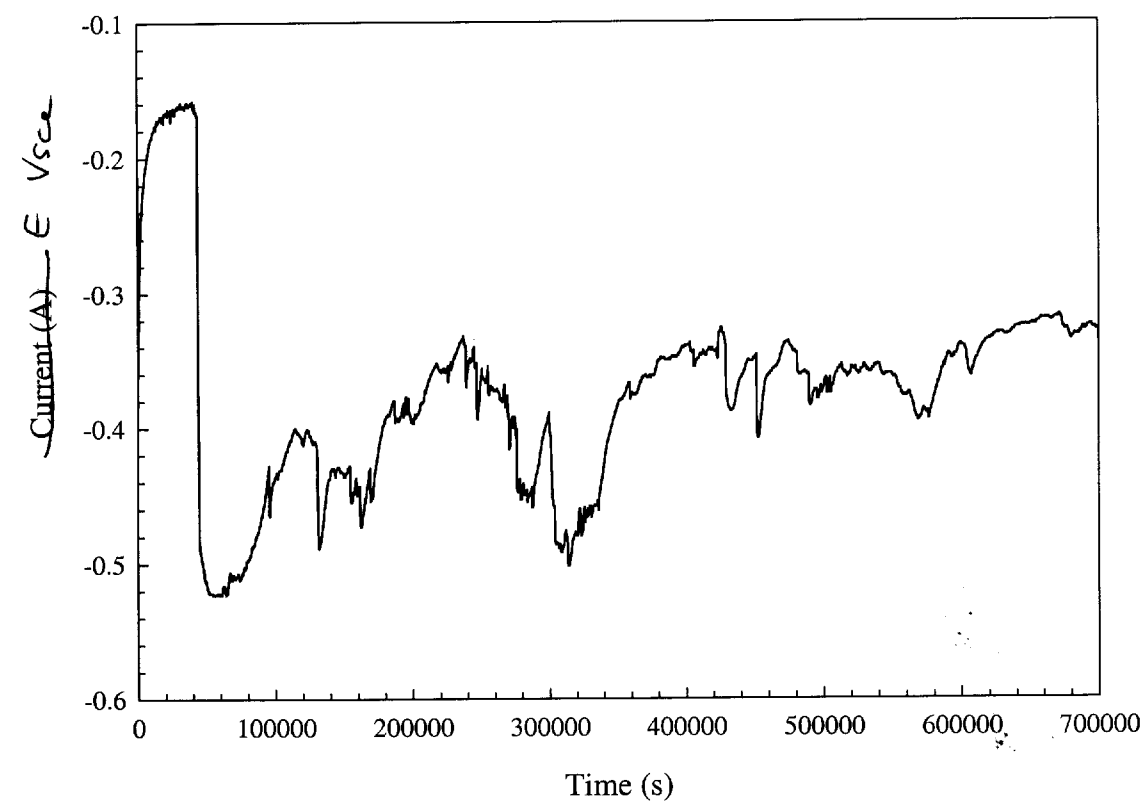
Observations

minor-med crevice pitting on 7 feet

10-14-98

10-14-98

516PS113



10-5-98

To 23

from 22

Cell 3 516PS114.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = \text{OCP}$

Init wt = 28.73572g

Final wt = 28.73628g

Final Solution pH = 10.789

Observations

minor-med crevice pitting 6 feet

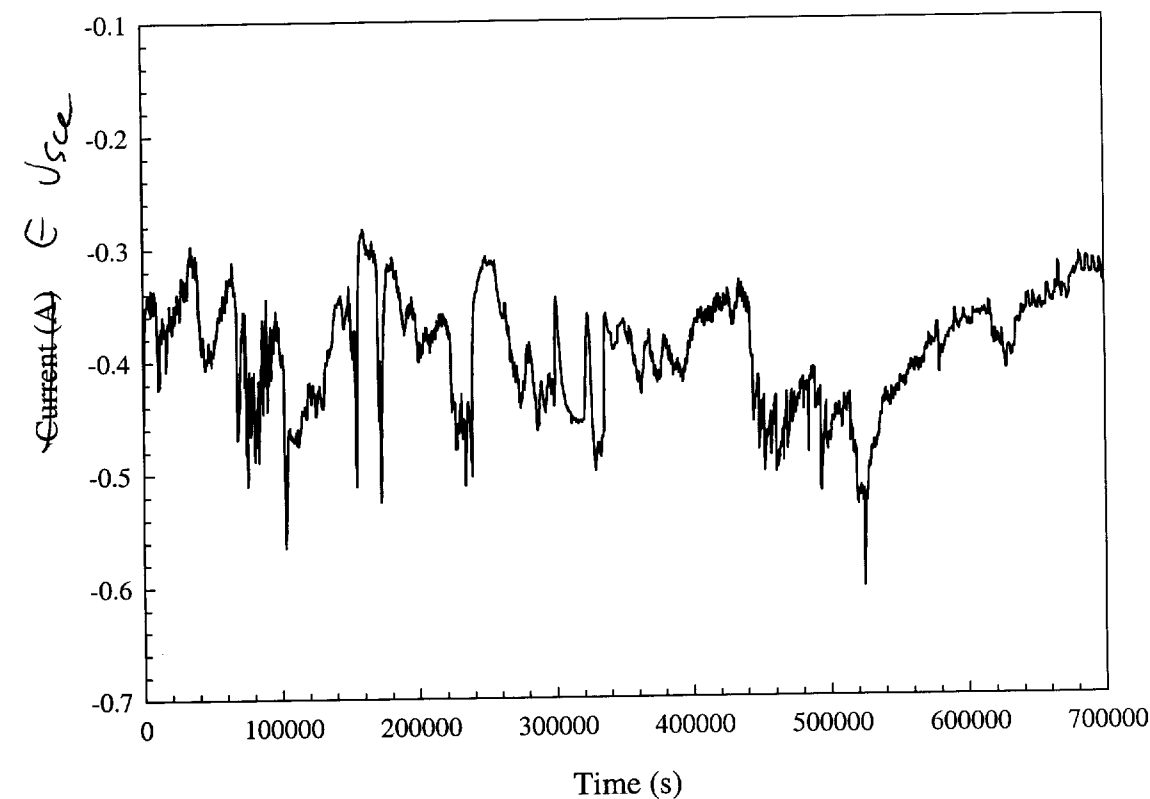
film above vapor line

10-14-98

10-14-98

10-14-98

516PS114



10-5-98

from p. 23

Start Solution 10-20-98

Cell 1 120 mM $\text{NaCO}_3 \rightarrow 12.7188 \text{ g/Lt}$
 12 mM $\text{NaCl} \rightarrow 0.0701 \text{ g/Lt}$
 pH = 11.299

Cell 2 120 mM $\text{NaCO}_3 \rightarrow 12.7188 \text{ g/Lt}$
 24 mM $\text{NaCl} \rightarrow 0.1403 \text{ g/Lt}$
 pH = 11.310

Cell 3 120 mM $\text{NaCO}_3 \rightarrow 12.7188 \text{ g/Lt}$
 12 mM $\text{NaCl} \rightarrow 0.07013 \text{ g/Lt}$
 pH = 11.306

All Specimens Polished to 600 grit & heat treated @ 700°C
 for 24 hours, the ultrasonically cleaned in acetone before heat treat
 Crevices ultrasonically cleaned in methanol
 Solution Deaerated in high purity Nitrogen

10-20-98 To p. 25

from P. 24

Cell 1 516PS115.DAT

T = 95°C E_{set} = +225 mV

Init wt = 28.98808 g

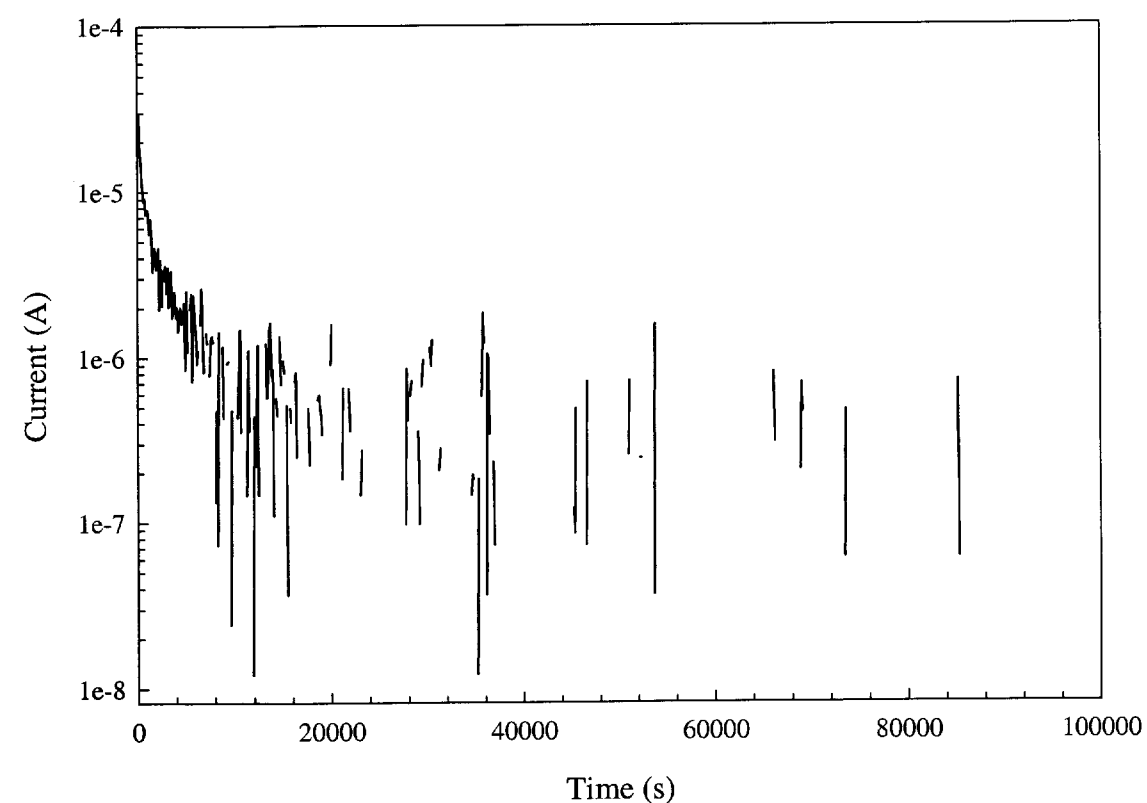
Final wt = 28.98783 g 10-21-98

Final Solution pH = 10.935 10-21-98

Observations

Some minor crevice pitting noted 10-21-98
 Only on 6 feet and not full crevice

516PS115



10-20-98 To p. 26

from 25

5/19/98

Stock Solution

PH = 11 \Rightarrow 12 mm $\text{Na}_2\text{CO}_3 \Rightarrow 2.54376 \text{ g/2L}$ Fisher Lot # 960685
 100 ppm Cl \Rightarrow 0.32958 g/2L Fisher Lot # 972274

Initial PH = 11.251

All samples polished to 600 grit + ultrasonically cleaned in Acetone

Start

Change File Names for new spec
 Check pulses for 2 hour
 System change Copr. to
 to new file names
 Change Cell potentials

File - ALT - Left Mouse Click
 turns on ICON
 Right Click File Run
 Turn on Potentiostat

Shut down

Double Click each Pulse for each Cell
 change for 2 minutes low/low
 After both drives A+C are
 accessed Right Click Select
 Stop
 ALT Left Click File Free
 + System Iron

A. H. P. 5/19/98

Cont to 27

from 26

A516PS04.DAT

Temp = 20°C

Eset = -320 mV

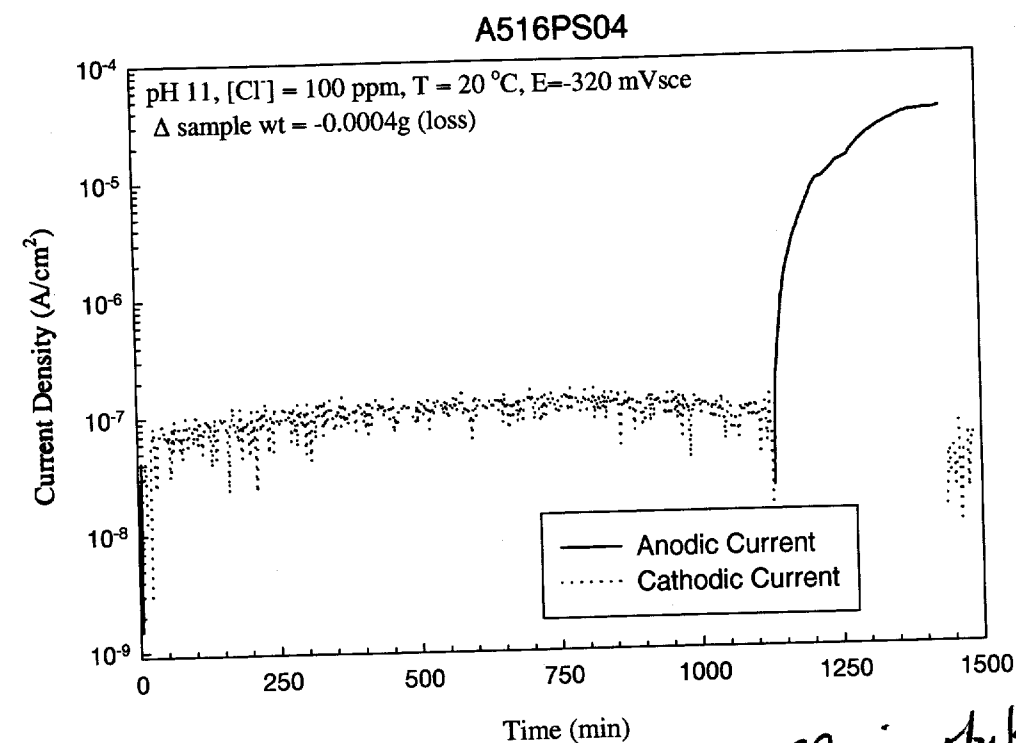
Init Sample wt = 11.42389 g

Final Sample wt = 11.42385 g 5-20-98

Final Solution PH = Dumped before ph taken 5-20-98

Observations Nitrogen low at end of test

Water line buildup on specimen 5-20-98



san 5/20/98

A. H. P. 5/19/98

Cont to 28

From 27

Cell 2

A516PS05.DAT

Temp = 95°C

Eset = -420 mV

Init Sample wt = 11.40679 g

Final Sample wt = 11.40632 g

Final Solution PH = 10.968

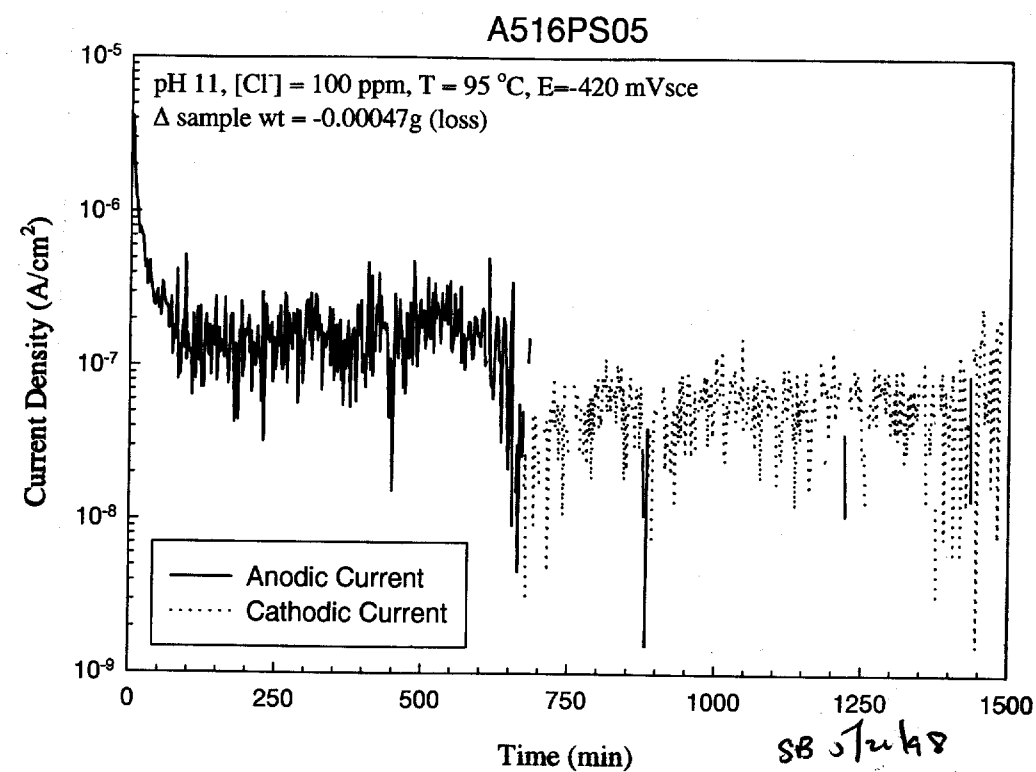
Observations: Water line film on specimen, rusting above water line

No notable pitting

S-20-98

S-20-98

S-20-98



SB 5/19/98

Cont to 29

From 28

Cell 3 A516PS06.DAT

Temp = 95°C

Eset = -320 mV

Init Sample wt = 11.40362 g

Final Sample wt = 11.39731 g

Final Solution PH = 10.795

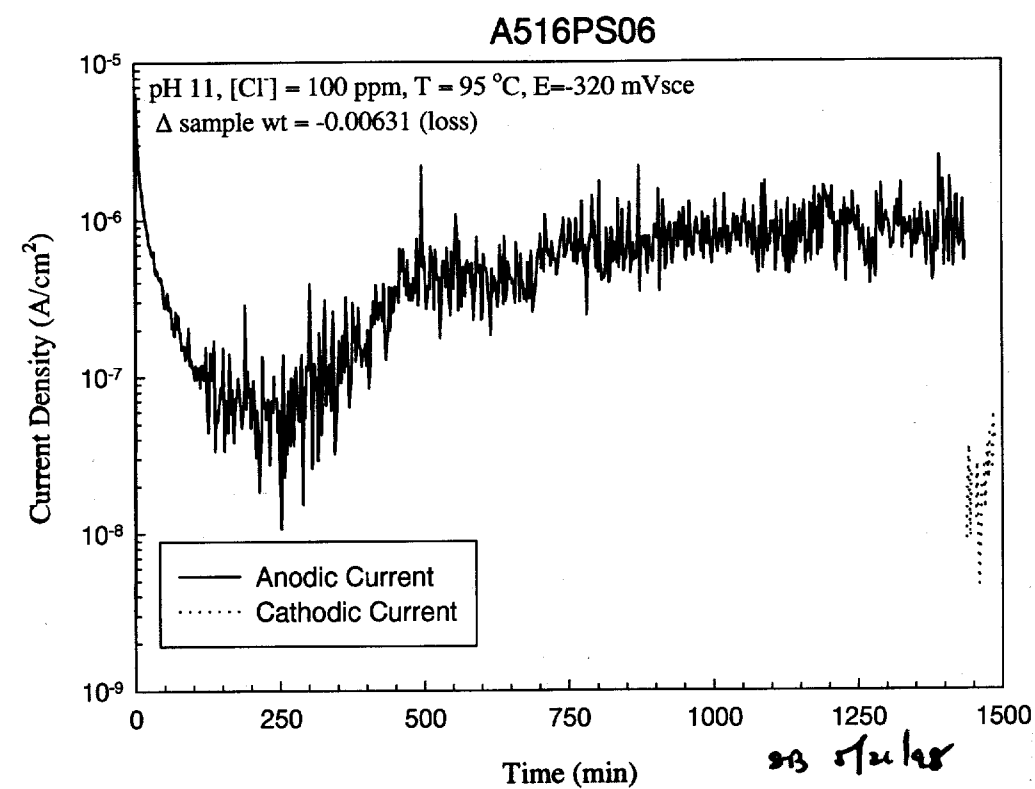
Observations: Water line film + rusting above water line

No notable pitting

S-20-98

S-20-98

S-20-98



SB 5/19/98

Cont to 30

from 29

5-20-98

Start Solution

PH = 11 \rightarrow 12 mm $\text{Na}_2\text{CO}_3 \Rightarrow 2.54376 \text{ g/L}$ Fisher Lot 960685
 1000 ppm Cl $\Rightarrow 3.2958 \text{ g/L}$ Fisher Lot 972224

Initial PH = 11.205 *AK* 5-21-98

All Samples ultrasonically cleaned in Acetone after polishing to 600 grit

AK 5-20-98

Cont to 31

from 30

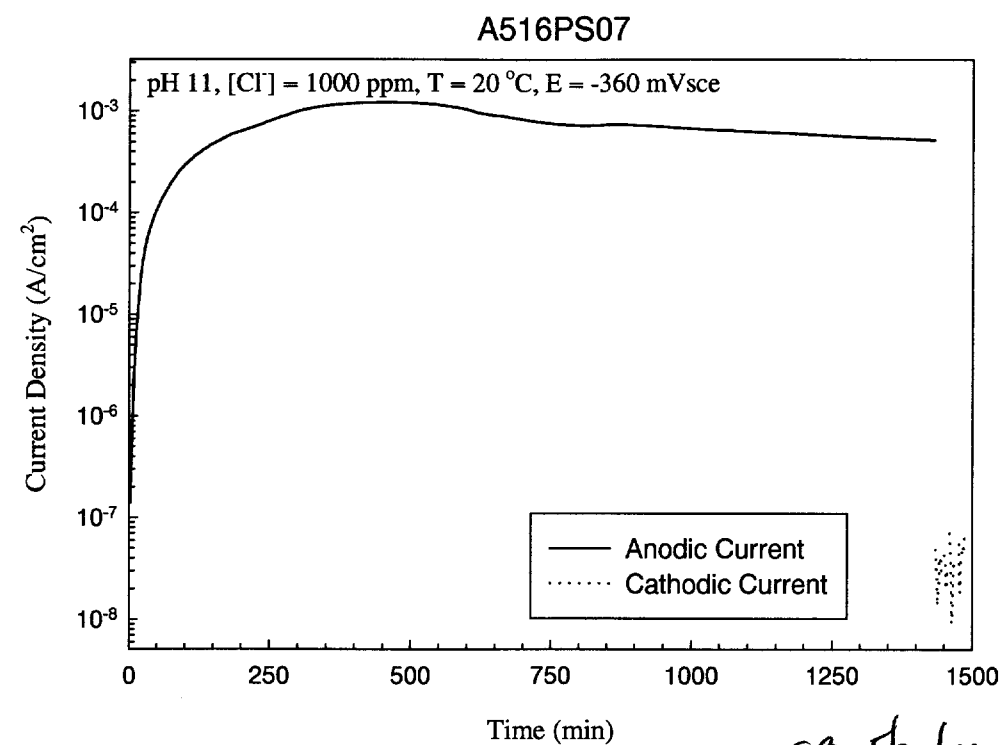
Cell 1

A516 PS07.DAT

Temp = 20°C

Eset = -360 mV

Init Sample wt = 11.39714

Final Sample wt = 11.25644 *AK* 5-22-98Final Solution PH = 11.717 *AK* 5-22-98Observations Heavy product buildup, some pitting *AK* 5-22-98*AK* 5-20-98

Cont to 32

From 31

Cell 2 A516PS08.DAT

Temp = 95 °C

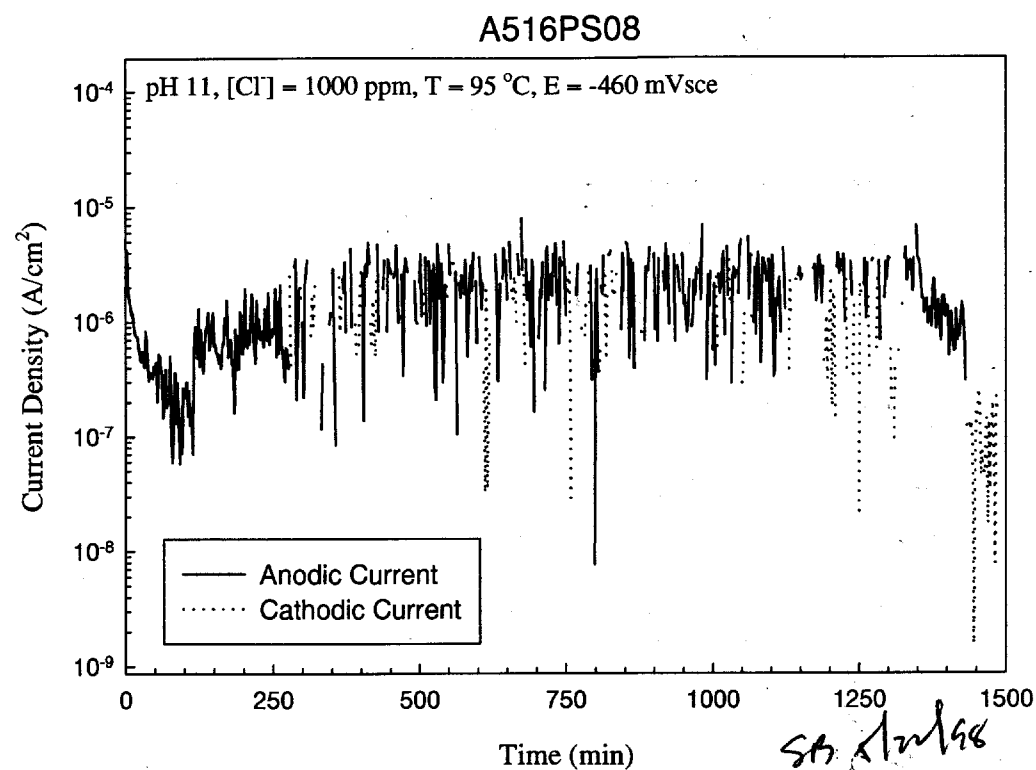
Eset = -460mv

Init Sample wt = 11.46693

Final Sample wt = 11.46901

Final Solution pH = 11.159

Observations No pitting, slight rusting above solution line



SA 5-20-98 Cont to 33

From 32

Cell 3 A516PS09.DAT

Temp = 95 °C

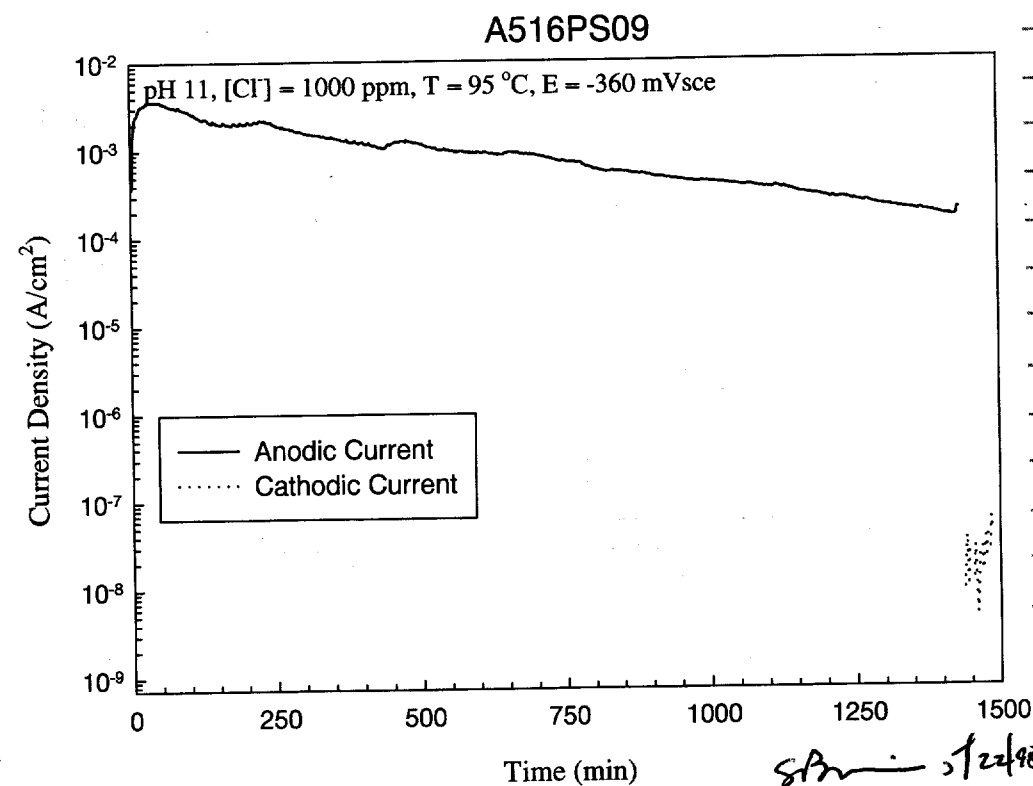
Eset = -360mv

Init Sample wt = 11.44650

Final Sample wt = 11.29136

Final Solution pH = 10.822

Observations Heavy product buildup, rust & pitting, slight rust above solution line



SA 5-20-98

5/25/98 Attempt to make pH 9.5 solution

	100 mL of soln	measured pH
#1 12 mM Na_2CO_3 - 105.986 g/mol 1 mM NaHCO_3 - 84.0049 g/mol	0.1272 g 0.0084 g	10.918
#2 12 mM Na_2CO_3 0.1 mM NaHCO_3	0.1272 g 0.00084 g actual 0.00140	11.018
#3 11 mM Na_2CO_3	0.1166 g	11.040
#4 10 mM Na_2CO_3 1 mM NaHCO_3	0.1060 g 0.0084 g	10.880
#5 10 mM Na_2CO_3 2 mM NaHCO_3	0.1060 g 0.0168 g	10.765

After discussion w/ N. Sridhar and G. Cragnolino, key issue seems to be $\text{CO}_3^{2-}/\text{Cl}^-$ ratio to generate conditions that lead to pitting. Ratios that have worked to some extent thus far:

CO_3^{2-}	Cl^-	ratio
12 mM	1.41 mM (50 ppm)	8.51
12 mM	0.282 mM (10 ppm)	42.6 - best case

ratios that led to general corrosion

CO_3^{2-}	Cl^-	ratio
11.5 mM	2.82 mM (100 ppm)	4.1
11.5 mM	28.17 mM (1000 ppm)	0.41
12 mM	2.82 mM	4.3
12 mM	28.17 mM	0.43

from p34

From tests so far given that $\text{CO}_3^{2-}/\text{Cl}^-$ ratio is critical parameter, following experiments are proposed

5/25/98

$[\text{CO}_3^{2-}]$ as Na_2CO_3	ratio	$[\text{Cl}^-]$ mM	ppm	g NaCl/2L
12 mM	6:1	2	71	0.233768
	8:1	1.5	53	0.175326
	10:1	1.2	42.6 ^{CSN 5/25/98}	0.14026
	20:1	0.6	21	0.07013
	30:1	0.4	14	0.046754
	50:1	0.24	8.5	0.028052
	75:1	0.16	5.7	0.018701
	100:1	0.12	4.3	0.014026
	500:1	0.024	0.85	0.002805
	1000:1	0.012	0.425	0.0014026

make from stock solution:

0.48 M solution (1 L = 0.02805 g NaCl)

0.024 mM final $[\text{Cl}^-]$ in 2L \rightarrow 100 mL stock Cl^- soln
 0.012 mM final $[\text{Cl}^-]$ in 2L \rightarrow 50 mL stock Cl^- soln

	potentials	$E_{\text{set}}^{45^\circ\text{C}}$	$E_{\text{set}}^{55^\circ\text{C}}$	$E_{\text{set}}^{25^\circ\text{C}}$
- 6:1	-514	$E_{\text{p}} + 100$	$E_{\text{p}} + 200$	$E_{\text{p}} + 200$
- 8:1	-509			
10:1	-505			
20:1	-493			
30:1	-486			
50:1	-477			
75:1	-470			
100:1	-465			
500:1	-437			
1000:1	-425			

5/25/98

Cont. Pg 36

cont on p35

from 35

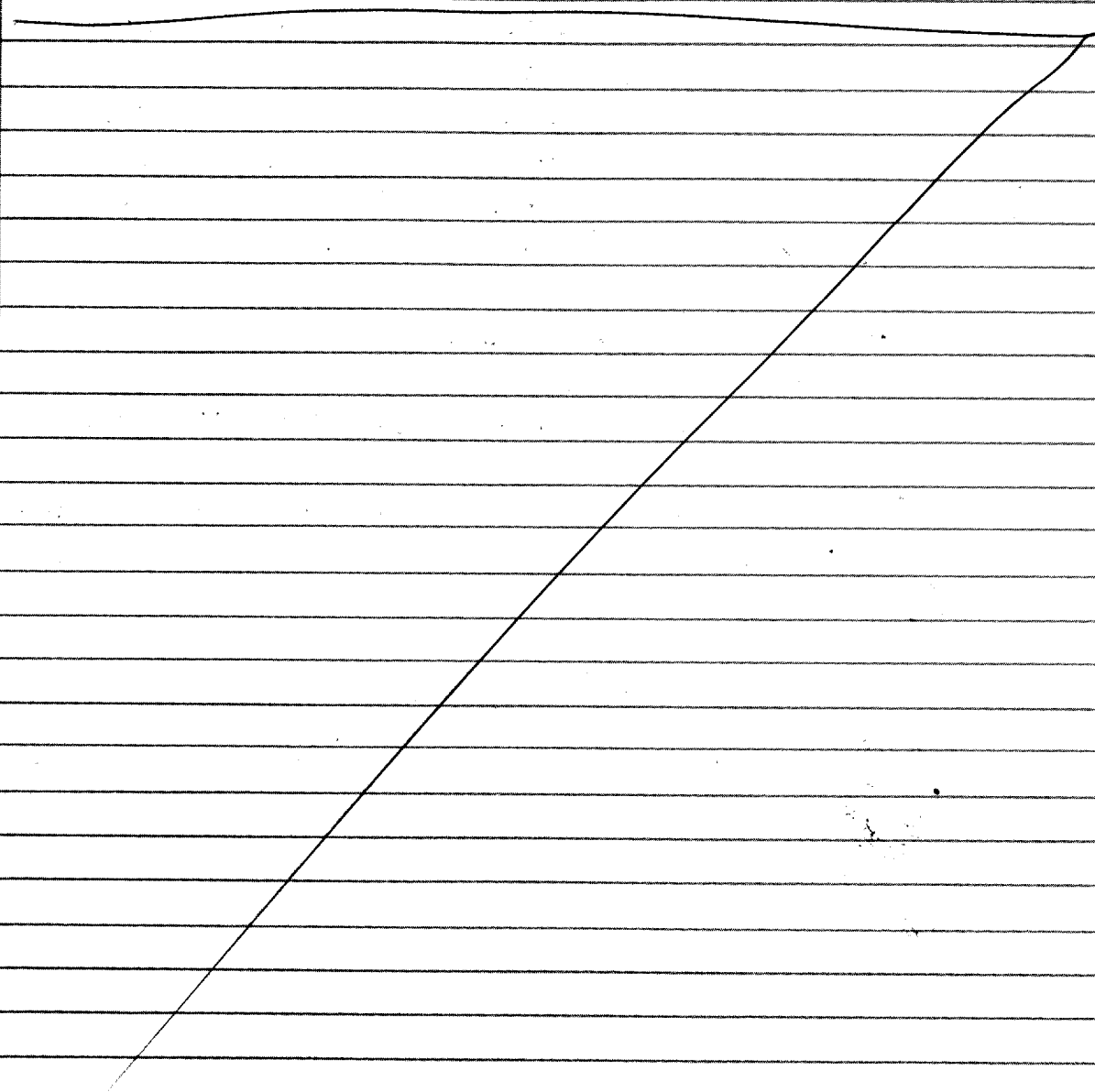
5-26-98

Stock Solution

$\text{PH} = 11 \rightarrow 12 \text{ mm } \text{Na}_2\text{CO}_3 \Rightarrow 2.54376 \text{ g/2L Fidelity 960685}$
 $\rightarrow 71 \text{ ppm Cl} \Rightarrow .233768 \text{ g/2L Fidelity 972274}$

Initial PH = 11.075 *MLB* 5-25-98

All samples polished to 600 grit & cleaned w/ Acetone in Ultrasonic



MLB 5-26-98

Cont pg 37

from 36

Cell 1 A516PS10.DAT

Temp = 20°C

Eset = -314 mV

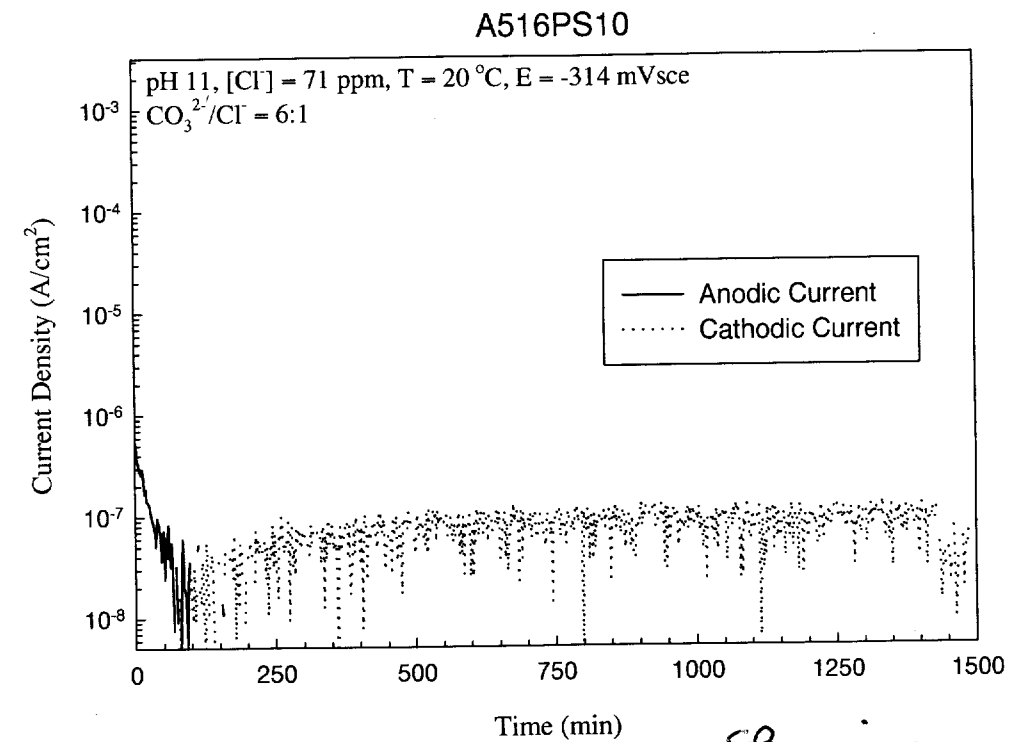
Init Sample wt = 11.44881 g

Final Sample wt = 11.44732 g *MLB* 5/27/98

Final Solution PH = 11.030 *MLB* 5/27/98

Observations

No corrosion/pitting evident on entire sample



MLB 5-26-98

Cont pg 38

From 37

Cell 2

A516PS11.DAT

Temp = 95°C

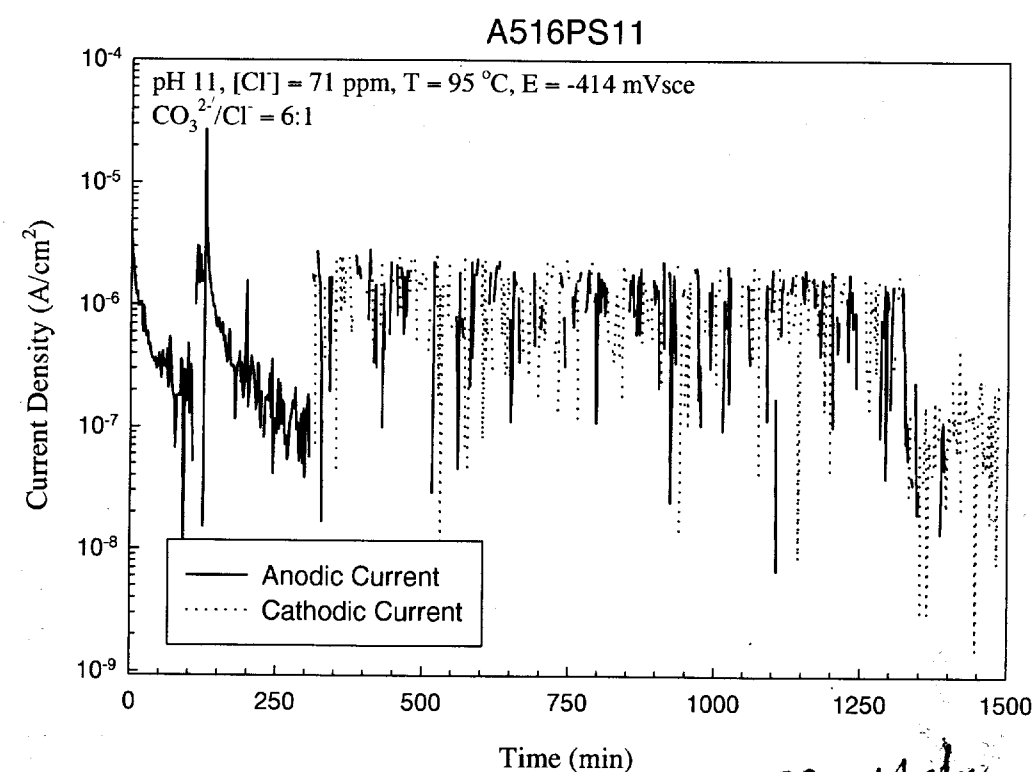
Eset = -414 mV

Init Sample wt = 11.40642 g

Final Sample wt = 11.40461 g M. B. 5/27/98

Final Solution pH = 11.213 M. B. 5/27/98

Observations vapor phase & water line attack



SB 4/2/98

H. Q.

5-28-98

Cont pg 39

From 38

Cell 3

A516PS12.DAT

Temp = 95°C

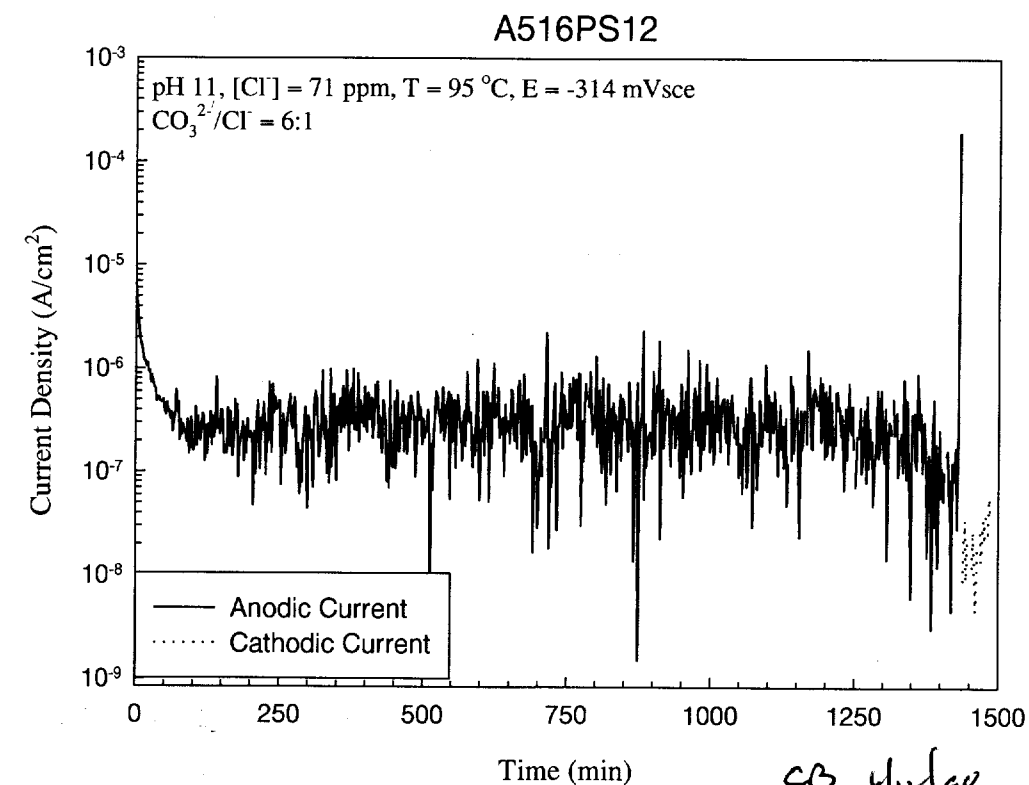
Eset = -314 mV

Init Sample wt = 11.38665 g

Final Sample wt = 11.38572 g M. B. 5/27/98

Final pH of Solution = 11.271 M. B. 5/27/98

Observations vapor phase and water line attack



SB 4/2/98

H. Q.

5-28-98

Cont 40

From 39

5-28-98

Stock Solution

PH-11 \rightarrow 12 mm $\text{Na}_2\text{CO}_3 \Rightarrow 2.54376 \text{ g/Lt}$ Fid. Lt 960685

1 \rightarrow 53 ppm Cl $\Rightarrow .175326 \text{ g/Lt}$ Fid. Lt 972274

Initial PH = 11.058

S-28-98

All Samples polished to 600 grit & ultrasonically cleaned in Acetone

S-28-98

Cat 41

From 40

Cell 1

A516

A516PS13.DAT

Temp = 20°C

Eset = -309 mV

Init Sample Wt = 11.45128 g

Final Sample Wt = 11.45098 g

S-29-98

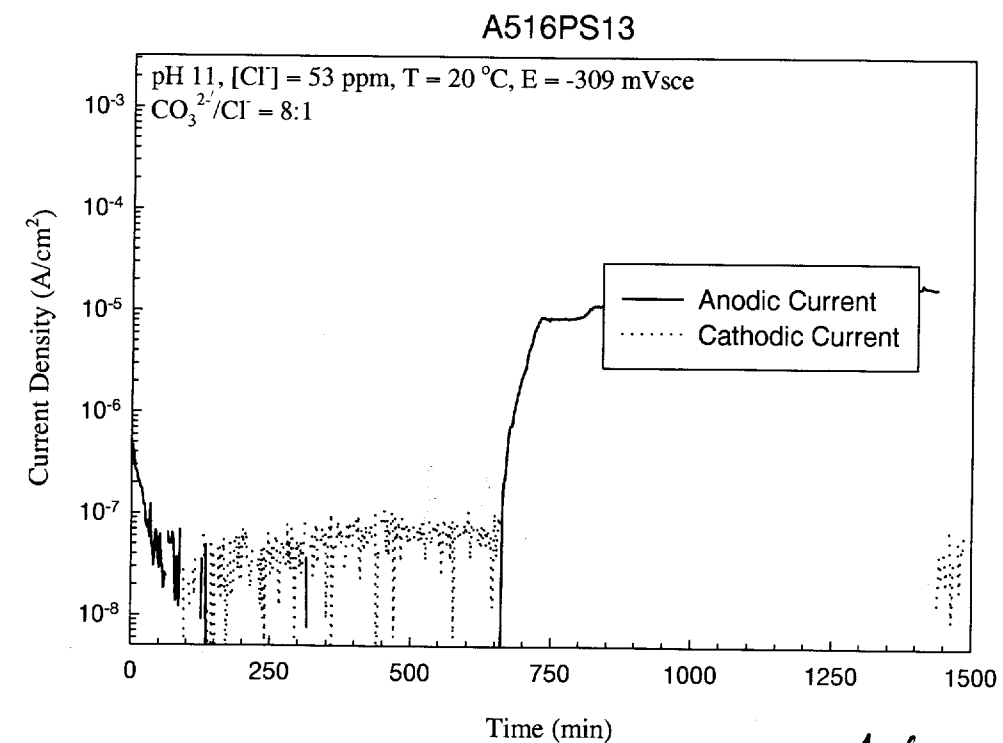
Final Solution PH = 11.058

S-29-98

Observations

No pitting, slight buildup at vapor line

S-29-98



S-29-98

S-28-98

Cont 42

From 41

Cell 2 A516PS14.DAT

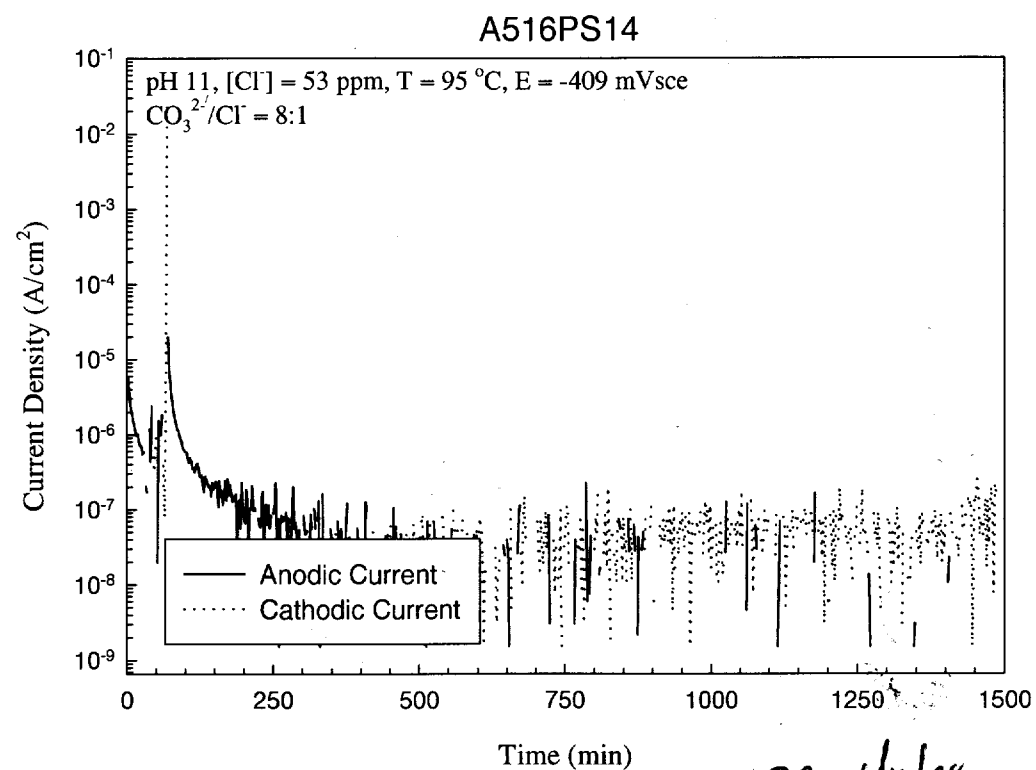
Temp = 95°C

Eset = -409 mV

Initial Sample wt = 11.40596g

Final Sample wt = 11.40569g *SB 5-29-98*Final Solution pH = 10.6 *SB 5-29-98*

Observations

No Pitting, slight vapor changes *SB 5-29-98**SB 5-28-98*

Cont 43

From 42 Cell 3 A516PS15.DAT

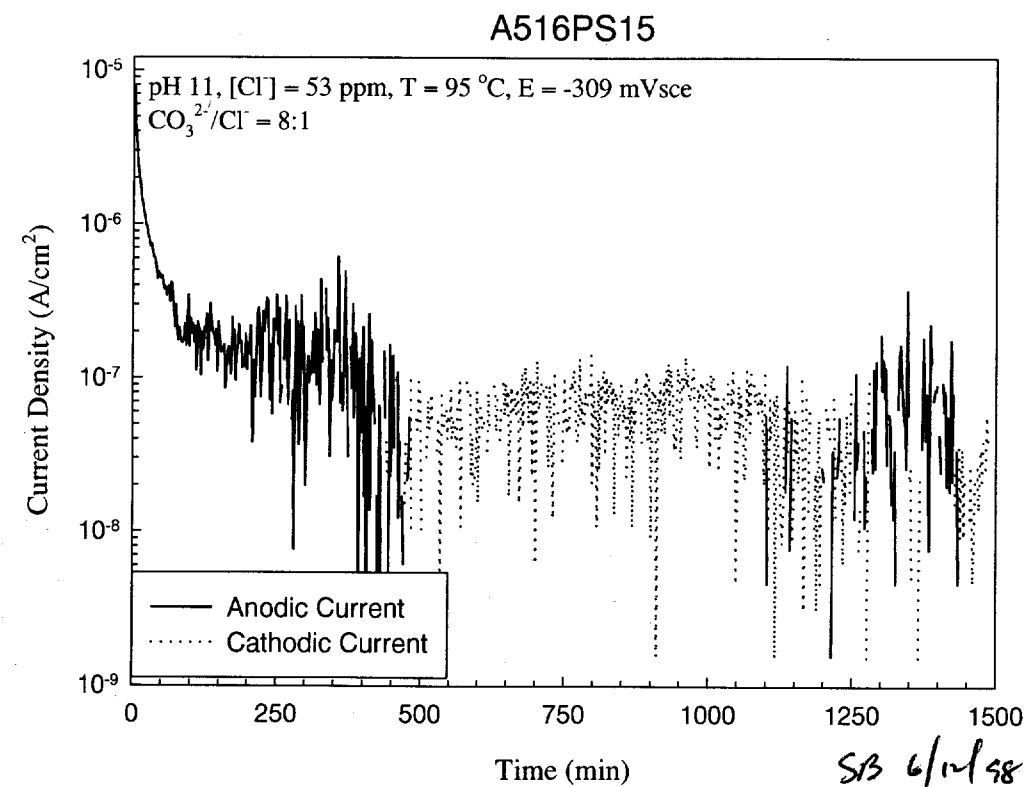
Temp = 95°C

Eset = -309 mV

Initial Sample wt = 11.46107g

Final Sample wt = 11.46065g *SB 5-29-98*Final Solution pH = 11.102 *SB 5-29-98*

Observations

No Pitting, slight vapor attack *SB 5-29-98**SB 5-28-98*

Cont 44

from 43

6-1-98

Stock Solution

pH=11 \rightarrow 12 mm $\text{Na}_2\text{CO}_3 \Rightarrow 2.54376\text{g}/2\text{L}$ Fisher # 960685
 \rightarrow 42 ppm Cl $\Rightarrow .14026\text{g}/2\text{L}$ Fisher # 972274

Initial pH = 11.071 *SB* 6-1-98

All Samples polished to 600 grit + ultrasonically cleaned in Acetone

SB 6-1-98

Cont 45

from 44

Cell 1 A516PS16.DAT

Temp = 20°C

Eset = -305 mV

Init Sample wt = 11.37783g *SB* 6-1-98Final Sample wt = 11.37754g *SB* 6-2-98Final Solution pH = 10.842 *SB* 6-2-98

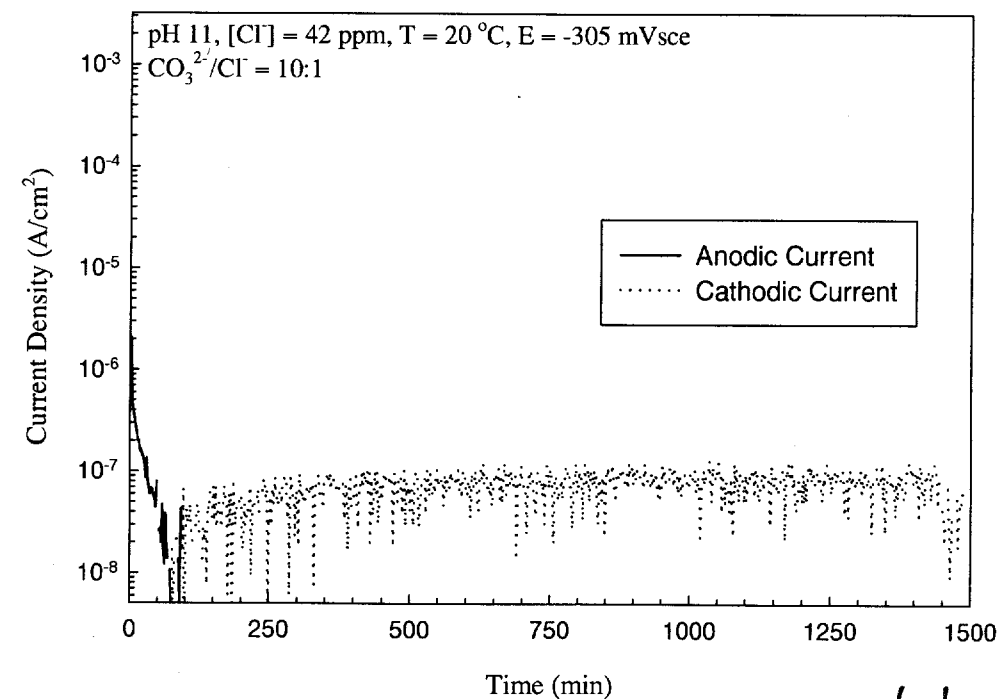
Observations

No Pitting or changes noticed below vapor line

Some small marks in vapor area

SB 6-2-98

A516PS16

*SB* 6/2/98

SB 6-1-98

Cont 46

from 45

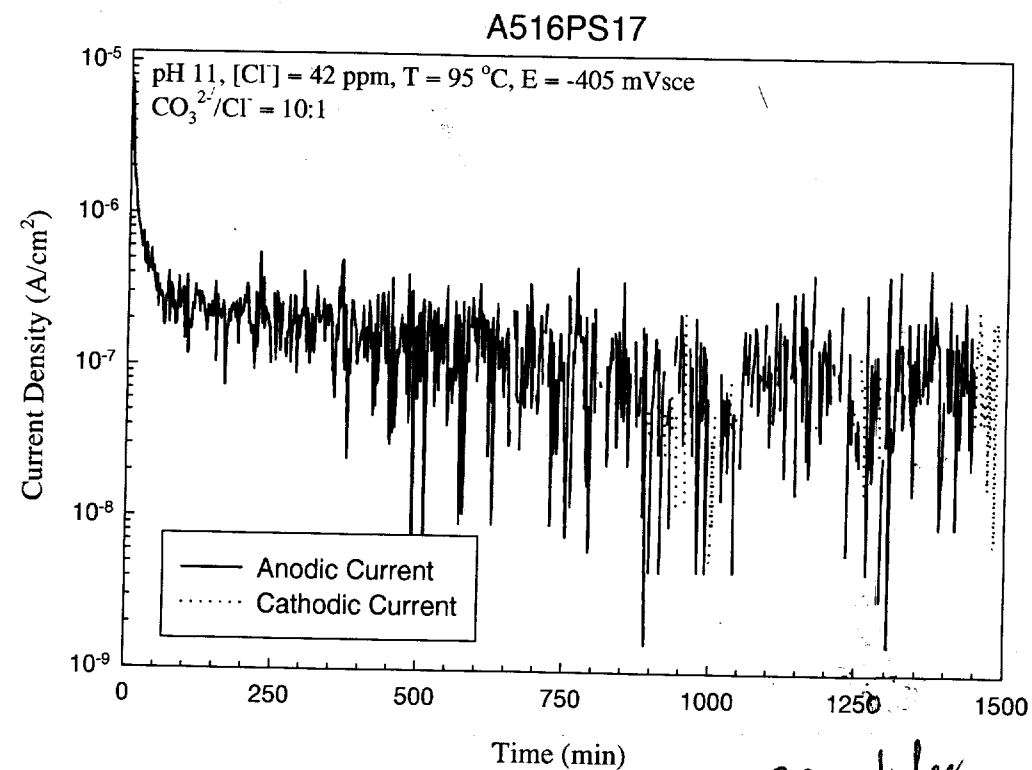
Cell 2 A516PS17.DAT

Temp = 95°C

Eset = -405 mV

Init Sample wt = 11.30289g *6-1-98*Final Sample wt = 11.29953g *6-2-98*Final Solution pH = 10.770 *6-2-98*

Observations

No pitting noted below vapor line, discoloration
in vapor area *6-2-98**6-1-98 Cont 47*

from 46

Cell 3 A516PS18.DAT

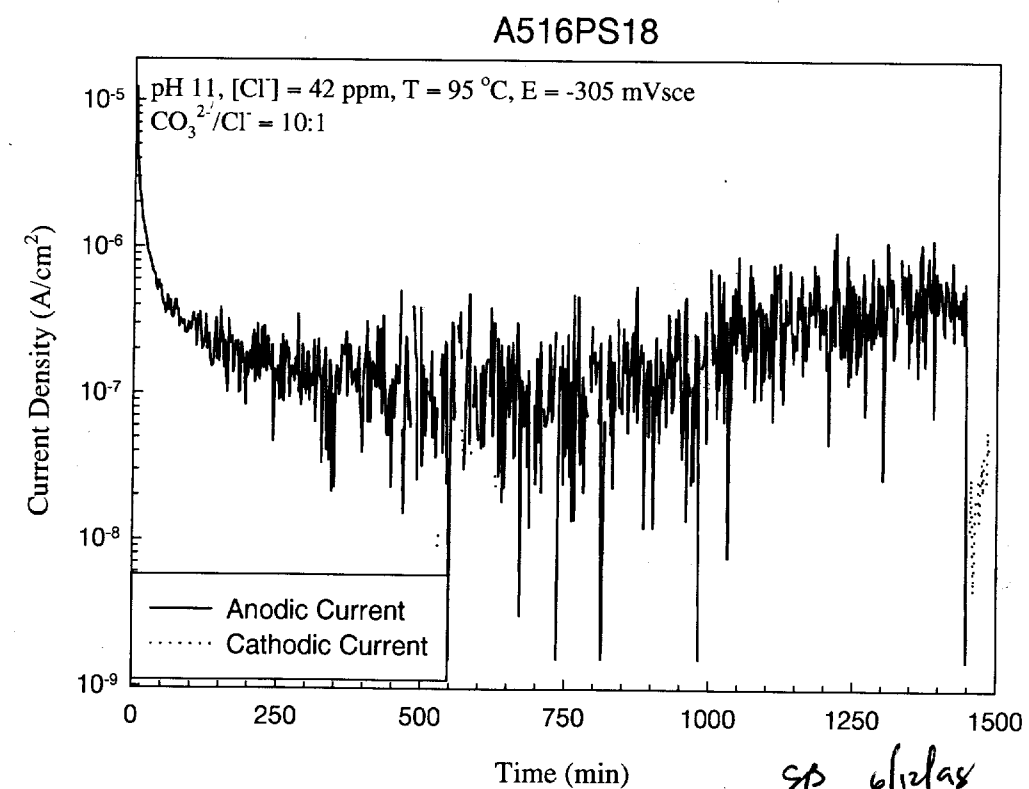
Temp = 95°C

Eset = -305 mV

Init Sample wt = 11.41842g *6-1-98*Final Sample wt = 11.41528g *6-2-98*

Final Solution pH = 10.861

Observations

No pitting noted below vapor line, discoloration
and slight rusting in vapor area *6-2-98**6-1-98 Cont 48*

from 47

6-2-98

Stock Solution

 $\text{PH} = 11 \rightarrow 12 \text{ mm Na}_2\text{CO}_3 \Rightarrow 2.54376 \text{ g/Lt Fisher Lot \# 960685}$
 $\Rightarrow 21 \text{ ppm Cl} \Rightarrow .07013 \text{ g/Lt Fisher Lot \# 972274}$
Initial PH = 11.047 *ML* 6-2-98

All Samples polished to 600 Grit & ultrasonically cleaned in Acetone

48

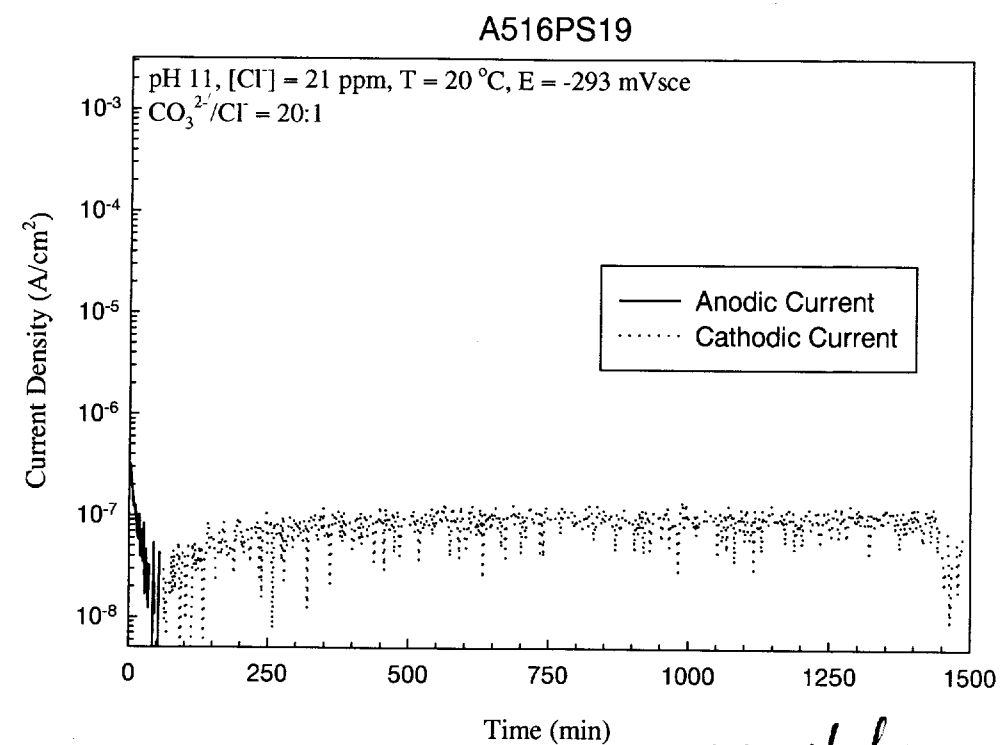
Cell

A516PS19, NAT

Temp = 20°C

E_{set} = -293 mVInit Sample wt = 11.38535g *ML* 6-2-98Final Sample wt = 11.38623g *ML* 6-3-98redox = 11.38593g *ML*Final Solution PH = 11.029 *ML* 6-3-98

Observations

No pitting observed *ML* 6-3-98*ML* 6/17/98*ML*

6-2-98

Cont 49

ML

6-2-98

Cont 50

Lor 49

Cell 2 A516PS20.DAT

Temp = 95°C

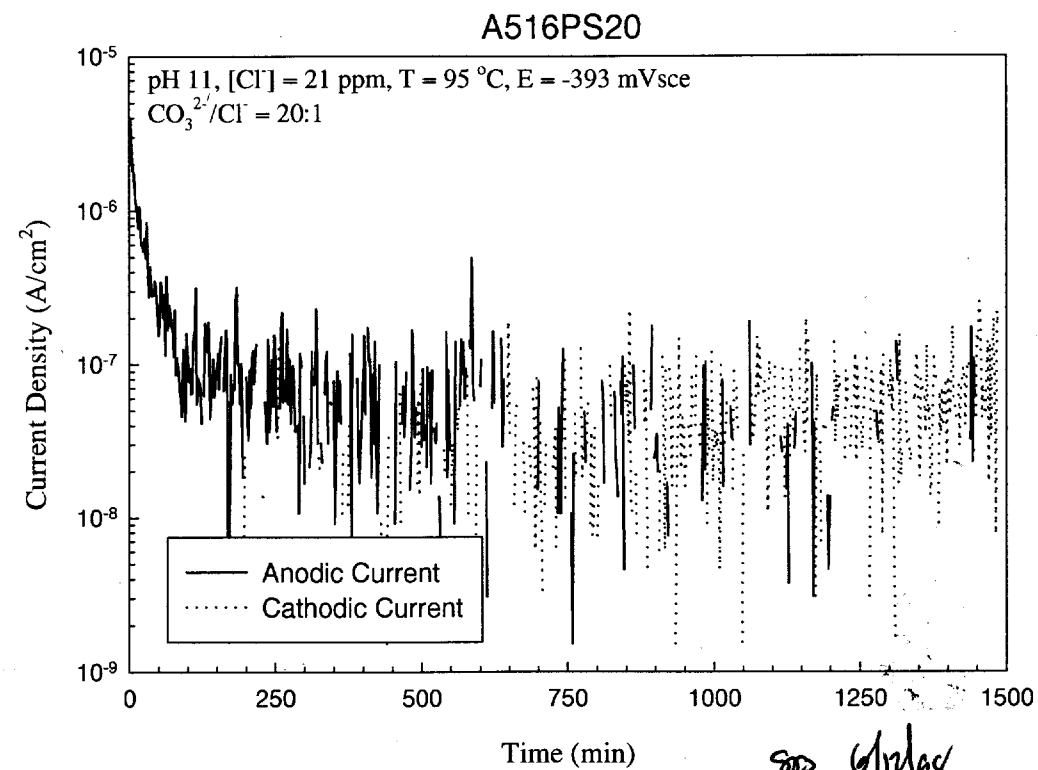
Eset = -393 mV

Init Sample wt = 11.43569 g 6-2-98

Final Sample wt = 11.434945 g 6-3-98

Final Solution PH = 10.741 6-3-98

Observations

1/4" loss of solution Some rusting in vapor area
none in solution 6-3-98

6-2-98

Cont 51

Lor 50

Cell 3 A516PS21.DAT

Temp = 95°C

Eset = -293 mV

Init Sample wt = 11.39660 g 6-2-98

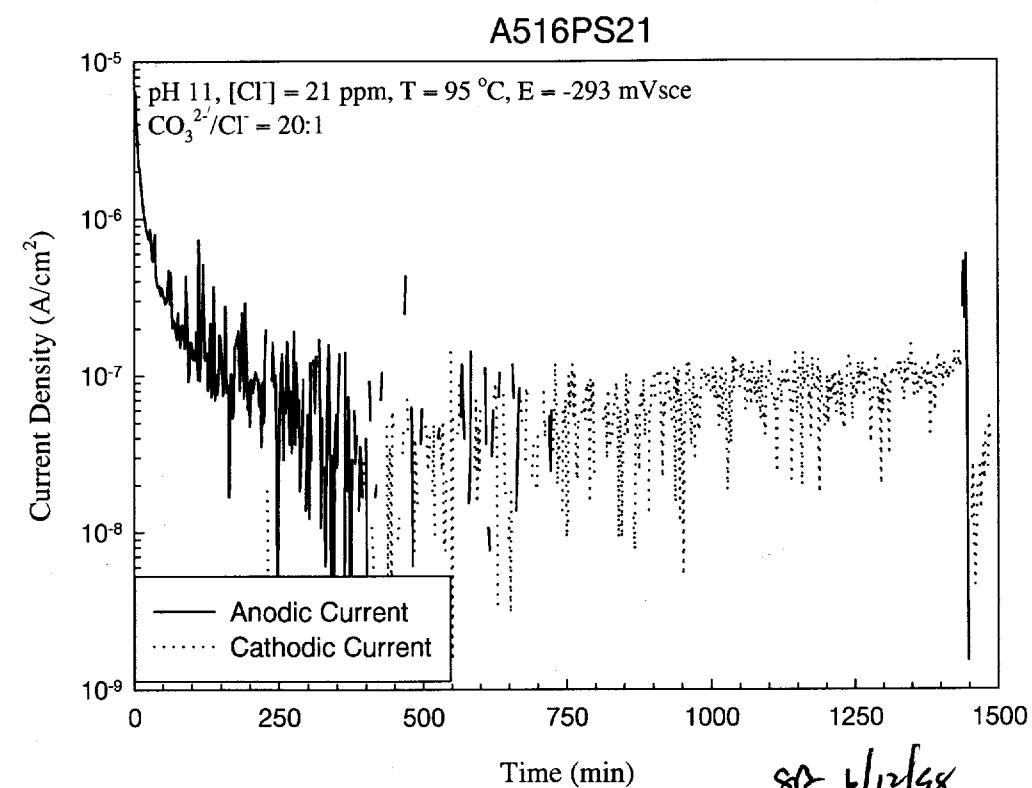
Final Sample wt = 11.39482 g

Final Solution PH = 11.117 6-3-98

Observations

1/4" loss of solution 6-3-98

Some rusting in vapor area none in solution 6-3-98



6-2-98

Cont 52

from S1

6-3-98

Start Solution

PH = 11 \rightarrow 12 mm $\text{Na}_2\text{CO}_3 \Rightarrow 2.54376\text{g}/2\text{L}$ Fisher Lot# 960685
 \rightarrow 14 ppm Cl $\Rightarrow .046754\text{g}/2\text{L}$ Fisher Lot# 972274

PH Initial = 10.969

All samples polished to 600 grit + ultrasonically cleaned in Acetone

St. Q 6-3-98

Cont 53

from S2

Cell 1

A516PS22.DAT

Temp = 20 °C

E_{set} = -286 mV

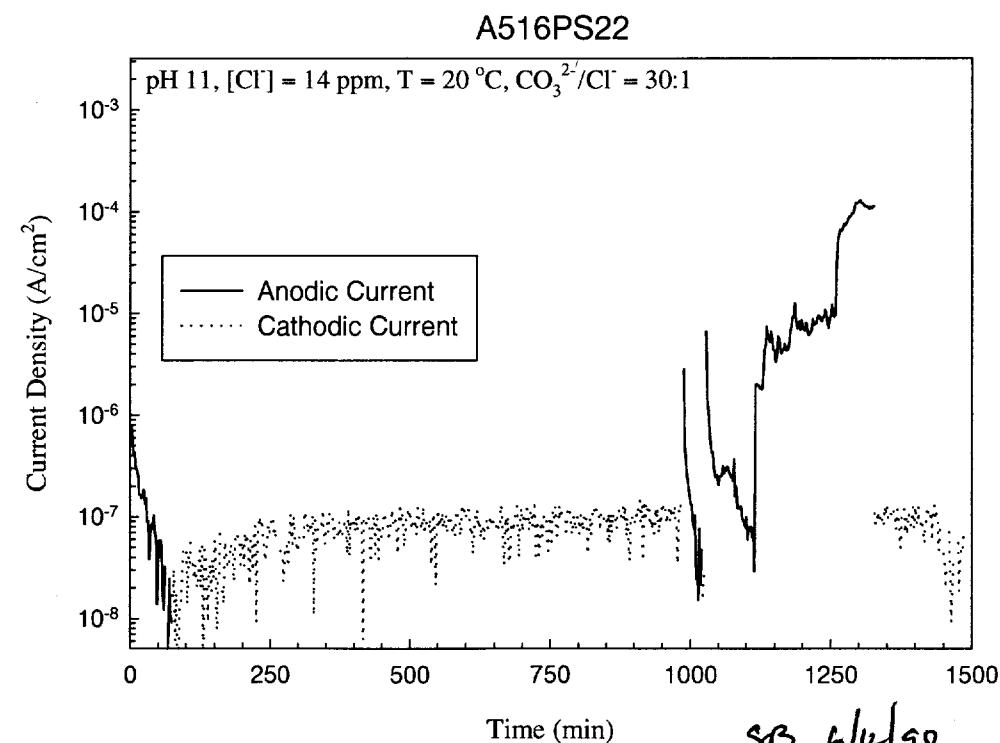
Init wt = 11.34903g

Final wt = ~~11.053~~ 11.34569g 6-4-98

Final Solution PH = 11.053 6-4-98

Observations - no attack observed ^{6/12/98} incr.

CSB 6/12/98 potential to ~~10~~ ⁺⁶² V_{sce} @ 810' Am 6/12/98
 no pitting - increased E to +490 mV - 1 small pit
 observable to 15 Am - incr. E to E_{pot} +250 (790 mV)
 End at 2000 pitting + particulate on specimen 6-4-98



CSB 6/12/98

St. Q 6-3-98

Cont 54

from 53

Cell 2 A516PS23.DAT

Temp = 95°C

Eset = -386 mV

Init wt = 11.35095 g

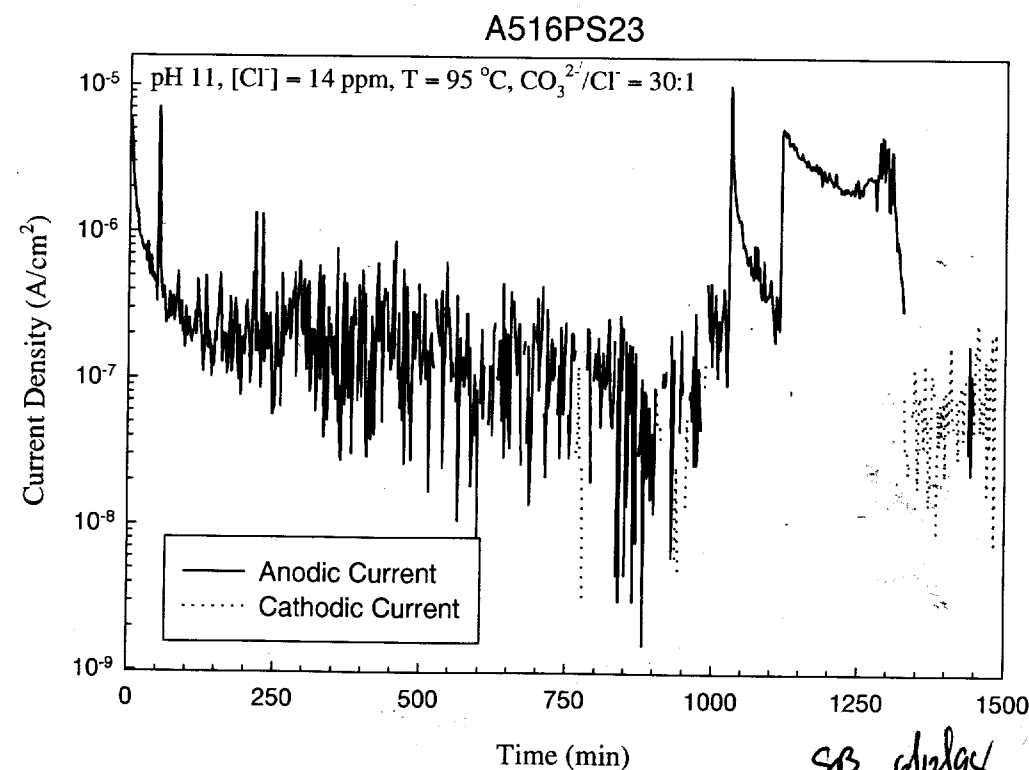
Final wt = 11.35102 g 6-4-98

Final Solution PH = 11.009 6-4-98

Observations - no pitting obs. E_{rp} @ 95°C w/ 14 ppm Cl^- is approx -438 mV_{sce} (-196 mV_{she}) $E_{pit} = 590$ mV_{sce}; potential increased to $E_{rp} + 250 = -188$ @ 8¹⁰ am 6/4/98 csg9 am no pitting - increased E to $E_{pit} - 200 = +390$ 10¹⁵ no pits observable, E incr. to $E_{pit} + 100 = 690$ mV

End 200 ppm corrosion above water in vapor area

no pitting observed in solution 6-4-98



6-3-98 Cont 55

from 54

Cell 3 A516PS24.DAT

Temp = 95°C

Eset = -286 mV

Init wt = 11.36644 g

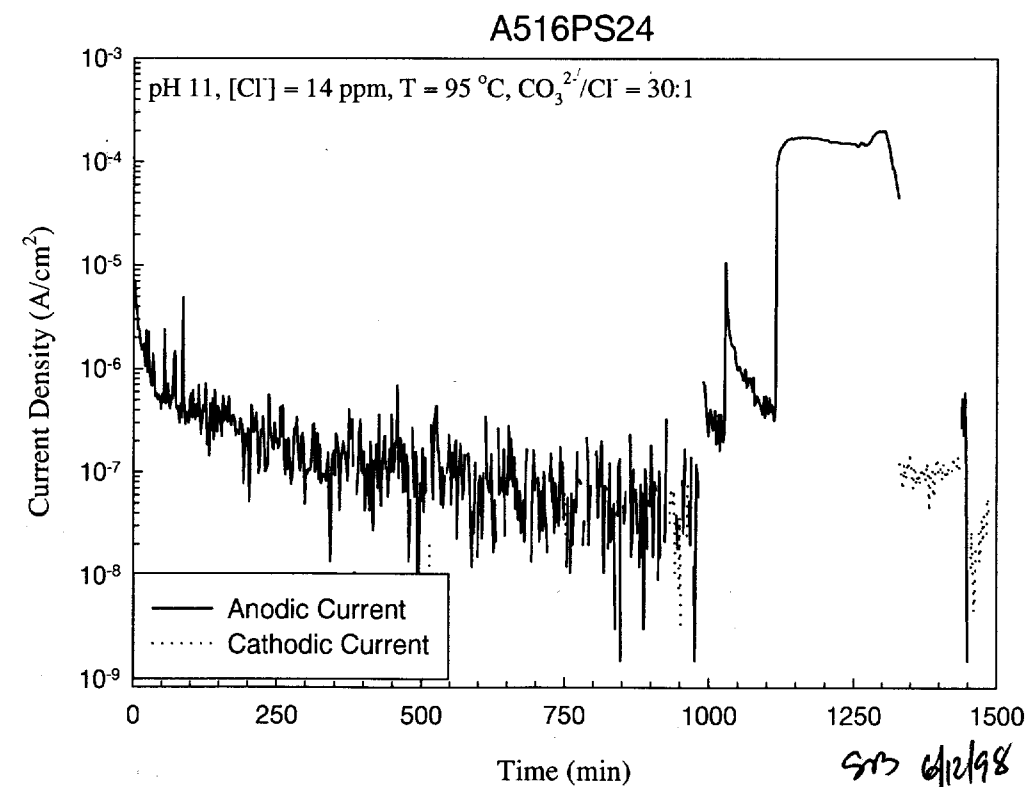
Final wt = 11.36351 g 6-4-98

Final Solution PH = 11.165 6-4-98

Observations - no pitting as E_{rp} @ 95°C w/ 14 ppm Cl^- is approx -438 mV_{sce} (-196 mV_{she}); $E_{pit} = 590$ mV_{sce}CSB 6/4/98 E increased to $E_{rp} + 500 = +62$ @ 8¹⁰ am 6/4/98 csg9 am no pitting, increased E to $E_{pit} - 100 = +490$ 10¹⁵ no pits observable - E incr. to $E_{pit} + 200 = 790$ mV

End 200 ppm corrosion in vapor area no pitting

observed in solution 6-4-98



6-3-98

Cont 56

from 55

6-4-98

Stock Solution

→ 60 mm $\text{Na}_2\text{CO}_3 \Rightarrow 12.71880 \text{ g/21}$ → 100 ppm Cl $\Rightarrow .32958 \text{ g/21}$

Initial pH = 11.277

All samples polished to 600 Grit + ultrasonically cleaned in Acetone

6-4-98

Cat 57

from 56 Cell 1

A516PS25.NAT

Temp = 20°C

 $E_{\text{set}} = -200 \text{ mV}$

Init wt = 11.37092 g

Final wt = 11.36997 g

6-5-98

Final Solution pH = 11.286

6-5-98

Observations 8⁰⁵ AM no noticeable pitting 6/5/98E_{mer} to 243 mV/sec @ 8¹⁵

9 AM - cathode held for 10 min @ -750 mV

then reinstated to previous potential (-243)

9³⁰ AM potential to +750

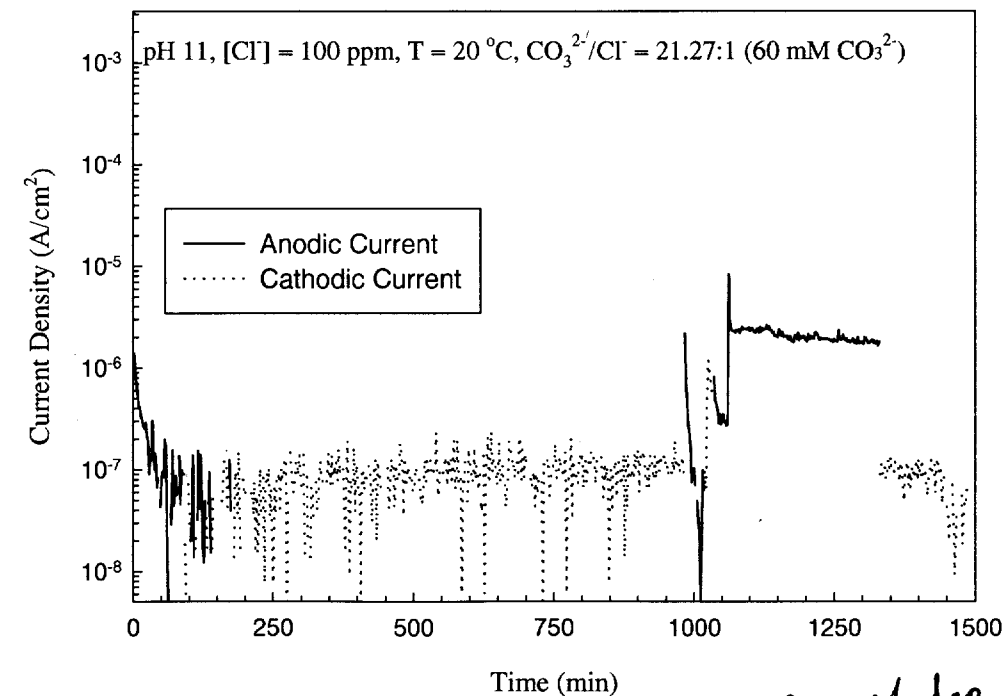
End 2:00 PM 6-5-98 79912 seconds

Some small pitting on sample base to side in to fire

Slight discoloration overall

6-5-98

A516PS25



SP 6/12/98

6-4-98

Cat 58

From 57

Cell 2 A516PS26, DAT

Temp = 95°C

Eset = -300 mV

Init wt = 11.36067 g

Final wt = 11.36031 g 6-5-98

Final pH of Solution = 10.981 6-5-98

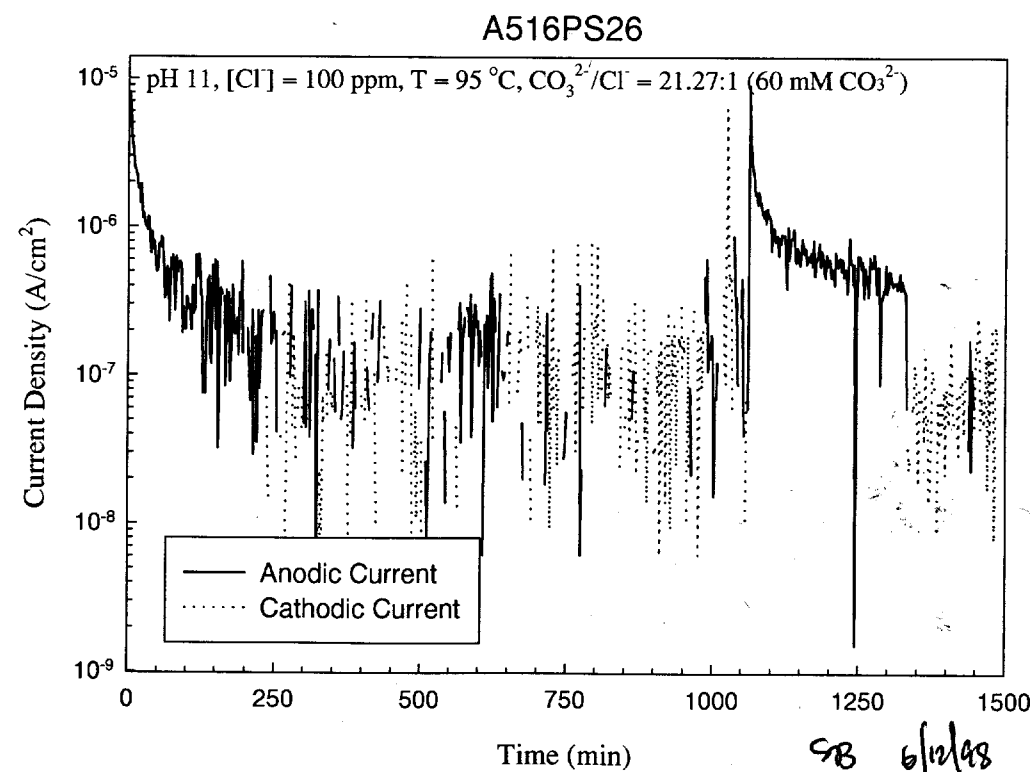
Observations 805 no noticeable pitting 6/5/98

E_{pit} (mV SCE) = -159 - 242 log [Cl⁻] = +343 mV SCEE_{meri} to E_{pit} - 200 = 143 mV SCE @ 8159^{am} - cathodic hold @ -750 mV for 10 min then

reinstated to previous potential (+143)

9³⁰ incr. potential to +650

No pitting observed, slight change in vapor area 6-5-98



6-4-98

C-59

Cell 3 A516PS27, DAT

Temp = 95°C

Eset = -200 mV

Init wt = 11.30834 g

Final wt = 11.30820 g 6-5-98

Final Solution pH = 11.315 6-5-98

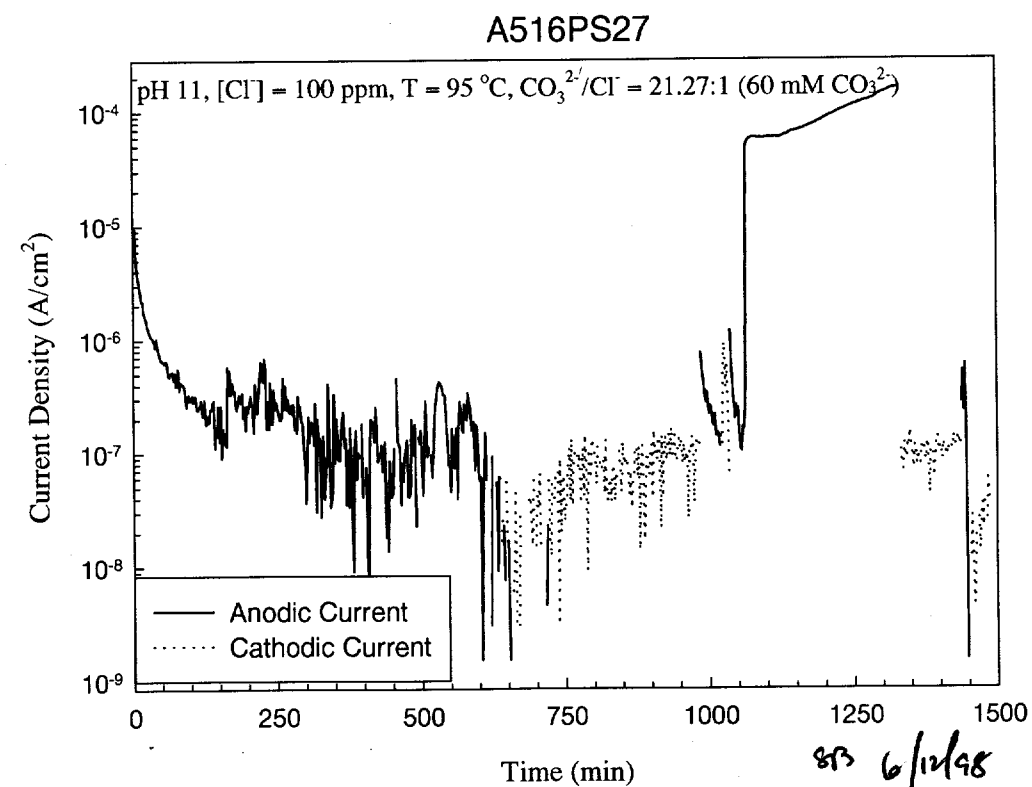
Observations 805 am no noticeable pitting 6/5/98

G incr. to E_{pit} - 100 = 243 mV SCE @ 8159^{am} - cathodic hold @ -750 mV for 10 min then

reinstated to previous potential (+243)

9³⁰ incr. potential to +750

no pitting 6-5-98



6-4-98

C-60

from 59

6-8-98

Stock Solution

→ 12 mM $\text{Na}_2\text{CO}_3 \Rightarrow 2.54376 \text{ g/21L}$ Fisher Lot # 960685→ 1000 ppm $\text{Cl}^- \Rightarrow 3.2958 \text{ g/21L}$ Fisher Lot # 972274

Initial pH = 11.036

6-8-98

Crevice sample area ~ 170 cm^2 for total sample incl. hole corr
 All samples polished to 600 grit + ultrasonically cleaned in Acetone
 Crevices cleaned in Methanol (ultrasonic) 6/8/98

Switched to crevice samples to try to
 induce attack @ specific locations
 on sample CSB 6/8/98

Crevice former's loaded to 40 m oz torque using
 torque wrench #2. CSB 6/8/98

6-8-98

Cont 61

from 60

Cell 1

A516PS28.DAT - CREVICE

Temp = 20°C $E_{\text{set}} = -0.450 \text{ V}$

Init wt = 29.29312 g

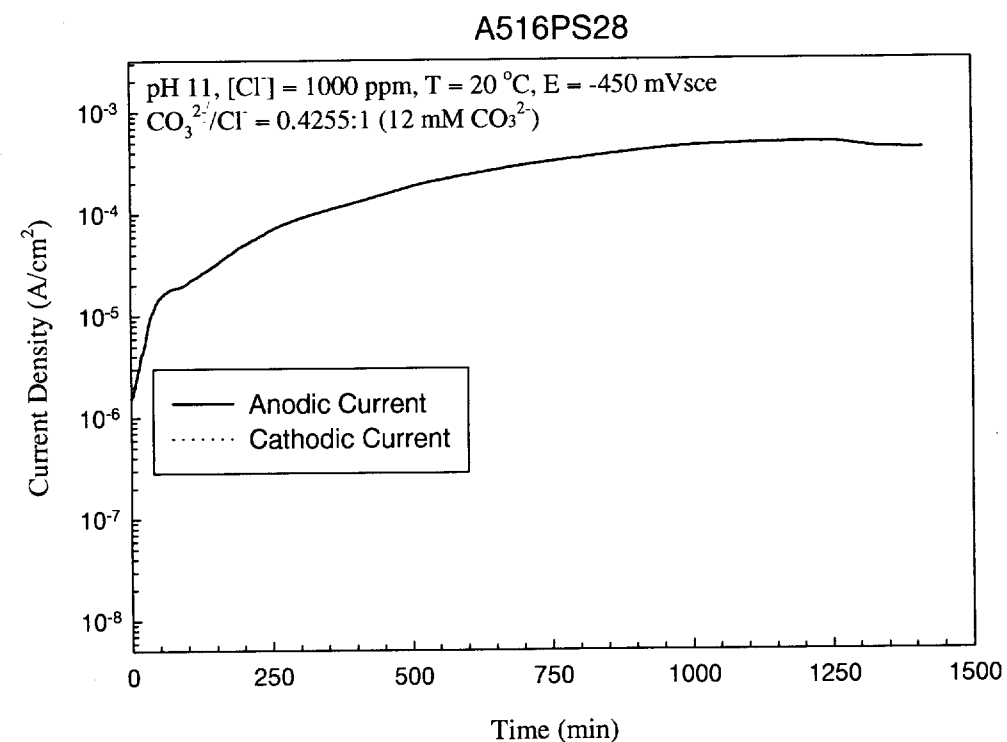
Final wt = 29.17318 g 6-9-98

Final Solution pH = 11.434 6-9-98

Observations Acquisition began @ 1685 s

Particle build occurred much later in test

Massive pitting observed. 6-9-98



9/12 6/12/98

6-8-98

Cont 62

from 61

Cell 2 A516PS29.DAT - crevice

Temp = 65°C

Eset = -0.300 V

Init wt = 29.29714 g

Final wt = 28.67316 g 6-8-98

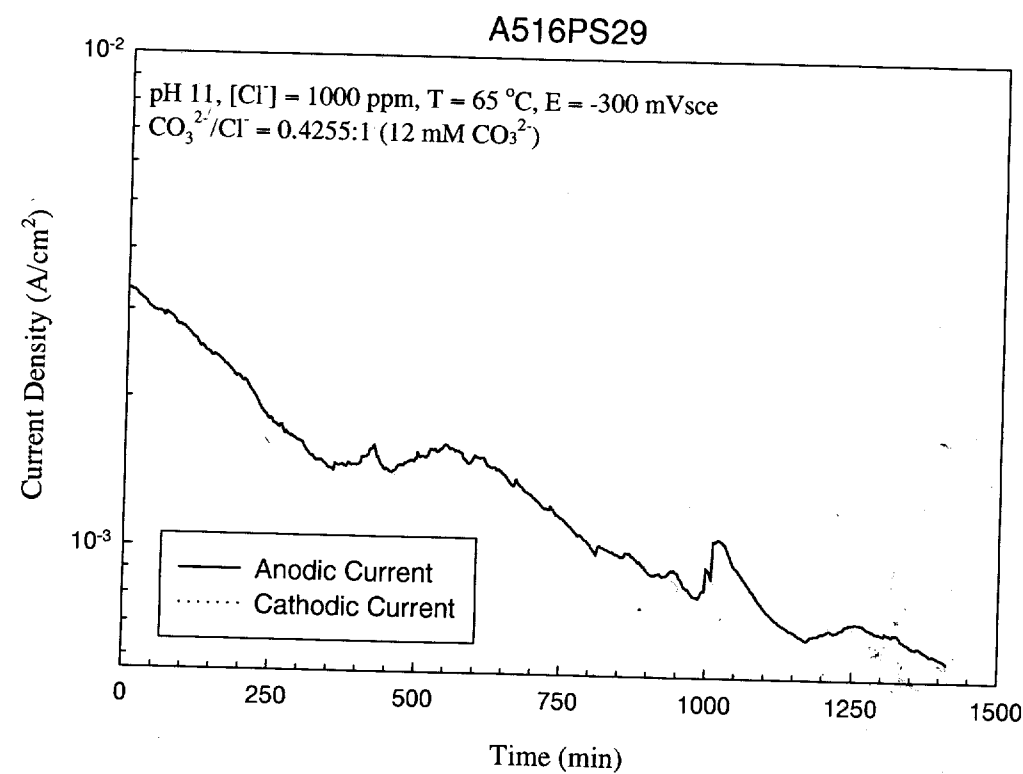
Final Solution pH = 11.507 6-8-98

Observations

Immediately after applying potential, noted buildup accumulating

Acquisition began @ 1685s 6-8-98

Massive pitting



SB 6/12/98

St Q 6-8-98

Cont 63

from 62

Cell 3 A516PS30.DAT - crevice

Temp = 95°C

Eset = -0.050 V

Init wt = 29.34919 g

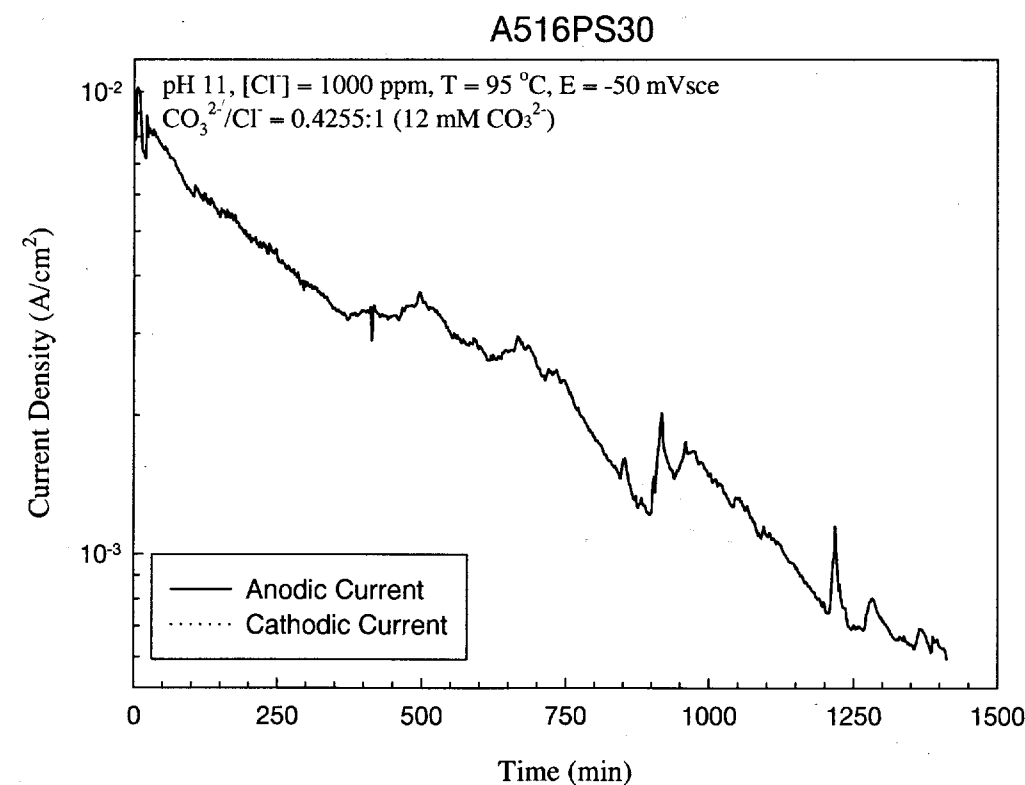
Final wt = 28.08745 g 6-8-98

Final Solution pH = 10.850 6-8-98

Observations

Immediately after applying potential, noted buildup accumulating and rusting taking place. Acquisition began @ 1685s

Massive pitting 6-8-98



SB 6/12/98

St Q 6-8-98

from 63


6-9-98

Stock Solution

→ 12 mm $\text{Na}_2\text{CO}_3 \Rightarrow 2.5437\text{g}/2\text{L}$ Fid. L# 960685→ 100 ppm Cl $\Rightarrow .32958\text{g}/2\text{L}$ Fid. L# 972274

Initial pH = 11.087

All samples polished to 600 grit & ultrasonically cleaned in Acetone
 Crevice material ultrasonically cleaned in Methanol

 6-9-98

Cat 64

from 64


Cell 1 A516PS31, DAT - crevice

Temp = 20 °C


Eset = -400 mV

Init wt = 29.32179g

Final wt = 29.32128g

 6-10-98

Final Solution pH = 11.053

 6-10-98


Observations

Start 6-9-98 / 15:50

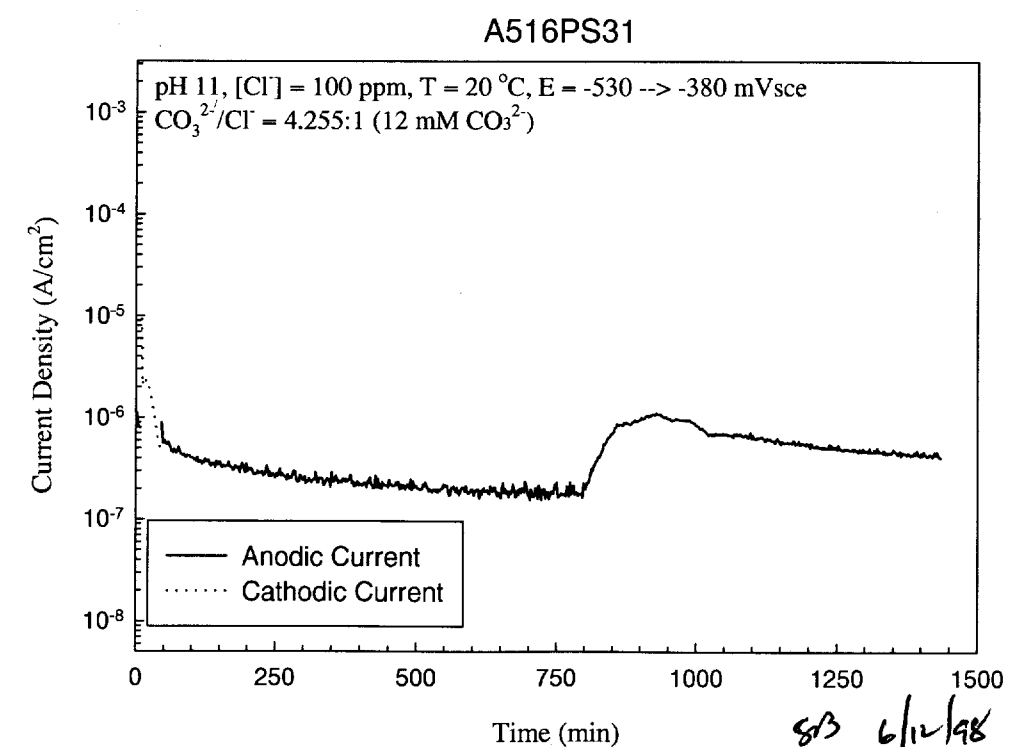
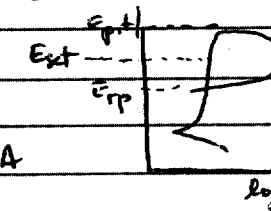
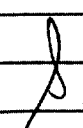
Change Eset to -530 mV @ 600 s

Eset ↑ to -380 mV @ 2700s ~ 1/2 passive range

Crevice pitting observed

 6-10-98
Note "1/2 passive range" = $[E_{pit} - E_{cp}]/2$ E_{pit} & E_{cp} are from Cragg's metal

(Corrosion/98) and other work in A516 C ENURA
 in Lab Notebook #157


 6-9-98

Cat 65

6-65

Cell 2 A516PS32.0AT - crevice

Temp = 65°C

Eset = -250 mV

Init wt = 29.37832 g

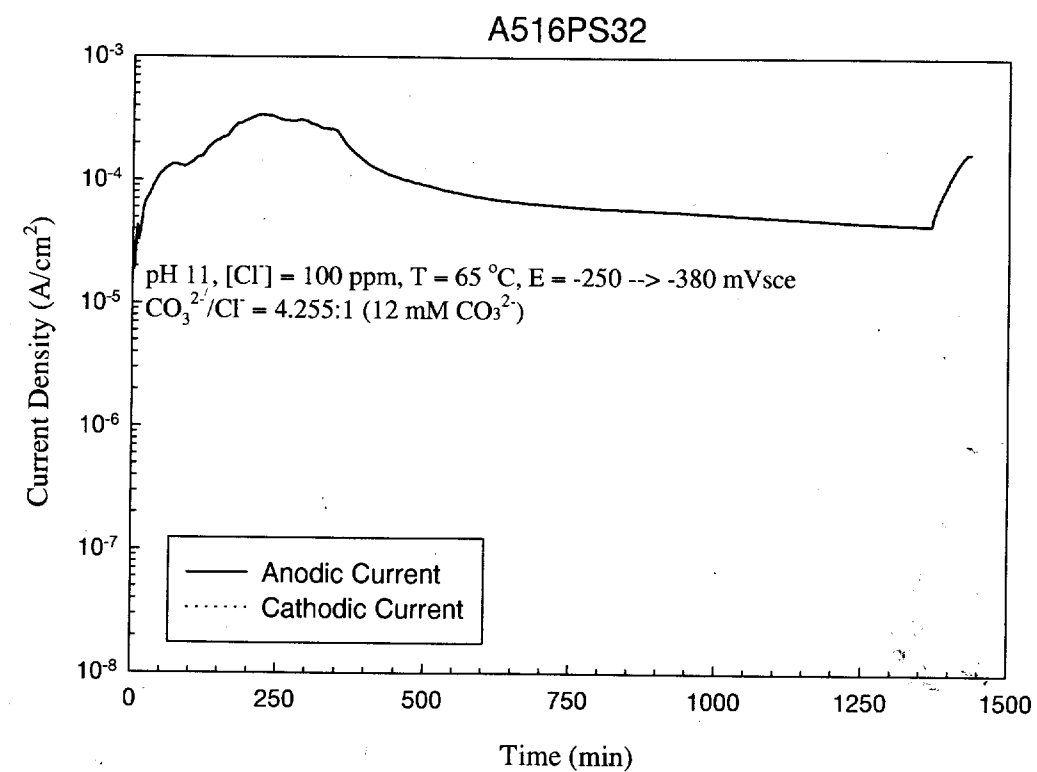
Final wt = 29.32809 g 6-10-98

Final Solution pH = 10.983 6-10-98

Observations

Change Eset -380 mV — 1/2 passive range

Pitting noted on both crevice surfaces but not where crevice made contact. 6-10-98



SBS 6/12/98

6-9-98

Cat 68

6-66

Cell 3 A516PS33.0AT - crevice

Temp = 95°C

Eset = +100 mV

Init wt = 29.32629 g

Final wt = 29.19822 g 6-10-98

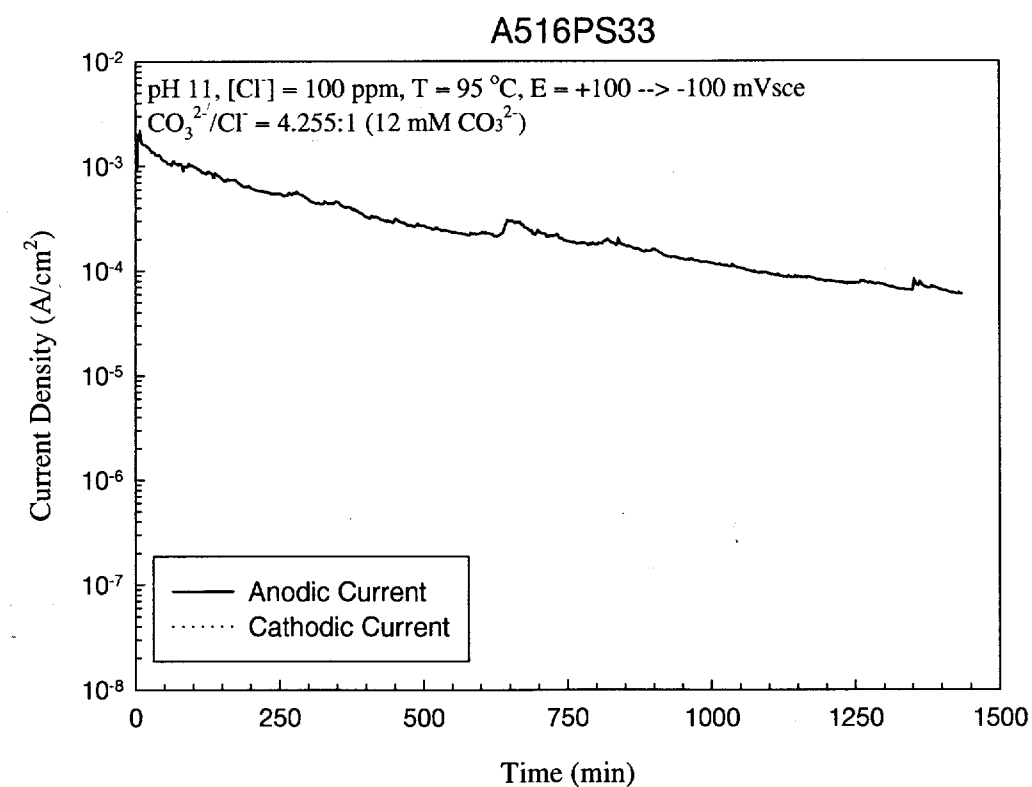
Final Solution pH = 10.668 6-10-98

Observations

Immediate signs of attacking directly after applied potential

Change Eset -100 mV 600 sec into test — 1/2 passive range

massive pitting on all surfaces, not where crevice made contact. 6-10-98



SBS 6/12/98

6-9-98

Run 67

6-11-98

Start Solution

→ 12 mm $\text{Na}_2\text{CO}_3 \Rightarrow 2.54376 \text{ g/L}$ → 10 ppm $\text{Cl} \Rightarrow .032958 \text{ g/L}$ Initial pH = 11.070 6-11-98

All samples polished to 600 grit + ultrasonically cleaned in acetone
 Crevices ultrasonically cleaned in Methanol

SL 1 6-11-98 Cut 69

Run 68

Cell 1 A516PS34.DAT - crevice

Temp = 20°C

Eset = -300 mV w/2 passive range

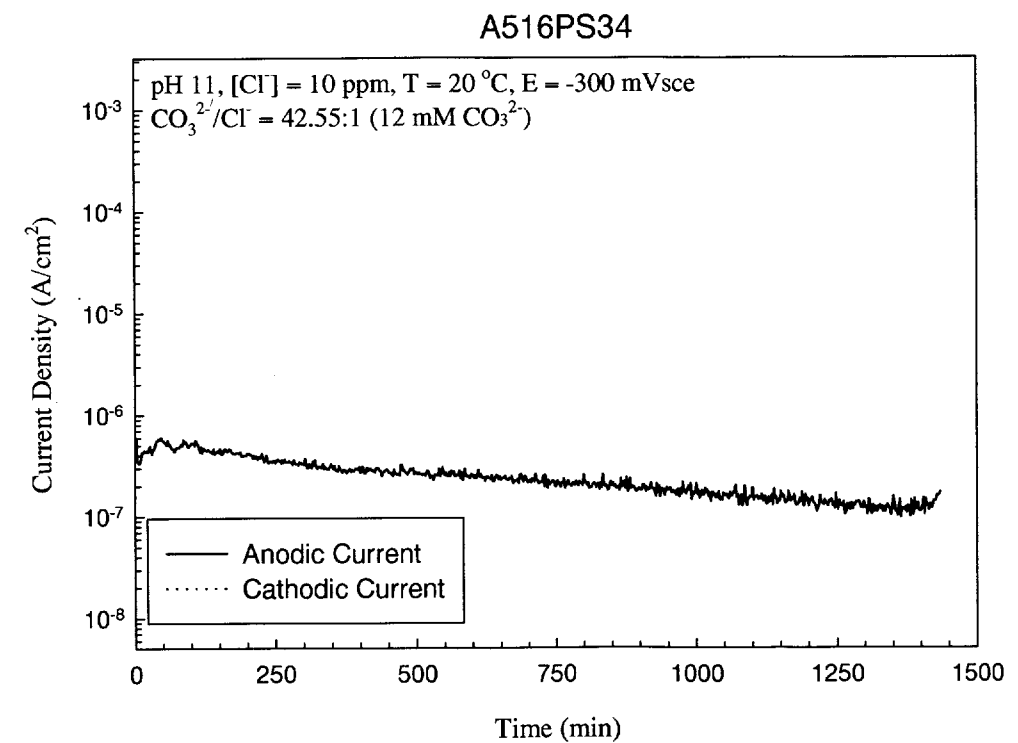
Int wt = 29.23887g

Final wt = 29.23634g

6-12-98

Final Solution pH = 11.048 6-12-98

Observations Begin Test 6-11-98 10:20am

Crevice pitting observed 6-12-98

CS 6/12/98

SL 1 6-11-98

Cut 70

6-11-98

Cell 2

A516PS35.DAT

Temp = 65°C

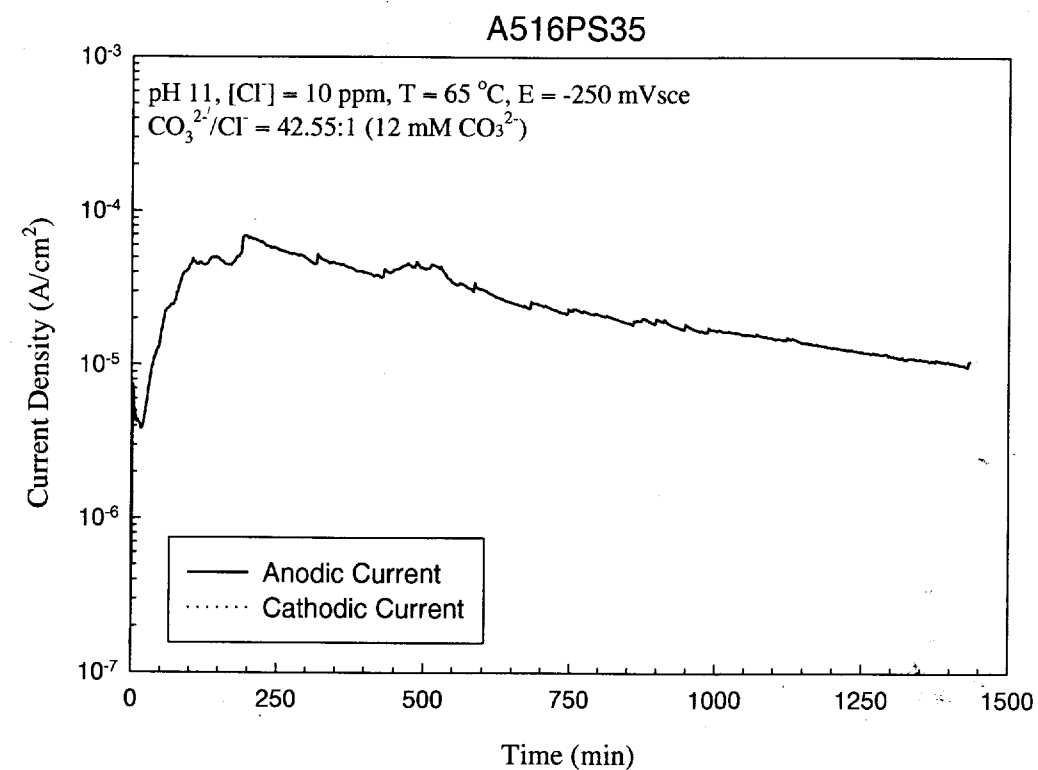
Eset = -250 mV ~ 1/2 passive range

Init wt = 29.25021g

Final wt = 29.23930g 6-12-98

Final Solution PH = 10.774 6-12-98

Observations

Crevice pitting observed with some pitting attack
outside crevice foot area. 6-12-98

6-12/98

6-11-98

Cut 71

6-11-98

Cell 3

A516PS36.DAT

Temp = 95°C

Eset = +100 mV ~ 1/2 passive range

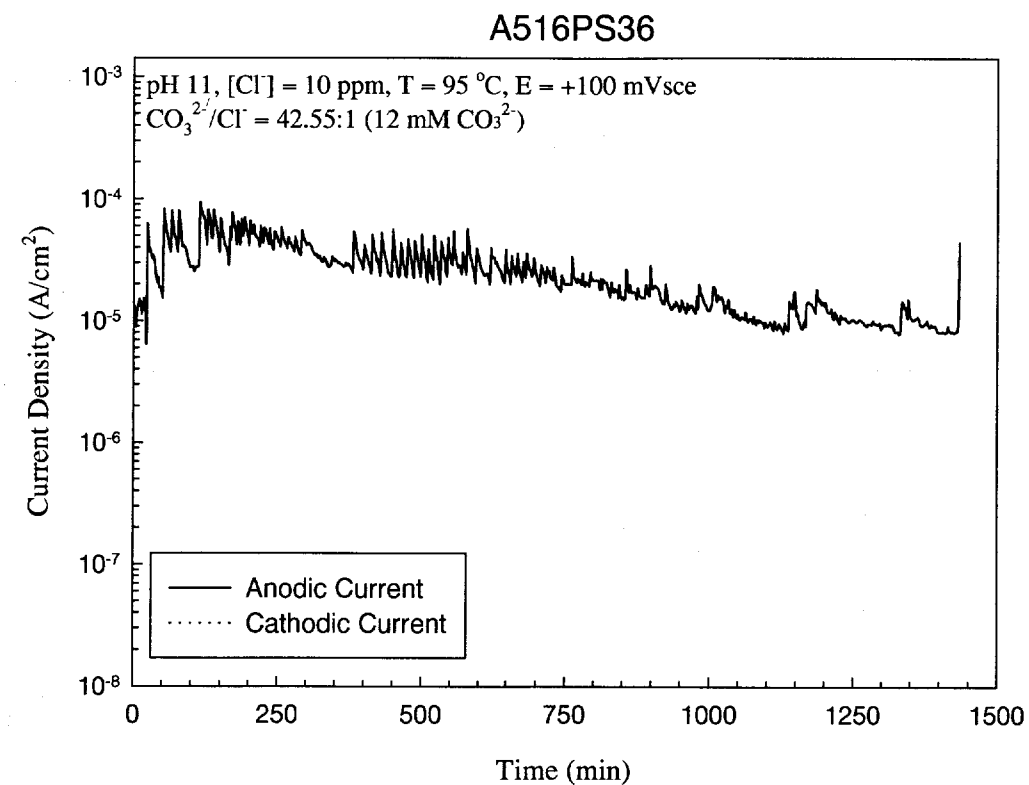
Init wt = 29.29444g

Final wt = 29.28630g 6-12-98

Final Solution PH = 10.796 6-12-98

Observations

Crevice pitting observed. 6-12-98



6-12/98

6-11-98

6-71

6-15-98

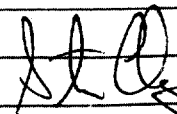
Stock Solution

→ 120 mm Na_2CO_3 ⇒ 25.4376 g / 2L Fisher # 960685

→ 100 ppm Cl ⇒ .32958 g / 2L Fisher # 972274

Initial pH = 11.386

All specimens polished to 600 grit and ultrasonically cleaned in Acetone
 Crevices ultrasonically cleaned in methanol

 6-15-98

Cat 73

6-72

Cell 1 A516PS37.DAT - crevice

Temp = 20°C

Eset = -380 mV

Init wt = 29.27947g

Final wt = 29.27551g

6-16-98

Final Solution pH = 11.352

6-16-98

Observations

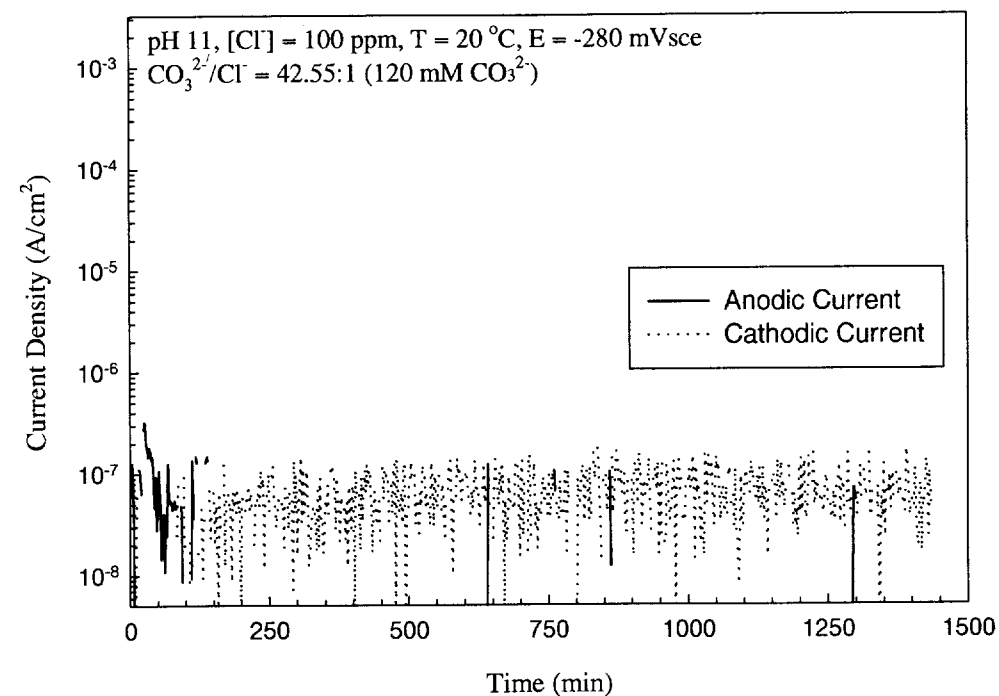
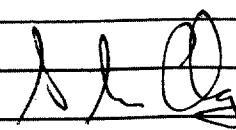
Start 10:33

E incr to -280 mV @ 1420s

No Pitting

6-16-98

A516PS37


 6-15-98

Cat 74

from 73

Cell 2 A516PS38.DAT - crevice

Temp = 65°C

Eset = -350 mV

Init wt = 29.23673g

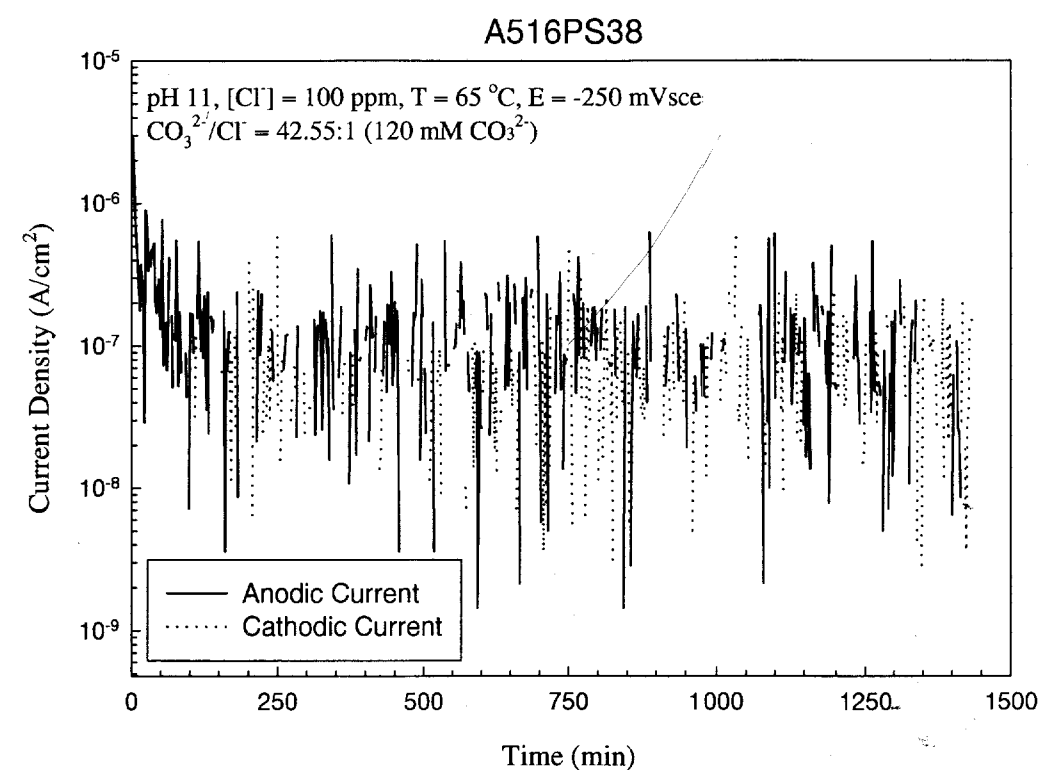
Final wt = 29.23342g 6-16-98

Final Solution pH = 11.114 6-16-98

Observations

E incr. to -200 @ 1420s

No Pitting 6-16-98



6-15-98

Cat 75

from 74

Cell 3 A516PS39.DAT - crevice

Temp = 95°C

Eset = -100 mV

Init wt = 29.33130g

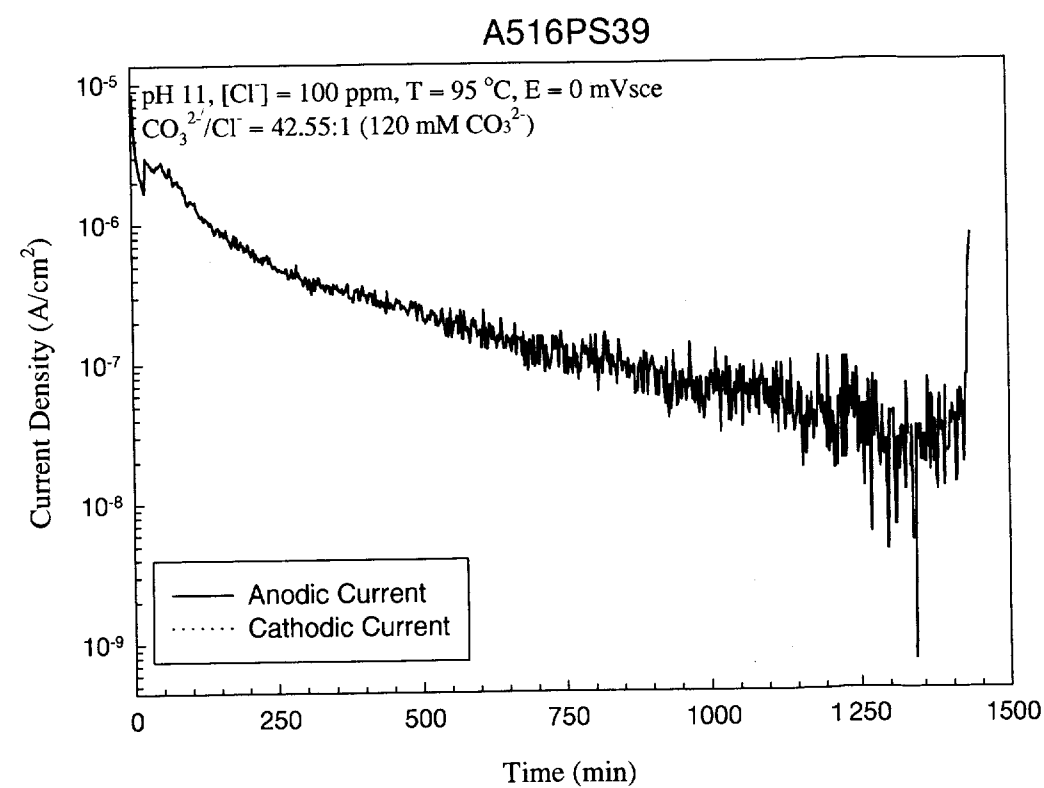
Final wt = 29.32791g 6-16-98

Final Solution pH = 11.107 6-16-98

Observations

E incr. to 0 @ 1420s

Some minor crevice pitting 6-16-98



6-15-98

Run 75

6-16-98

Start Solution

→ 120 mm Na_2CO_3 ⇒ 25.4376g / 2L Fisher Lot # 960685

→ 1000 ppm Cl ⇒ 3.2958g / 2L Fisher Lot # 972274

Initial pH = 11.366

All specimens polished to 600 grit and ultrasonically cleaned in Acetone
 All crevices ultrasonically cleaned in Methanol

Shu 6-16-98

Cat 77

Run 76

Cell 1 A516PS40.DAT - crevice

Temp = 20°C

Eset = -450 mV

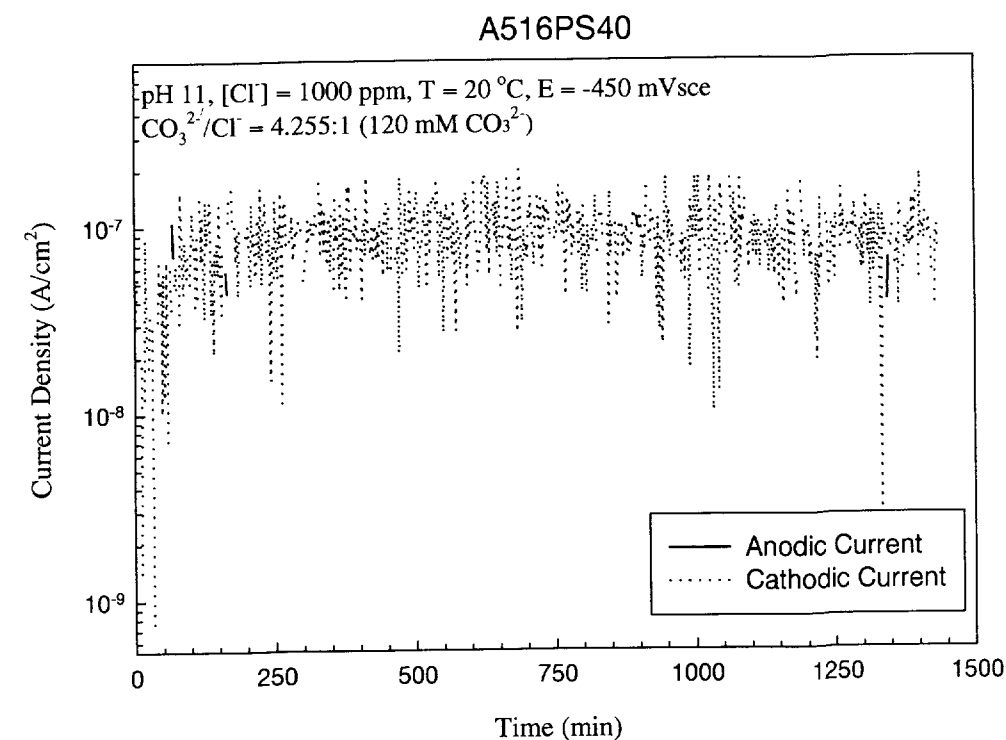
Init wt = 29.3046g 29.2989g 6-16-98

Final wt = 29.2966g 6-17-98

Final Solution pH = 11.344 6-17-98

Observations Start 1:43 pm

No Pitting 6-17-98



Shu 6-16-98

Cat 78

from 77

Cell 2 A516PS 41, DAT - crevice

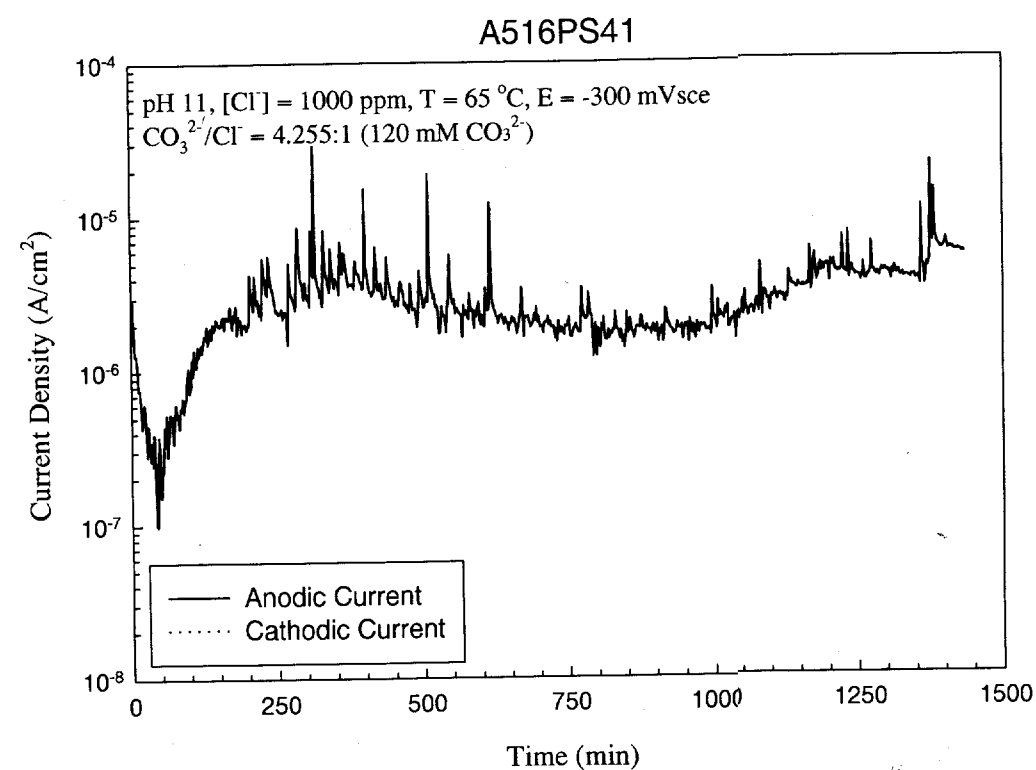
Temp = 65°C

Eset = -300 mV

Init wt = 29.24151g

Final wt = 29.23757g *St Q* 6-17-98Final Solution pH = 11.129 *St Q* 6-17-98

Observations

MODERATE CREVICE PITTING 6-17-98 *St Q**St Q* 6-15-98

Cat 79

from 78

Cell 3 A516PS 42, DAT - crevice

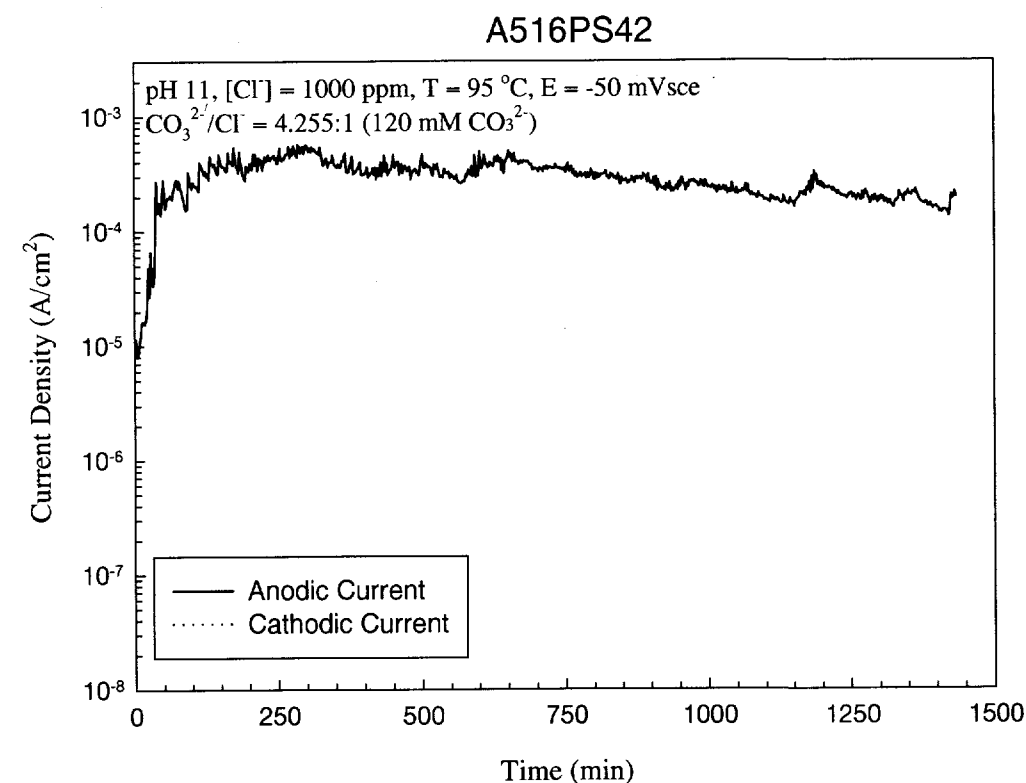
Temp = 95°C

Eset = -50 mV

Init wt = 29.32231g

Final wt = 29.31065g *St Q* 6-17-98Final Solution pH = 11.253 *St Q* 6-17-98

Observations

Heavy crevice pitting, corrosion inside crevice bolt hole. *St Q* 6-17-98*St Q* 6-16-98

from 79

6-17-98

Start Solution

12mm $\text{Na}_2\text{CO}_3 \Rightarrow 2.54376\text{g}/2\text{L}$ 100ppm $\text{Cl}^- \Rightarrow .32958\text{g}/2\text{L}$

Initial pH = 11.042

All samples polished on edges to 600 grit + ultrasonically cleaned before

Testing of mill specimens

mill scale area - 12.5 cm^2 machined area - 12.5 cm^2 overall area - 25 cm^2

JH 6-17-98

Cat 81

from 80

Cell 1 A516PS43, NAT - mill scale

Temp = 20°C Eset = -380 mV Init. wt = ~~69.088~~ 69.08234g

Final wt = 69.07892g 6-18-98

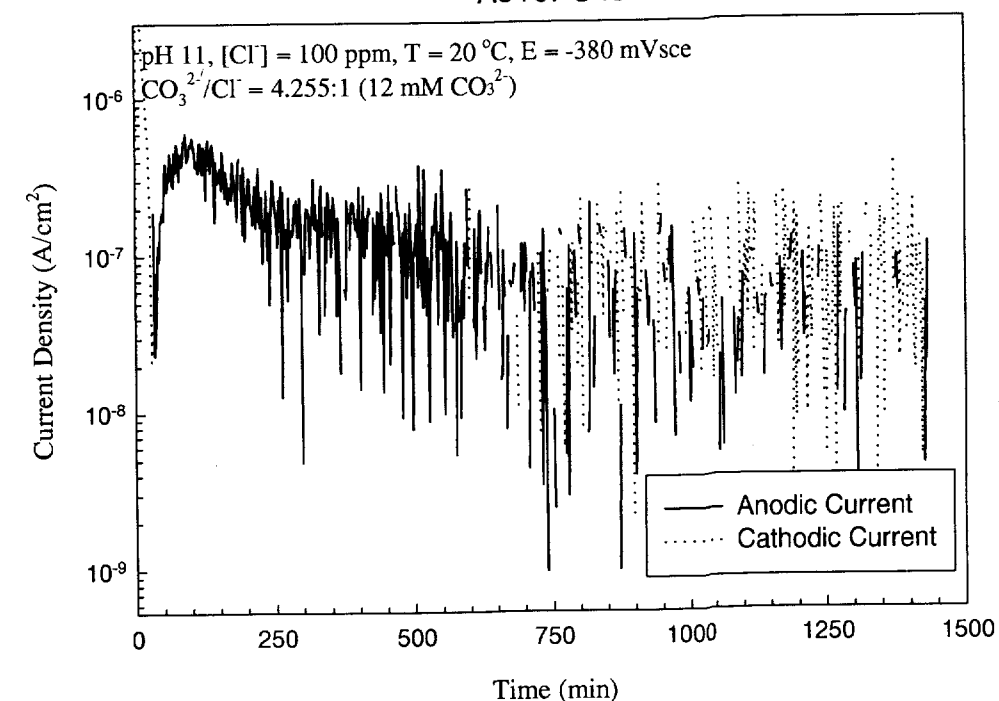
Final Solution pH = 11.085 6-18-98

Observations Start 3:20pm

No pitting on polished edges or mill surface

Some corrosion above vapor line 6-18-98

A516PS43



JH 6-17-98

Cat 82

From 81

Cell 2 A516PS44.DAT - mill scale

Temp = 65°C

E_{set} = -350 mV

Init. wt = 69.81044 g

Final wt = 69.75538 g 6-18-98

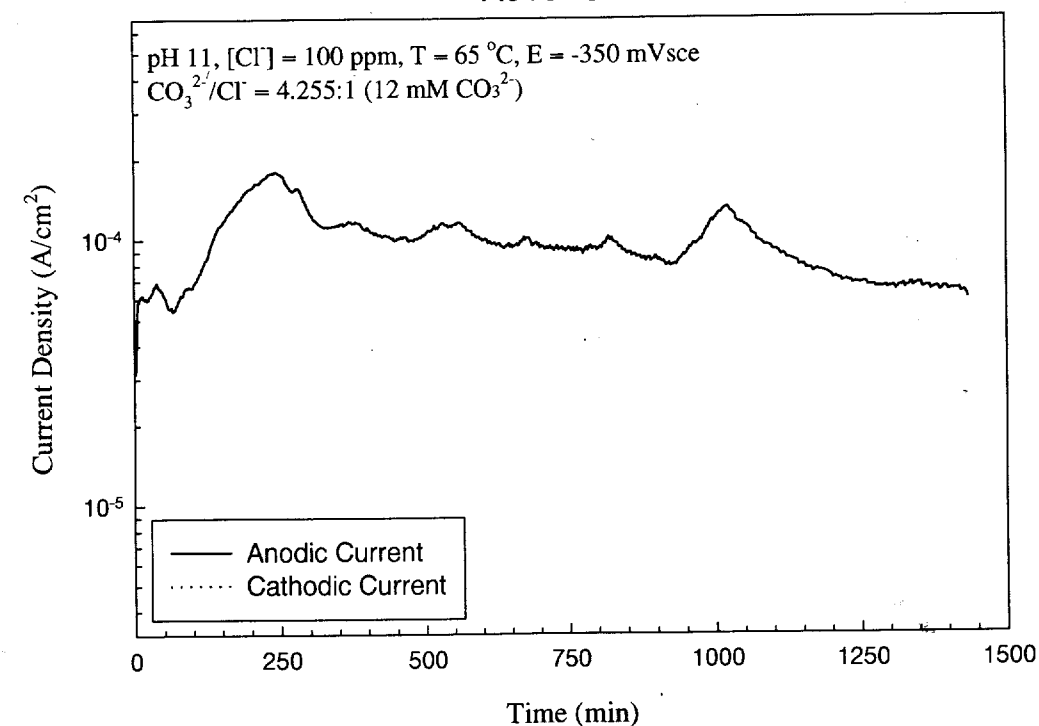
Final Solution pH = 10.962 6-18-98

Observations

No pitting on polished edges or mill surface

Some corrosion on top machined surface 6-18-98

A516PS44



St Q 6-17-98

Cat 83

From 82

Cell 3 A516PS45.DAT - mill scale

Temp = 95°C 87°

E_{set} = -100 mV

Init. wt = 69.88012 g

Final wt = 69.73813 g 6-18-98

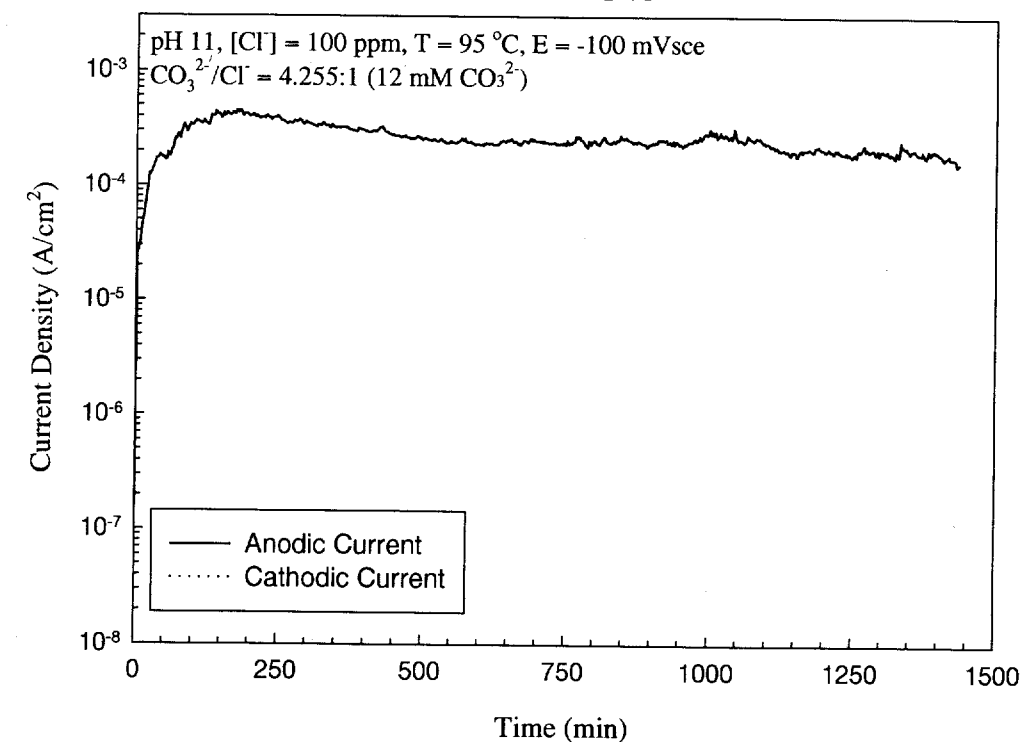
Final Solution pH = 11.085 6-18-98 11.478 6-18-98

Observations

Pitting on polished edges but not mill surface

Some corrosion on machined top surface 6-18-98

A516PS45



St Q 6-17-98

6-18-98

Stock Solution

12 mm $\text{Na}_2\text{CO}_3 \Rightarrow 2.54376 \text{ g/L}$ 10 ppm $\text{Cl}^- \Rightarrow .03296 \text{ g/L}$

Initial pH = 11.068

All samples edge polished to 600 grit + ultrasonically cleaned in acetone

CSB 6/24/98

Cell

A516PS46 .011

- null scale

6/18/98

Temp = 20°C

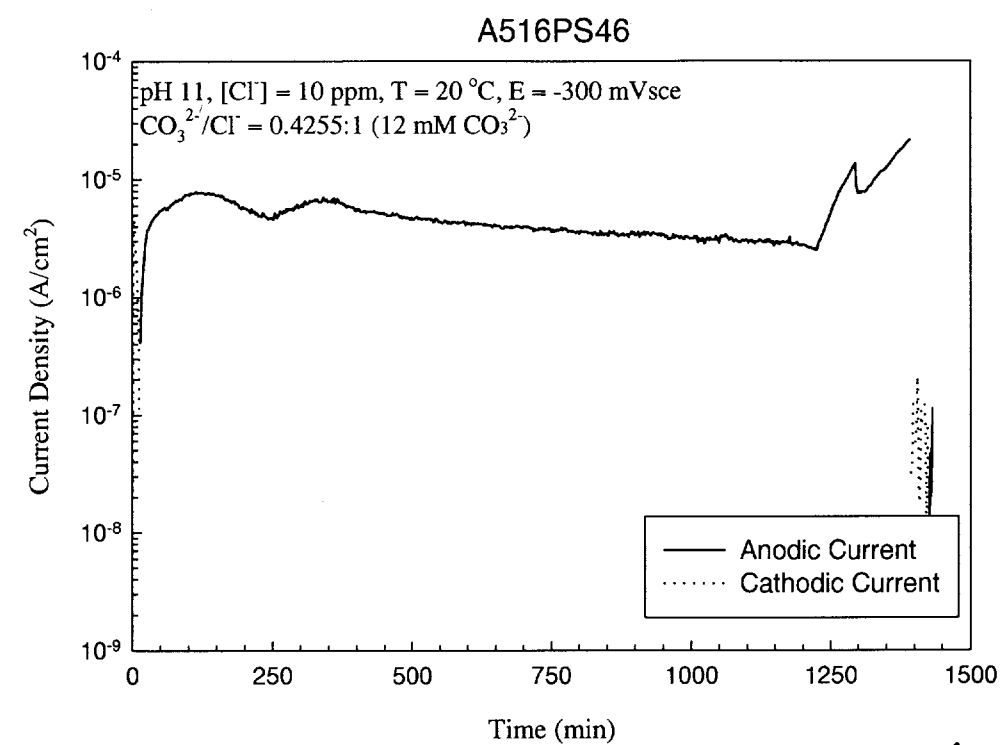
Eset = -300 mV

Init wt = 70.00812 g

Final wt = 70.00176 g CSB 6/18/98

Final Solution pH = 10.950 CSB 6/18/98

Observations

some water-line attack, and corrosion
on top of specimen

CSB 6/22/98

6/18/98

Cell 2 A516PS47.DAT - mill scale

Temp = 65°C

Eset = -250 mV

Init wt = 69.90712g

Final wt = 69.4044g

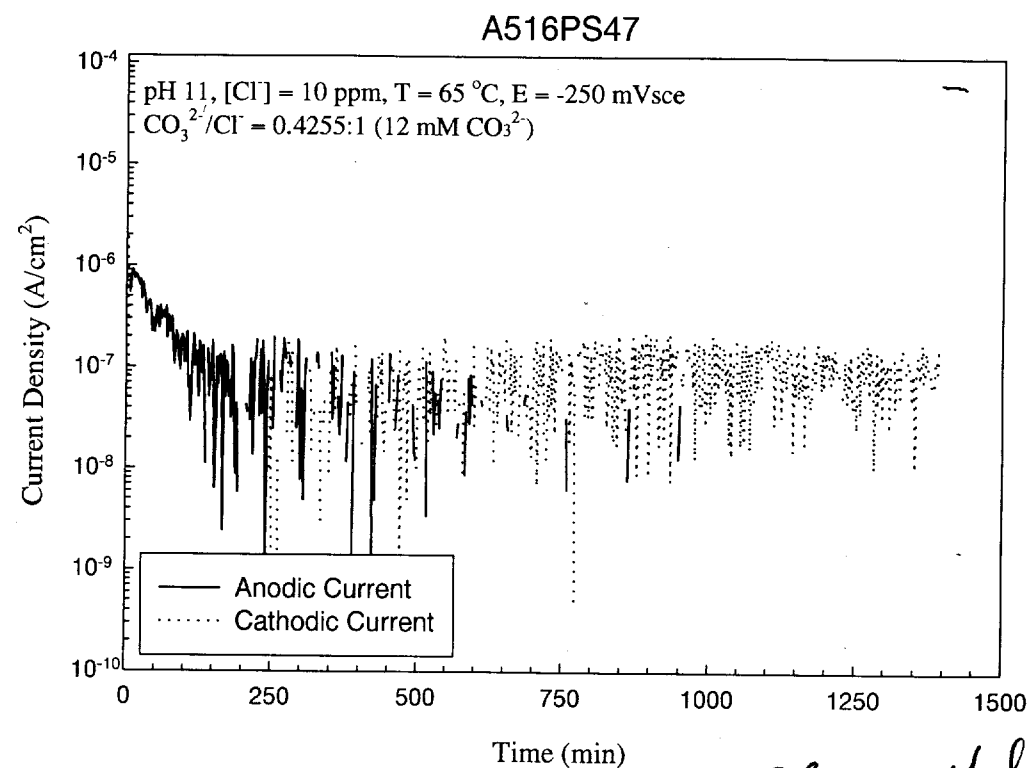
69.9044g CSB 6/19/98

- suspect wt loss may be

due to auth. rden of mill scale

Final Solution pH = 11.071 CSB 6/19/98

Observations no noticeable corrosion



SRB 6/19/98

6/18/98

Cell 3 A516PS48.DAT - mill scale

Temp = 95°C

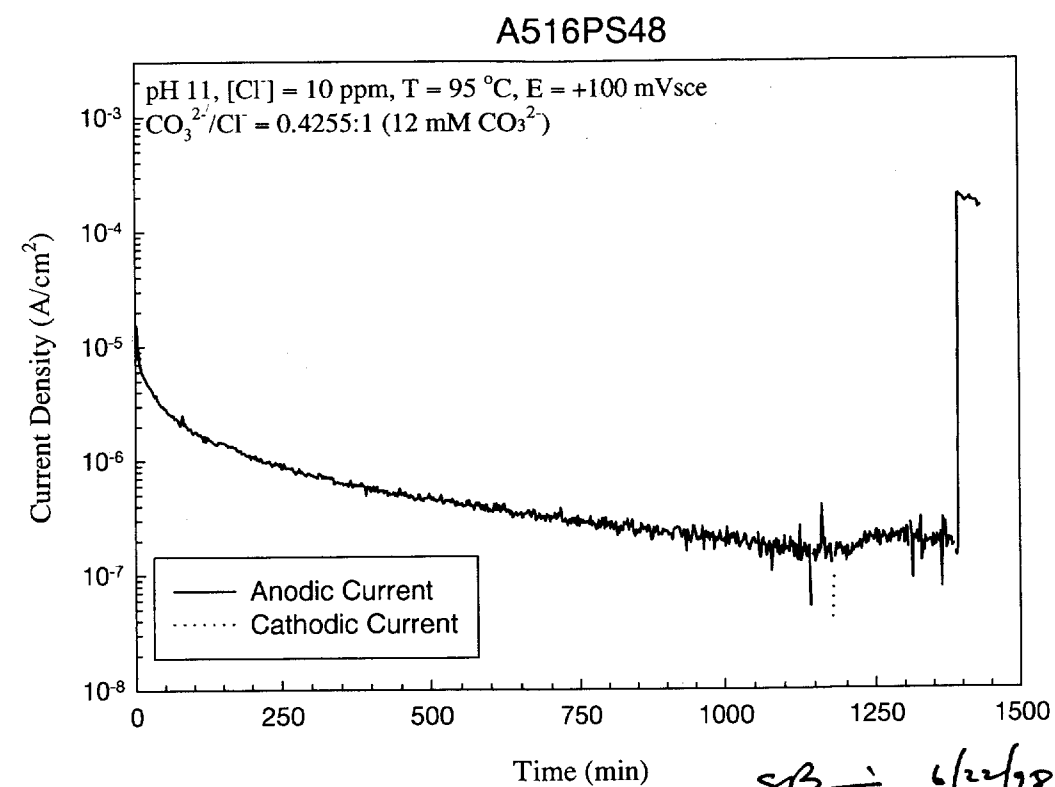
Eset = +100 mV

Init wt = 69.51632g

Final wt 69.4044g CSB 6/19/98

Final Solution pH = 10.840 6/19/98

Observations small pits observable on polished areas, but no noticeable attack on mill scale



SRB 6/22/98

6/22/98

Performance Verification

Actual $R = 10.048114$ Applying Potential to 10 Ω resistor (SN 171002)
and measuring current response

PSTAT 7 (Cell 1)

Applied (Strawberry Tree DAQ) E_{read} I

-1	-0.9979	$-9.4247 \times 10^{-2} \text{ A}$
-0.75	-0.7484	$-7.0688 \times 10^{-2} \text{ A}$
-0.50	-0.4994	$-4.7157 \times 10^{-2} \text{ A}$
-0.25	-0.2509	$-2.3719 \times 10^{-2} \text{ A}$
0	0.0003	$6.0177 \times 10^{-6} \text{ A}$
+0.25	0.2579	$2.3762 \times 10^{-2} \text{ A}$
+0.50	0.4999	$4.7153 \times 10^{-2} \text{ A}$
+0.75	0.7489	$7.0644 \times 10^{-2} \text{ A}$
+1	0.9980	$9.4145 \times 10^{-2} \text{ A}$

PSTAT 3 (Cell 2)

-1	-0.9918	$-9.5067 \times 10^{-2} \text{ A}$
-0.75	-0.7441	$-7.1356 \times 10^{-2} \text{ A}$
-0.5	-0.4943	$-4.7443 \times 10^{-2} \text{ A}$
-0.25	-0.2476	$-2.3852 \times 10^{-2} \text{ A}$
0	0.0020	$4.0667 \times 10^{-6} \text{ A}$
+0.25	0.2514	$2.3900 \times 10^{-2} \text{ A}$
+0.50	0.4976	$4.7433 \times 10^{-2} \text{ A}$
+0.75	0.7472	$7.1290 \times 10^{-2} \text{ A}$
+1	0.9945	$9.4939 \times 10^{-2} \text{ A}$

OSR
6/22/98

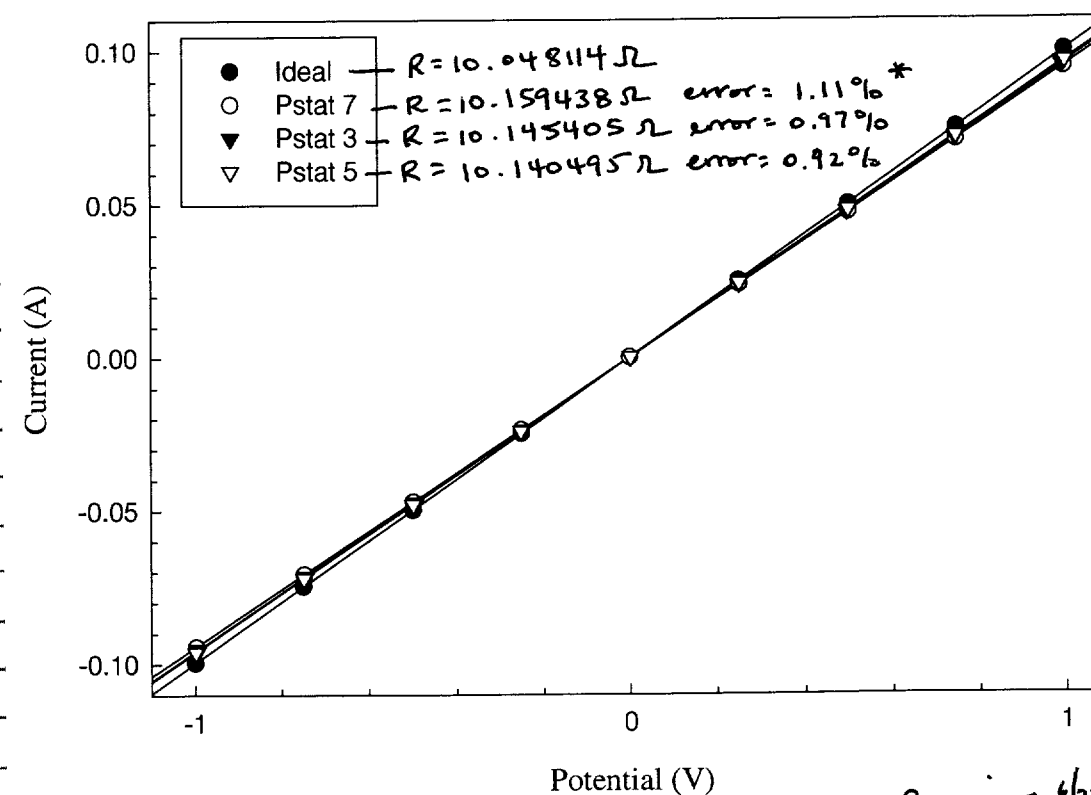
Cont on p69

6/22/98

from p88

PSTAT 5 (Cell 3)

E_{Applied}	E_{read}	I
-1	-0.9985	$-9.6002 \times 10^{-2} \text{ A}$
-0.75	-0.7489	$-7.1999 \times 10^{-2} \text{ A}$
-0.50	-0.4998	$-4.8050 \times 10^{-2} \text{ A}$
-0.25	-0.2513	$-2.4165 \times 10^{-2} \text{ A}$
0	0.0024	$2.315 \times 10^{-5} \text{ A}$
+0.25	+0.2517	$2.4204 \times 10^{-2} \text{ A}$
+0.50	+0.4998	$4.8026 \times 10^{-2} \text{ A}$
+0.75	+0.7488	$7.1952 \times 10^{-2} \text{ A}$
+1	1.0006	$9.6111 \times 10^{-2} \text{ A}$



OSR 6/22/98

* Note, outside of tolerance of resistor; according to TOP-22, potentiostat/data acquisition system is not functioning properly. However, based on limitations of 12-bit control system being used and the small error ($< 1.1\%$) noted between measured & known resistance, it is felt that the system is operating properly.

OSR 6/22/98

from 89

8-10-98

Stock Solution

12mm $\text{Na}_2\text{CO}_3 \Rightarrow 2.54376\text{g}/2\text{L}$ 100 ppm Cl $\Rightarrow 2.32958\text{g}/2\text{L}$

Initial pH = 11.007

All Samples Degreased in Acetone

JLL

8-10-98

To 91

from 90

Cell 1

AS16 PS 49.DAT

mill scale samples

Temp = 25°C

Eset = -300

Init Wt = 70.10206g

Final Wt = 69.82202g

JLL 8-17-98

Final Solution pH = 11.465

JLL 8-17-98

Observations started @ 12²⁵ pm 8/10/98

General corrosion product on machined edges

JLL 8-17-98

CSB

8/16/98

To 92

from 91

Cell 2 AS16 PS 50. DAT Multiscale Samples

Temp = 65°C

Eset = -250

Init wt = 70.10938g

Final wt = 69.20446g

Final Solution pH 11.234 8-17-98

Observations started @ 12²⁵ pm 8/10/98

Heavy corrosion product & pitting on machined surfaces

corrosion on non machined surfaces

8-17-98

8/10/98 CSB

To 93

from 92 Cell 3 AS16 PS 51. DAT Multiscale samples

Temp = 95°C

Eset = +100

Init wt = 70.06316g

Final wt = 69.06042g 8-17-98

Final Solution pH = 10.664 8-17-98

Observations started @ 12²⁵ pm 8/10/98

Heavy corrosion product and pitting on machined surfaces

corrosion on non machined surfaces. Corrosion

close vapor line.

8-17-98

CSB 8/10/98 10:47

from 93

8-17-98

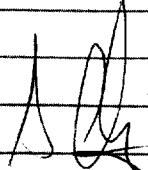
Crevice Specimens

Stock Solution

120 mm $\text{Na}_2\text{CO}_3 \rightarrow 25.4376 \text{ g/2L}$ 12 mm $\text{Cl} \rightarrow 1.4026 \text{ g/2L}$

Initial pH = 11.322

All Samples polished to 600 grit and ultrasonically
cleaned in Acetone

 8-17-98 To
95

from 94


Cell 1 A516PS52.DAT

Temp = 25°C


Eset = -250mV

Init wt = 28.68414g

Final wt = 28.68434g


 8-18-98

Final Solution pH = 11.301

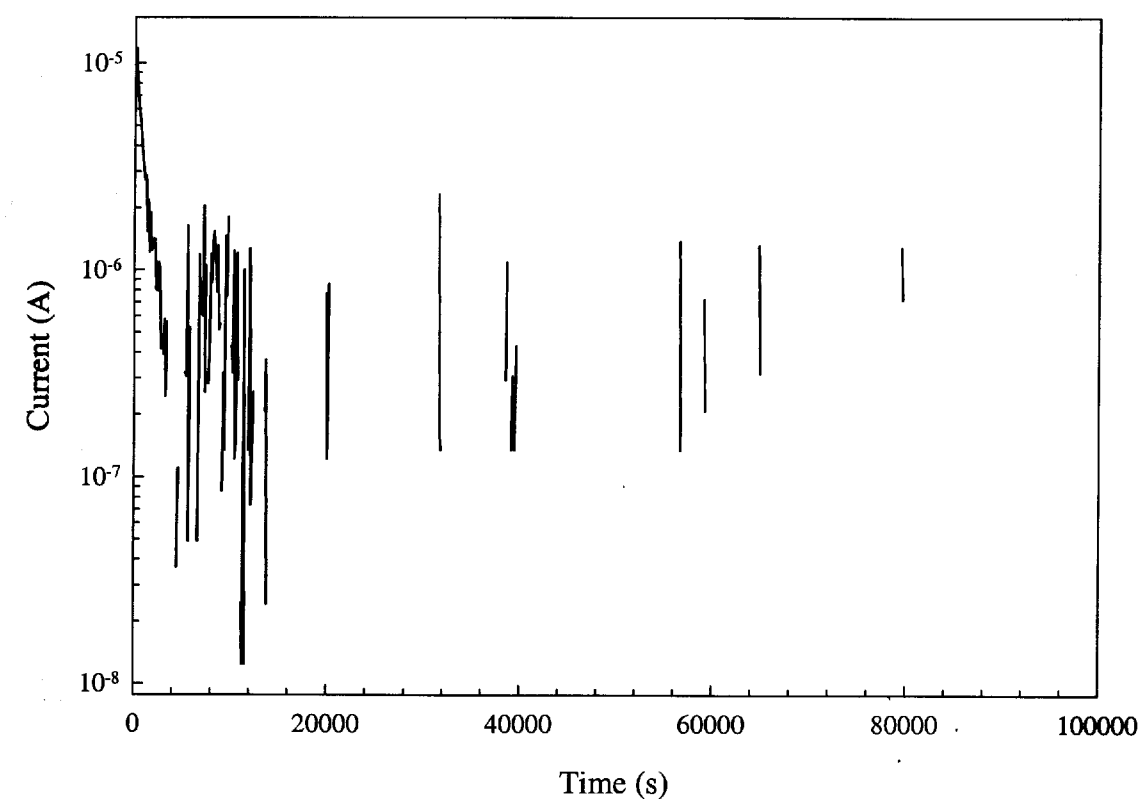
 8-18-98

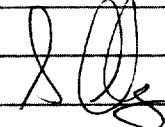
Observations

No corrosion or pitting

 8-18-98

A516PS52



 8-17-98 To
96

From 95

Cell 2 A516 PS53.DAT

Temp = 65°C

Eset = -200 mV

Init wt = 28.67494g

Final wt = 28.67368g

8-18-98

Final Solution pH = 11.145

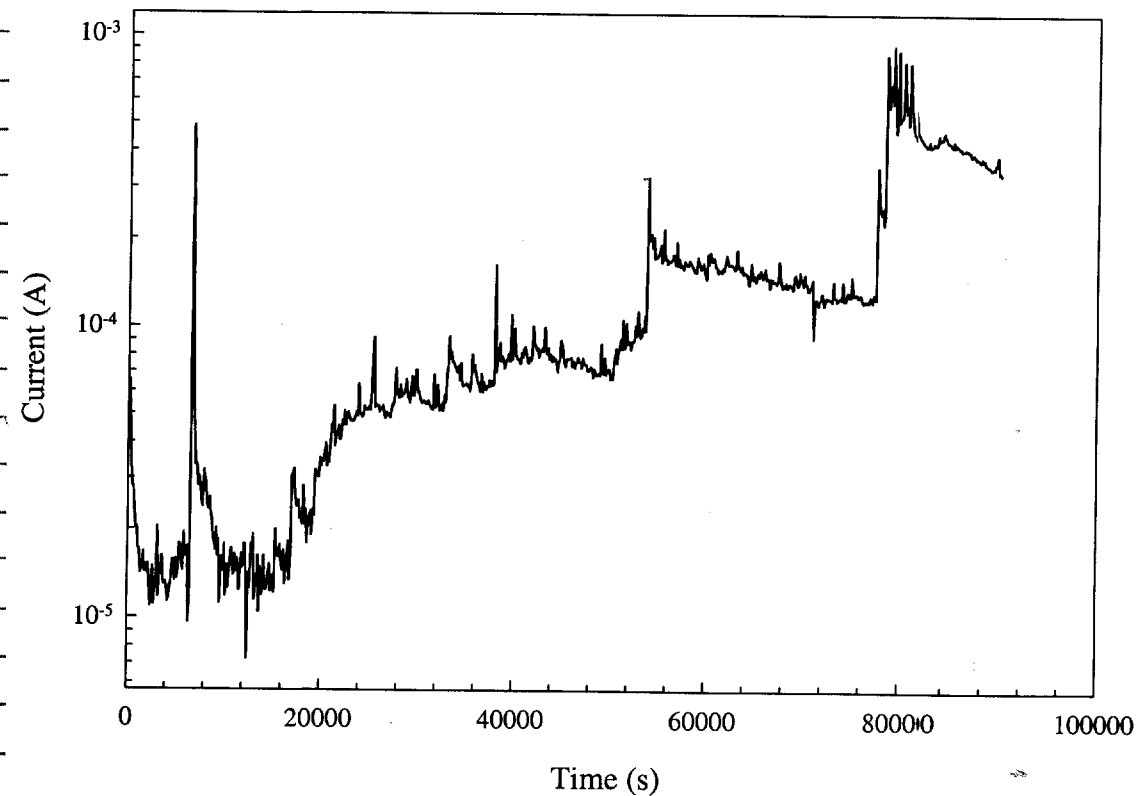
8-18-98

Observations

Crevice pitting. Some corrosion in inner hole.

8-18-98

A516PS53



697

8-17-98

From 96

Cell 3 A516 PS54.DAT

Temp = 95°C

i_{set} = 0 mV

Init wt = 28.97623g

Final wt = 28.97715g

8-18-98

Final Solution pH = 10.857

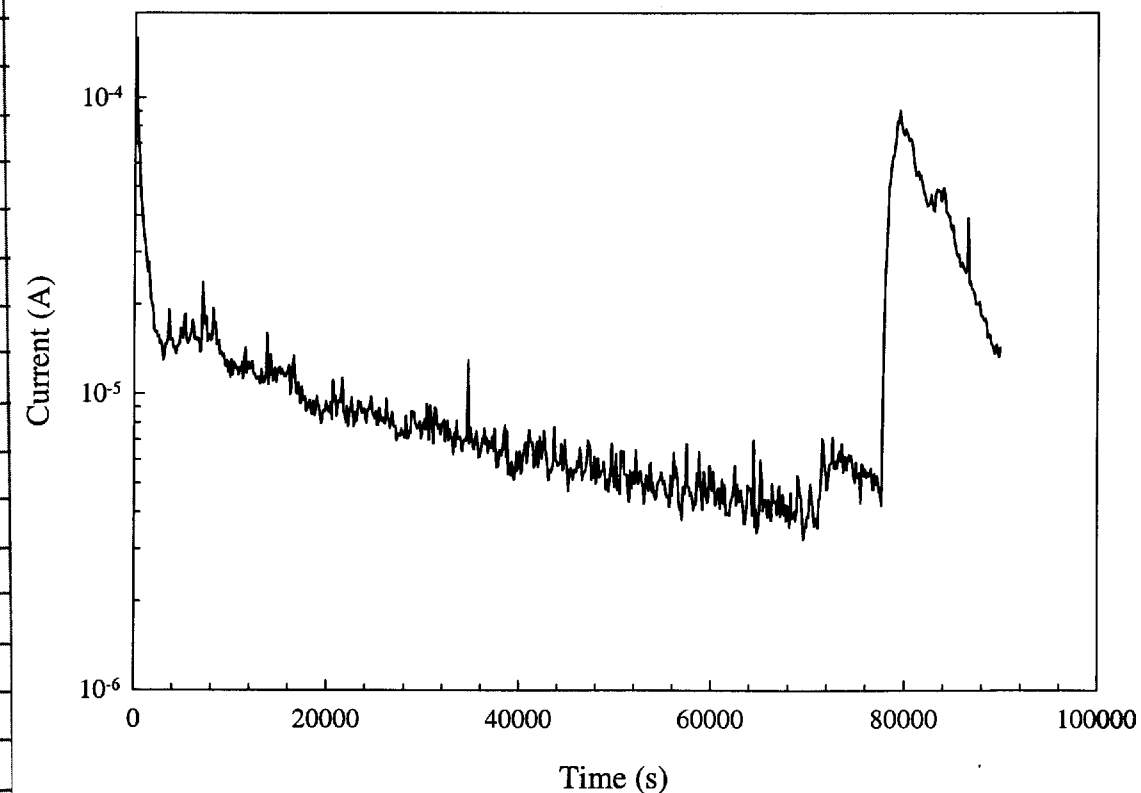
8-18-98

Observations

Crevice pitting

8-18-98

A516PS54



8-17-98

70

from 97

8-18-98

Stock Solution

120 mm $\text{NaCO}_3 \rightarrow 25.4376 \text{ g/L}$ 4.8 mm $\text{Cl} \rightarrow 0.5610 \text{ g/L}$

Initial pH = 11.324

All samples polished to 600grit & cleaned ultrasonically in Acetone
crevices cleaned in methanol.

8-18-98

To 99

from 98

Cell

A516PS55.DAT

Temp = 25°C

Eset = -200mV

Init wt = 28.81722g

Final wt = 28.81727g

8-19-98

Final pH = 11.288

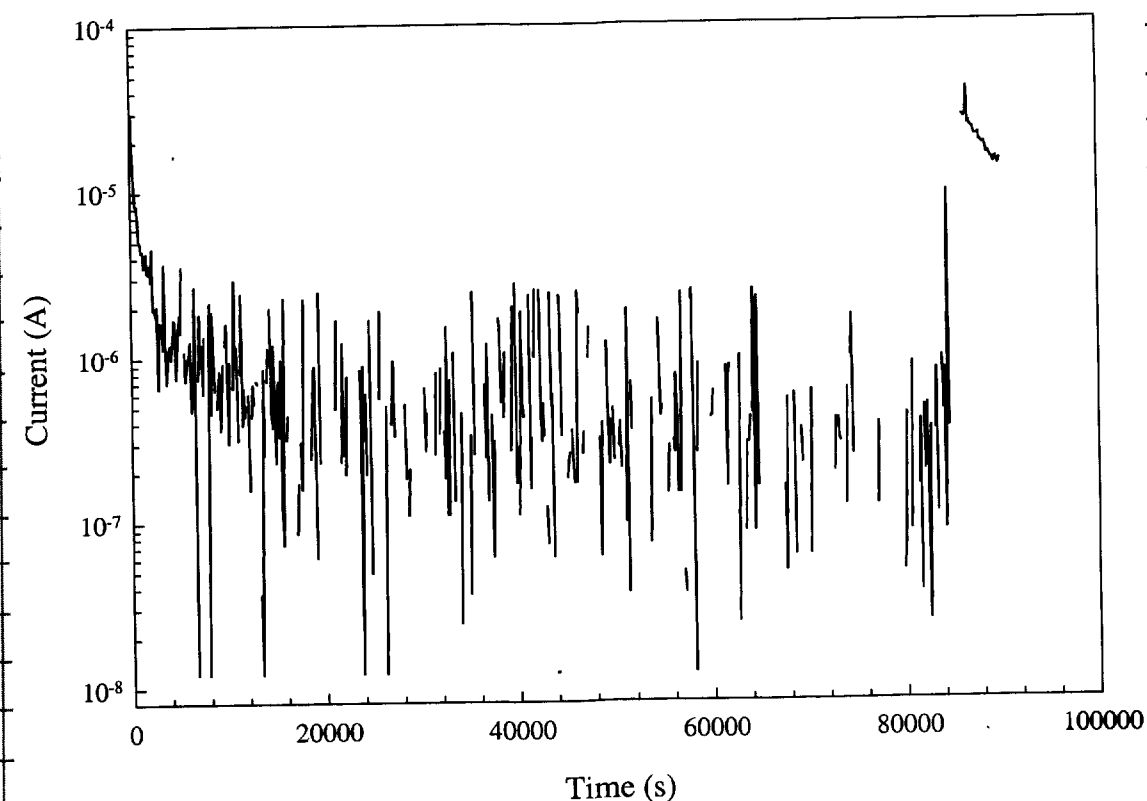
8-19-98

Observations

No pitting, very light markings at crevice feet

8-19-98

A516PS55



8-18-98

b 100

from 99

Cell 2 A516PS56.DAT

Temp 65°C

E_{set}

Init wt = 28.68480

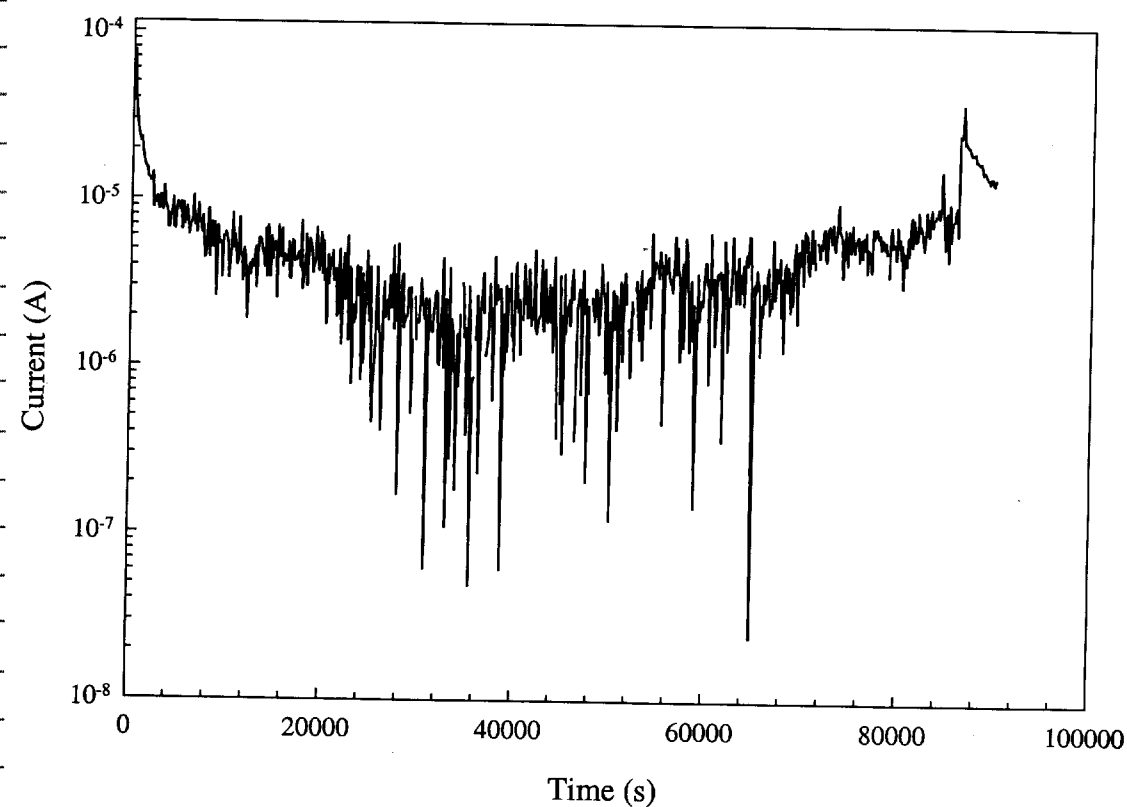
Final wt = 28.68535 8-19-98

Final PH 11.144 8-19-98

Observations

very slight pitting on one side of specimen 8-19-98

A516PS56



8-18-98

To 101

from 100

Cell 3 A516PS57.DAT

Temp 95°C

E_{set}

Init wt 28.58329g

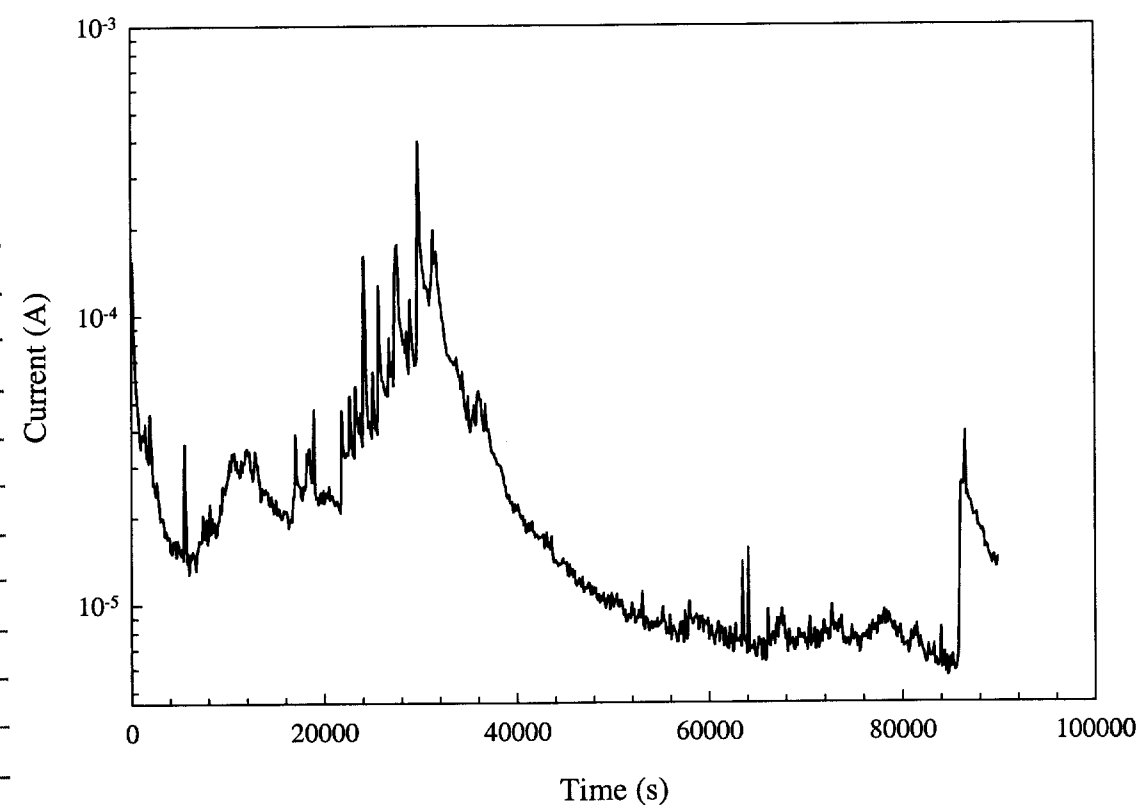
Final wt 28.58506g 8-19-98

Final PH 10.985 8-19-98

Observations

Very slight pitting at crevice feet on one side of specimen, Uniform pitting on the other 8-19-98

A516PS57



8-18-98

To 102

from 101

8-19-98

start 10:00 AM

Start Solution

120 mm $\text{Na}_2\text{CO}_3 \rightarrow 25.4376\text{g}/2\text{L}$ Fisher Lot # 9606852.4 mm $\text{Cl} \rightarrow 0.2805\text{g}/2\text{L}$ " 972274

Initial pH = 11.307

All Specimens polished to 600 grit & ultrasonically cleaned in
Acetone, crevices ultrasonically cleaned in Methanol

8-20-98 To 103

from 102

Cell 1

A516PS58.DAT

T 25°C

Eset = -175 mV

Init wt = 28.86627g

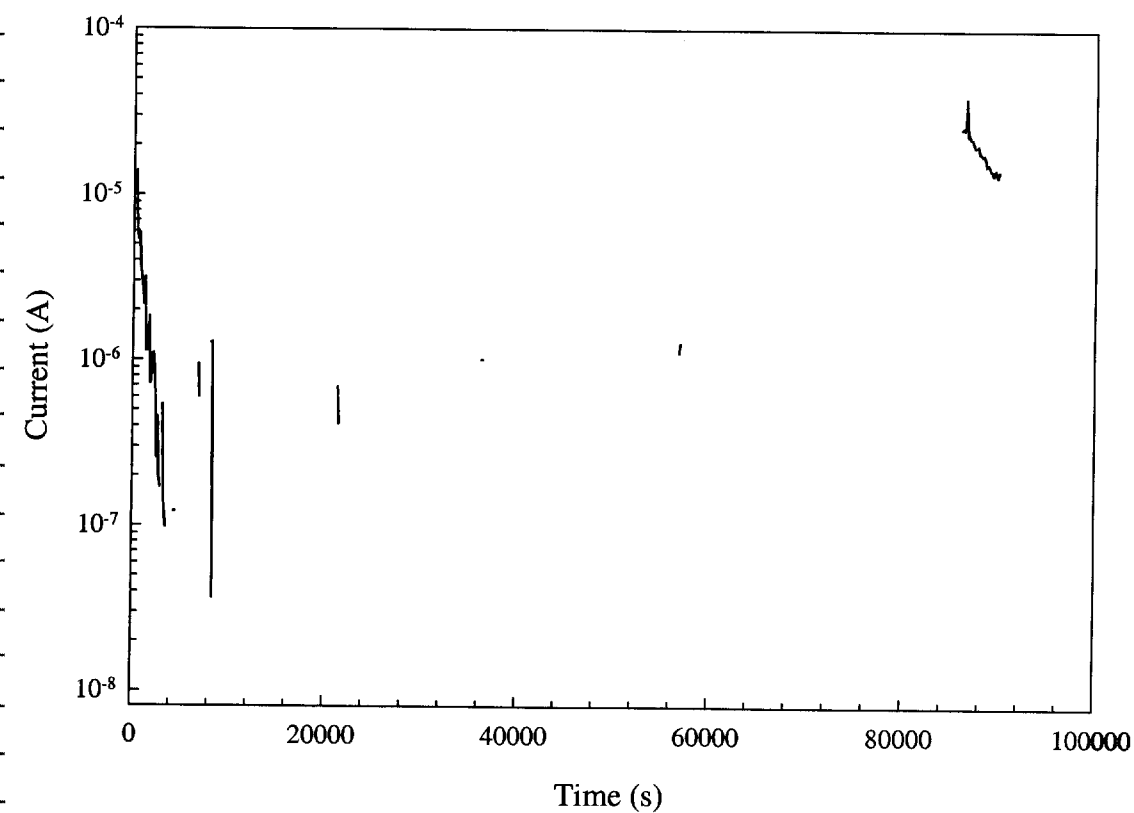
Final wt = 28.80679g 8-21-98

Final Solution pH = 11.283 8-21-98

Observations

No pitting on specimen 8-21-98

A516PS58



8-20-98 To 104

from 103

Cell 2 A516PS59.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -125\text{ mV}$

Init wt = 28.73686 g

Final wt = 28.73727 g

8-21-98

Final Solution pH = 11.110

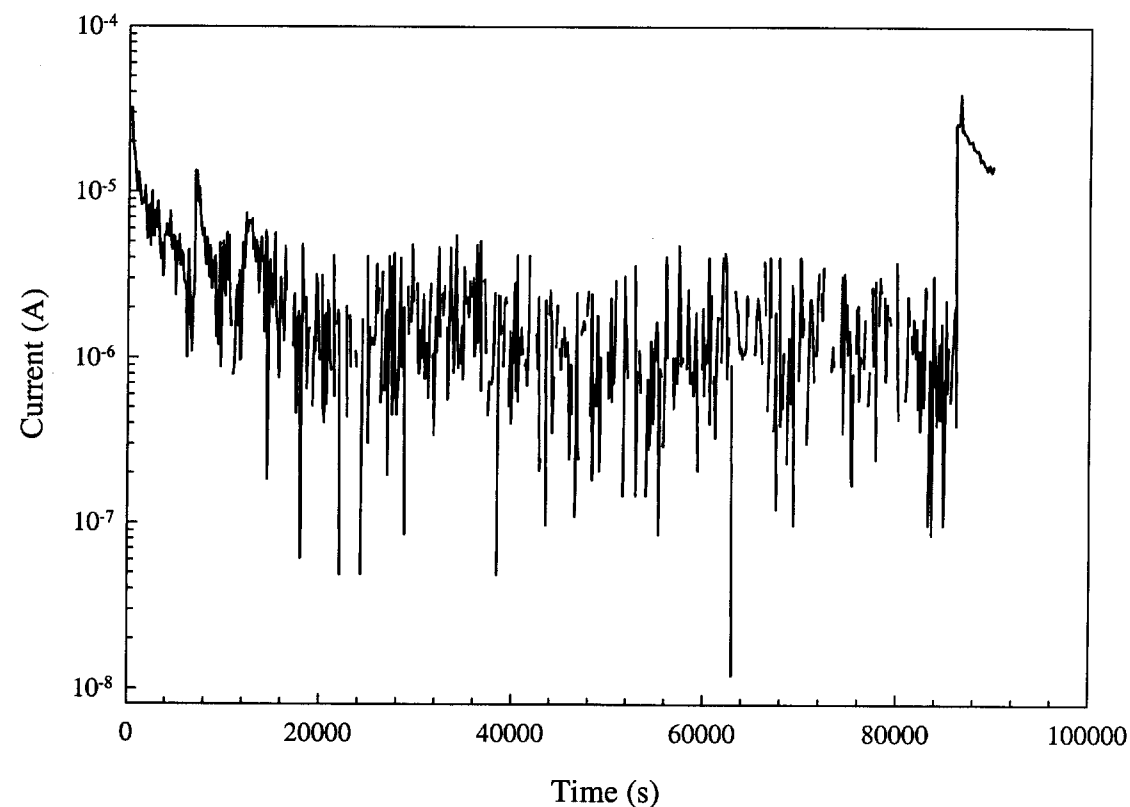
8-21-98

Observations

Very minor crevice pitting in some sporadic areas

8-21-98

A516PS59



8-20-98

To 105

from 104

Cell 3 A516PS60.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = 150\text{ mV}$

Init wt = 28.94290 g

Final wt = 28.94391 g

8-21-98

Final Solution pH = 11.048

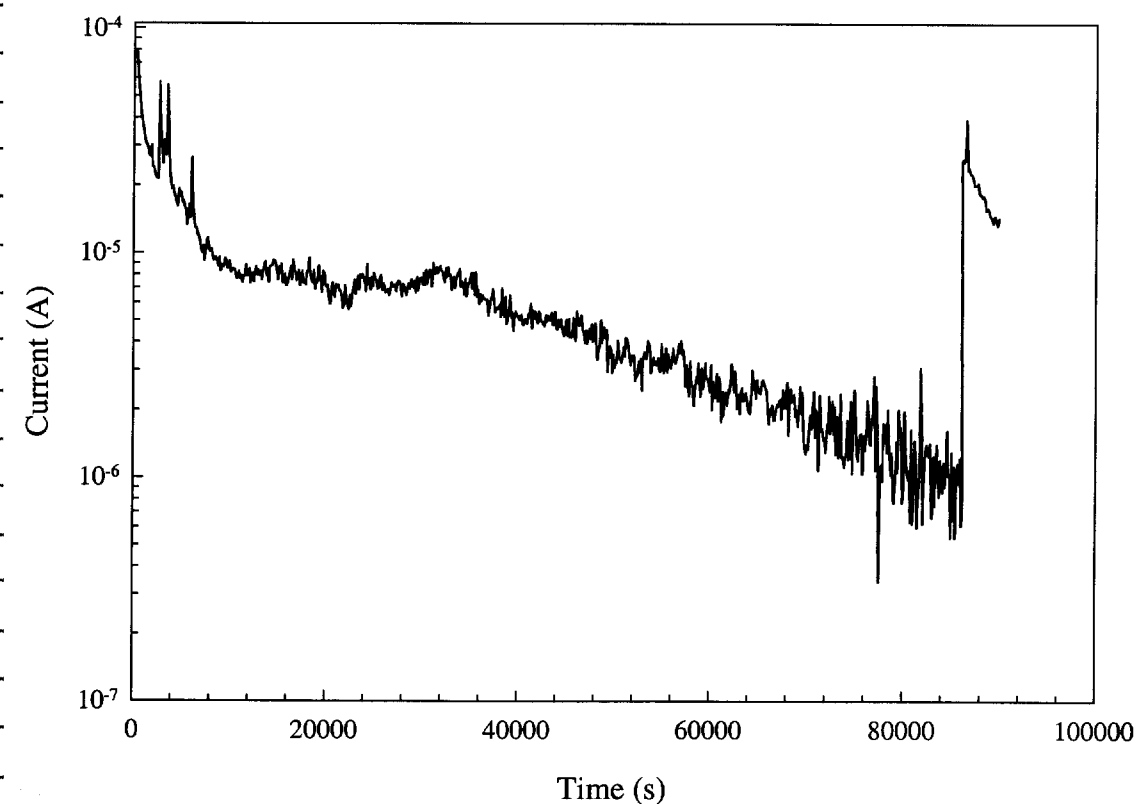
8-21-98

Observations

Small crevice pitting noted

8-21-98

A516PS60



8-20-98 to 106

From 105

8-24-98

Stock Solution

 $\text{Na}_2\text{CO}_3 = 120\text{mm} \rightarrow 25.4376\text{g}/2\text{Lt}$ $\text{Cl} = 16\text{mm} \rightarrow 0.1870\text{g}/2\text{Lt}$

Fisher Lot #

960685

972274

Initial pH = 11.304

All specimens polished to 600 grit + ultrasonicall,
cleaned in Acetone, crevices ultrasonicall, cleaned in Methanol

From 106

Cell 1

AS16 PS 61 .DAT

 $T = 25^\circ\text{C}$ $E_{\text{set}} = -150\text{mV}$

Init. wt = 28.85143g

Final wt = 28.85080g

8-25-98

Final Solution pH = 11.281

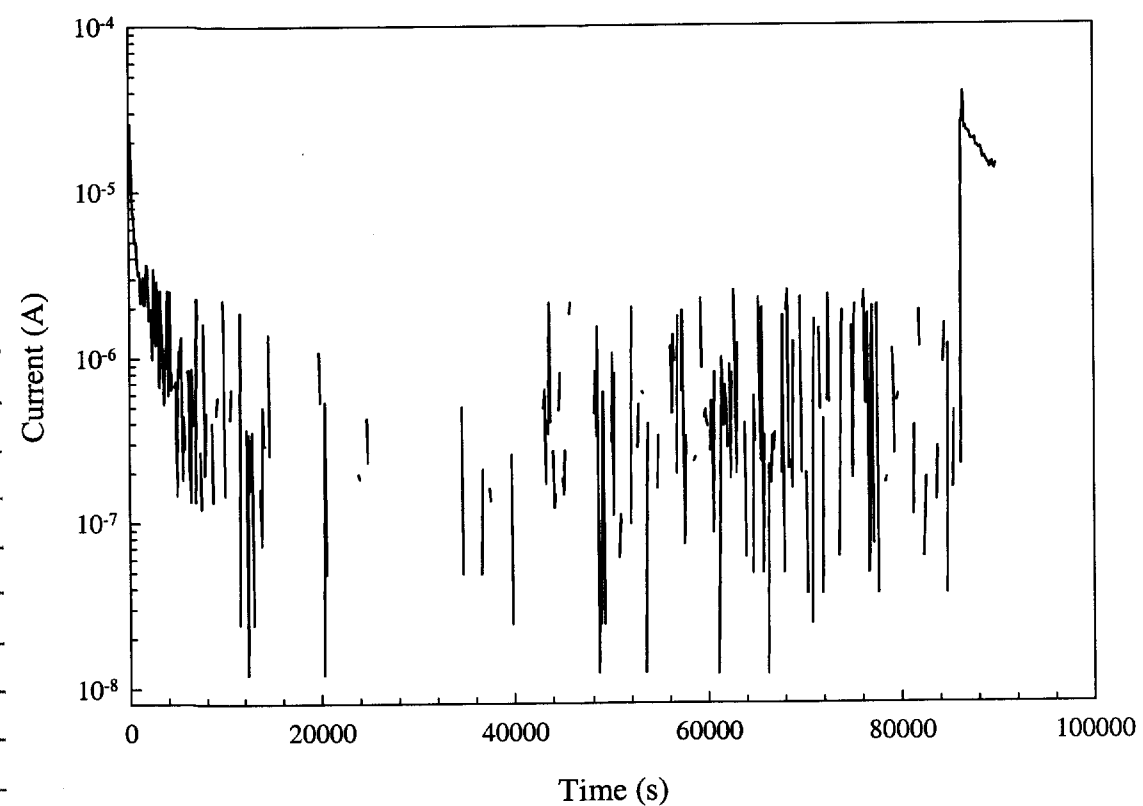
8-25-98

Observations

Very light crevice pitting

8-25-98

A516PS61



8-24-98 to 107

8-24-98

to 108

from 107

Cell 2 AS16PS62.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -100\text{ mV}$

Init wt = 28.95778g

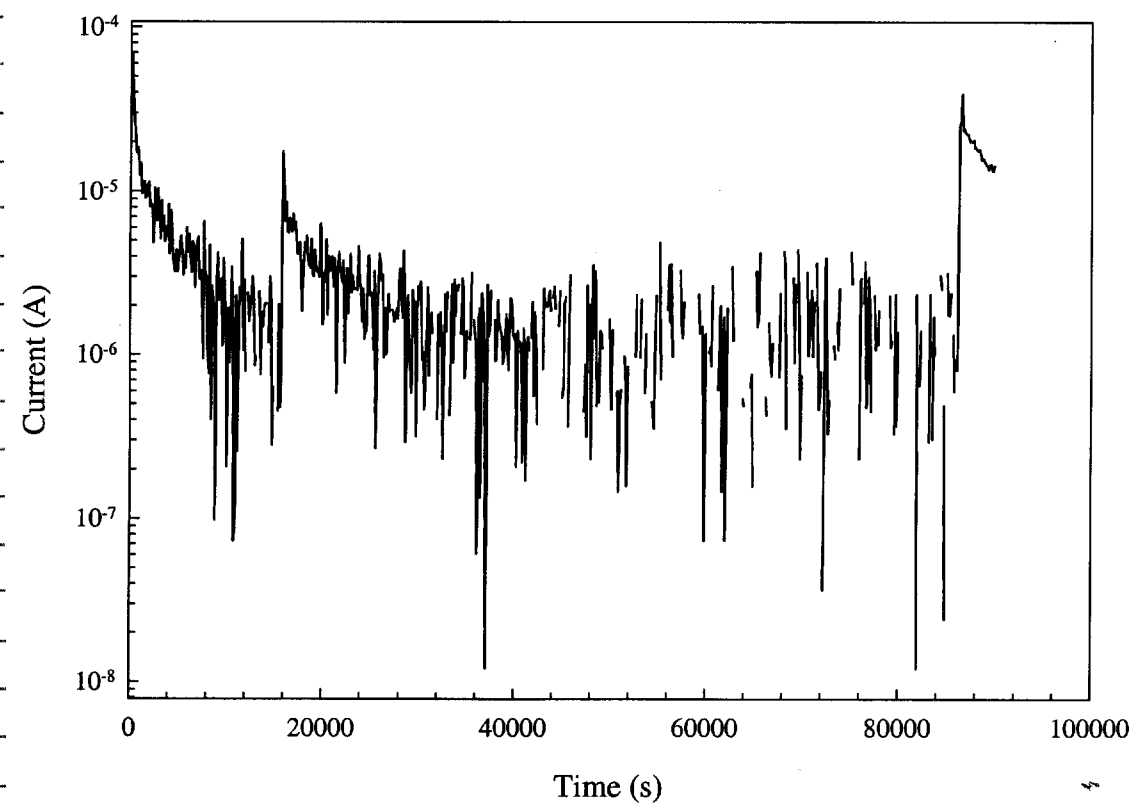
Final wt = 28.95762g 8-25-98

Final Solution pH = 11.120 8-25-98

Observations

Very light crevice pitting 8-25-98

A516PS62



8-24-98 to 109

from 108

Cell 3 AS16PS63.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = 200\text{ mV}$

Init wt = 28.76252g

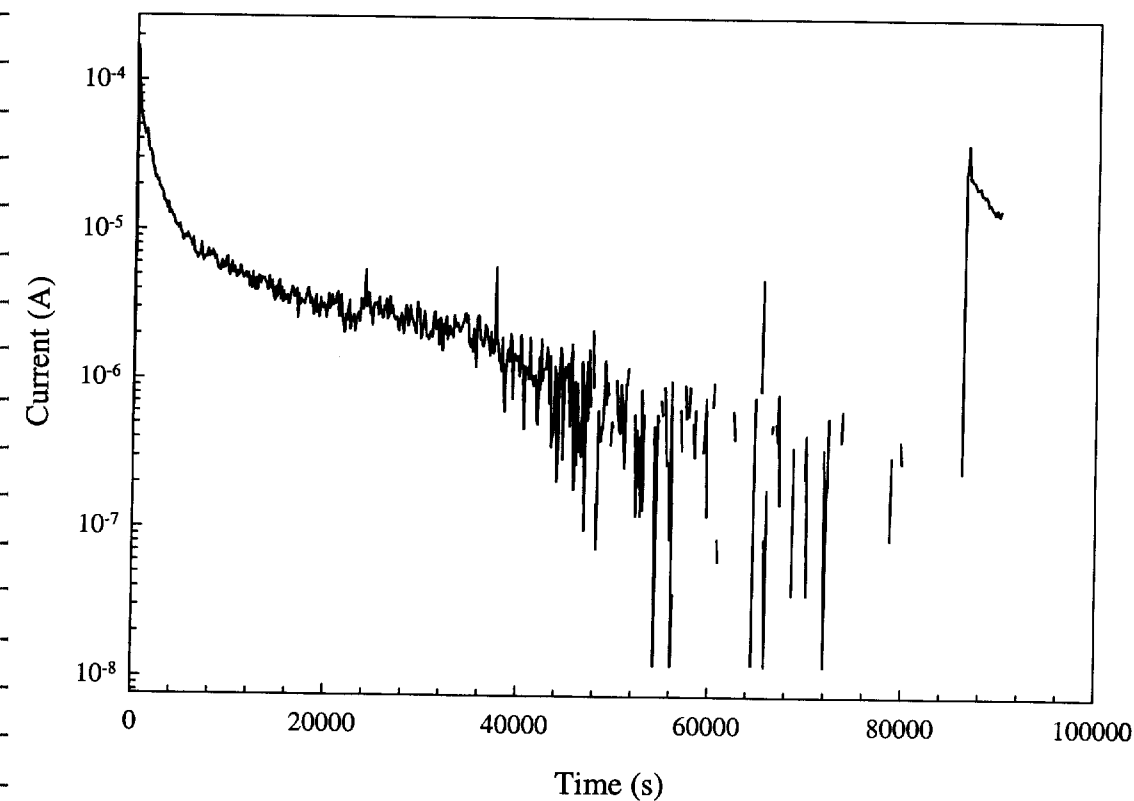
Final wt = 28.76363g 8-25-98

Final Solution pH = 11.084 8-25-98

Observations

Very light crevice pitting 8-25-98

A516PS63



8-24-98 to 110

From 109

8-25-98

Stock Solution

 $\text{Na}_2\text{CO}_3 \rightarrow 120 \text{ mm} \rightarrow 25.4376 \text{ g/2L}$ $\text{Cl} \rightarrow 1.2 \text{ mm} \rightarrow 0.1403 \text{ g/2L}$

Initial PH = 11.319

All

Set 11:33 AM

Fisher Lab

A60685

972274

From 110

Cell 1 A516PS64.DAT

 $T = 25^\circ\text{C}$

Eset = -150 mV

Init wt = 28.97570g

Final wt = 28.96836g

Final Solution PH = 11.297

Observations

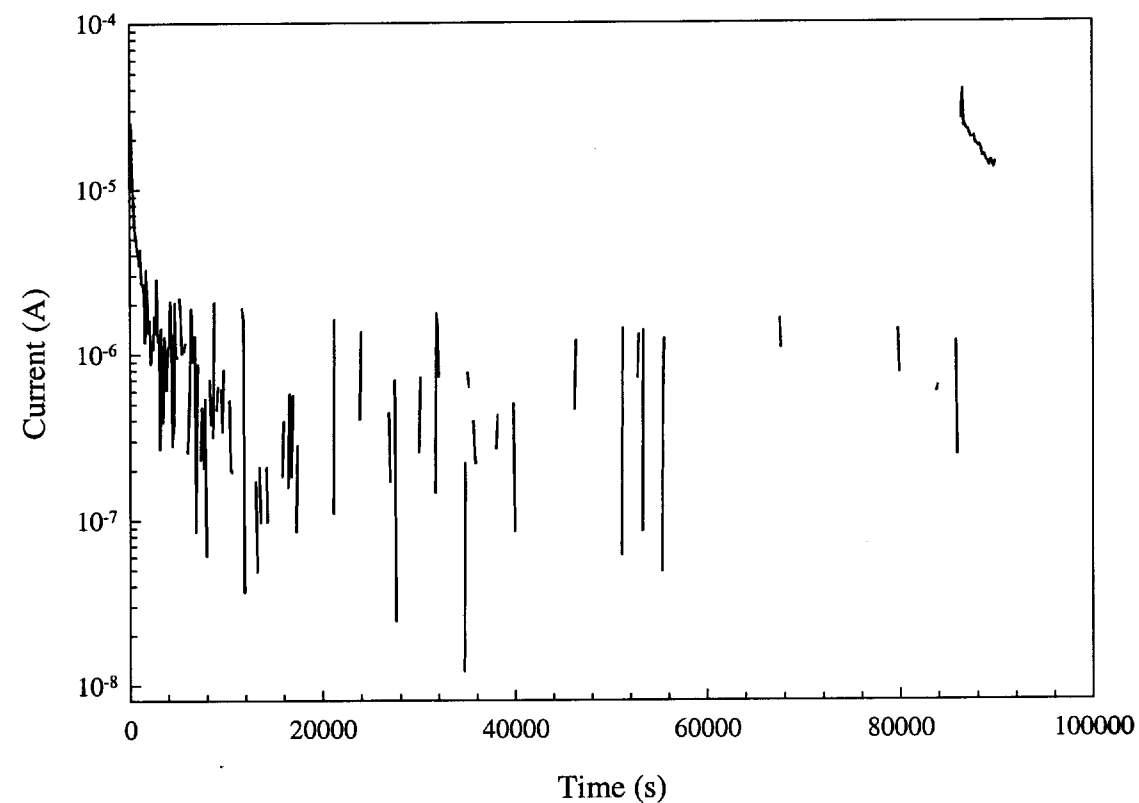
No pitting

8-26-98

8-26-98

8-26-98

A516PS64



8-25-98 to 111

8-25-98 to 112

from 111

Cell 2 A516PS65.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -100\text{ mV}$

Init wt = 28.90922g

Final wt = 28.90955g

8-26-98

Final Solution pH = 11.132

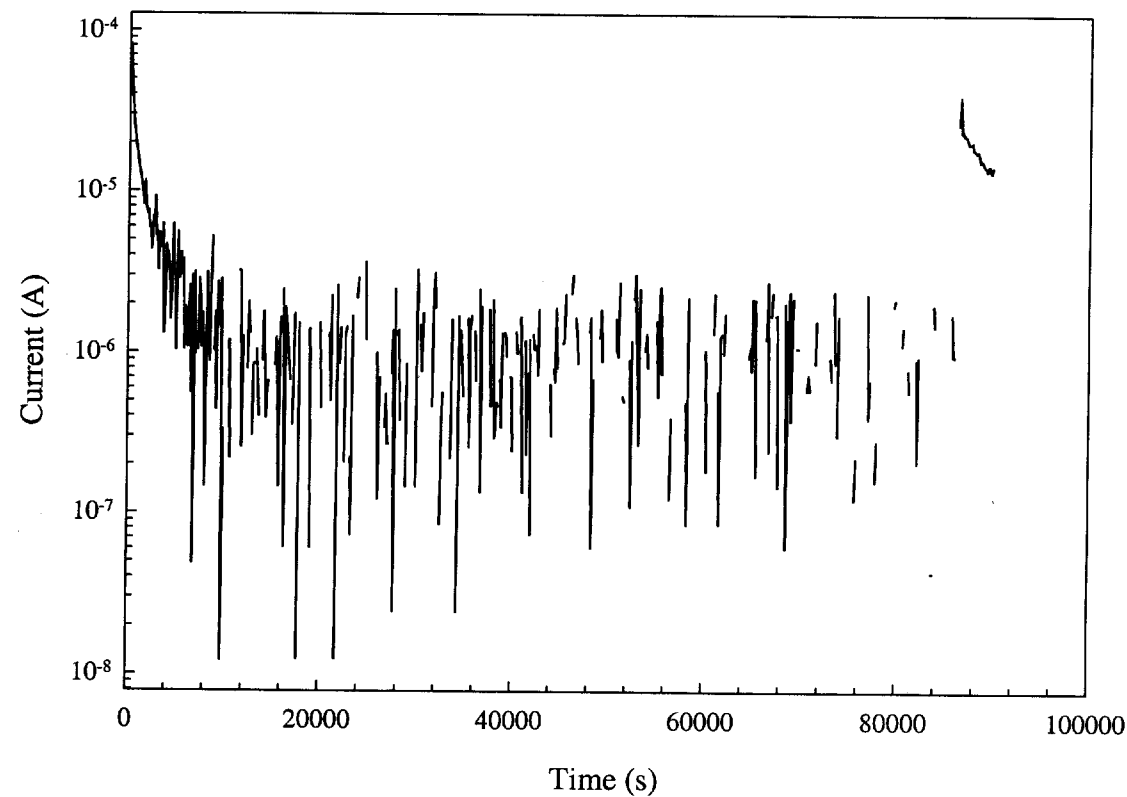
8-26-98

Observations

Two small pitted spots, very small

8-26-98

A516PS65



8-25-98

to 113

from 112

Cell 3 A516PS66.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = 225\text{ mV}$

Init wt = 28.77015g

Final wt = 28.77013g

8-26-98

Final Solution pH = 10.944

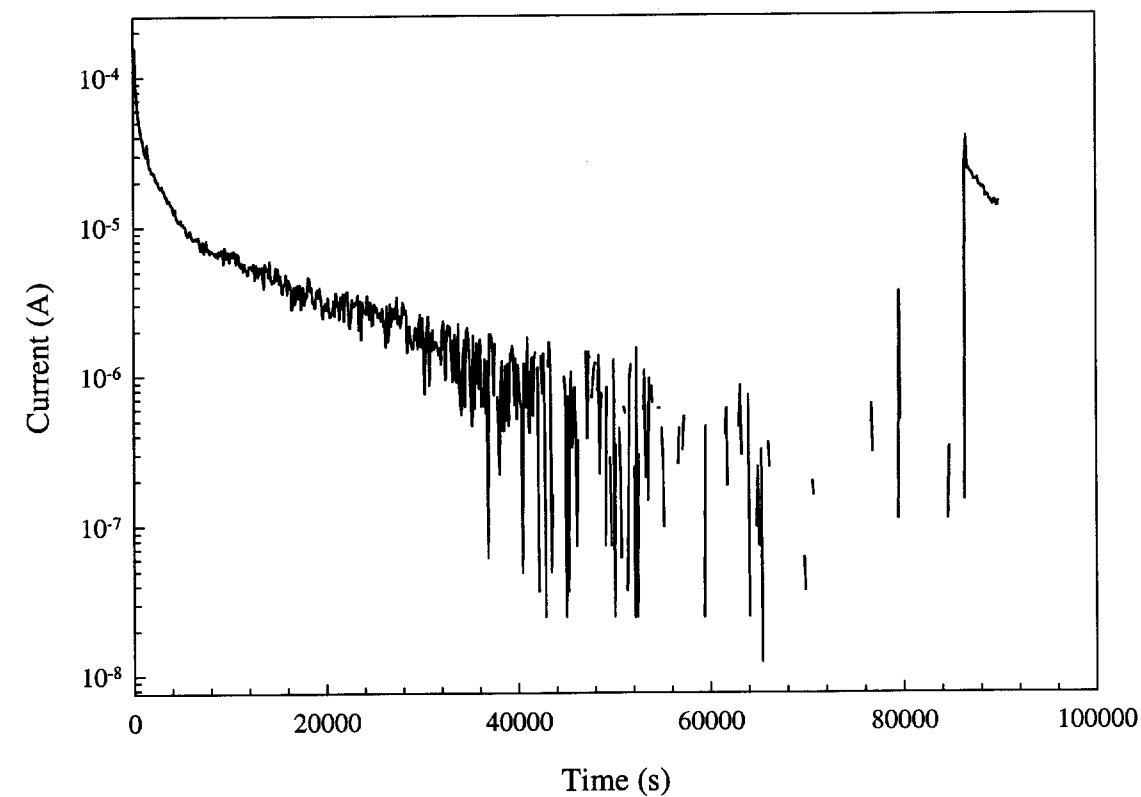
8-26-98

Observations

Several pits on both sides but very small

8-26-98

A516PS66



8-25-98

to 114

from 113

8-26-98

Stock Solution

 $\text{NaHCO}_3 \rightarrow 120\text{mm} \rightarrow 20.1624\text{g}/2\text{L}$ $\text{Cl} \rightarrow 30\text{mm} \rightarrow 3.5065\text{g}/2\text{L}$

fisher lot

#857289

972274

Init. pH = 8.143

All Specimens polished to 600 grit & ultra sonically
cleaned in Acetone, crevices ultra sonically cleaned in Methanol

8-26-98 to 115

from 114

Cell 1

A516 PS67 DAT

 $T = 25^\circ\text{C}$ $E_{\text{set}} = -300\text{mV}$

Init wt = 29.01942g

Final wt = 28.97915g 8-27-98

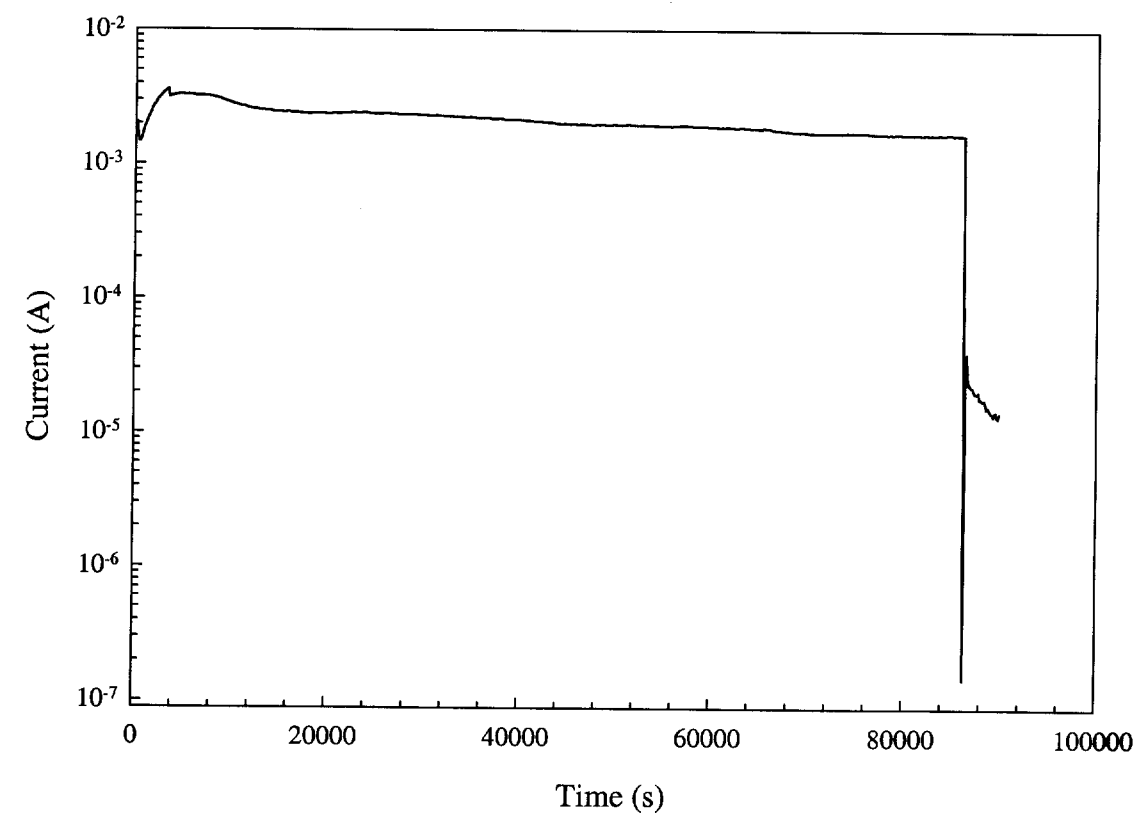
Final pH = 9.359 8-27-98

Observation

General corrosion on specimen.

Crevice fast protected specimen for pitting 8-27-98

A516PS67



8-26-98 to 116

from 115

Cell 2

A516PS68.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -370\text{ mV}$

Init wt = 29.06937g

Final wt = 28.97912g

8-27-98

Final pH = 9.859

8-27-98

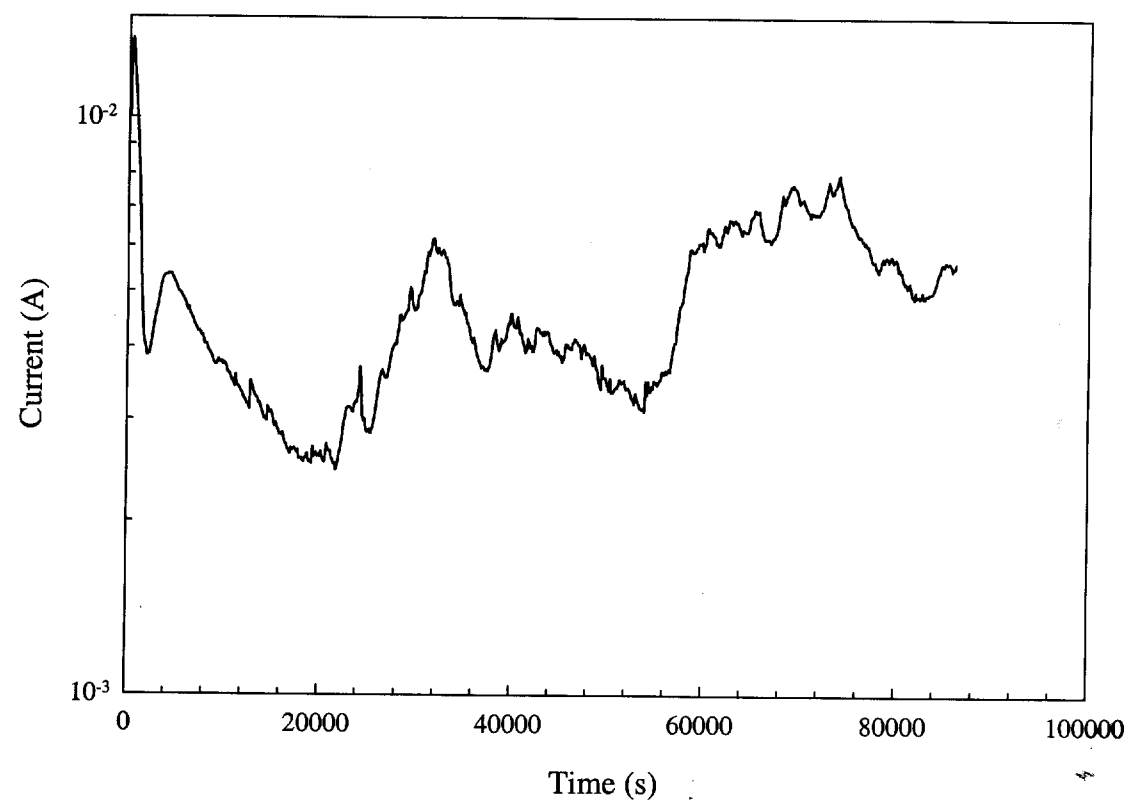
Observations

General corrosion on specimen with moderate deposits

Crevice fast protected specimen from pitting

8-27-98

A516PS68



8-26-98

to 117

from 116

Cell 3

A516PS69.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = -290\text{ mV}$

Init wt = 29.01942g

28.82012g

Final wt = 28.83014g

8-27-98

Final pH = 10.170

8-27-98

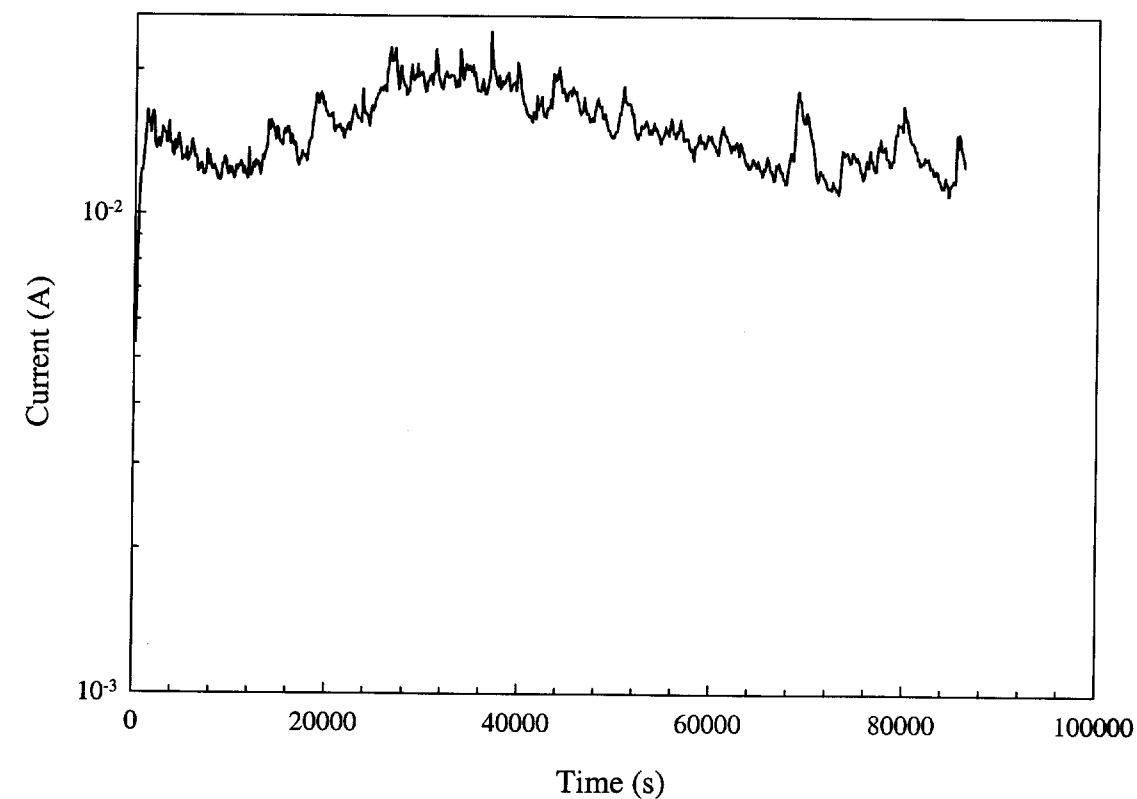
Observations

General corrosion on specimen with moderate deposits

Crevice fast protected from pitting

8-27-98

A516PS69



8-26-98

to 118

from 117

8-27-98

Stock Solution

 $\text{NaHCO}_3 \rightarrow 120\text{mM} \rightarrow 20.1624\text{g}/2\text{L}$ $\text{NaCl} \rightarrow 12\text{mM} \rightarrow 1.4026\text{g}/2\text{L}$

Fish Lot

897789

972274

Initial pH = 8.125

All specimens polished to 600 grit & ultrasonically cleaned
in Acetone, crevices ultrasonically cleaned in methanol

from 118

Cell 1

A516 PS70.DAT

 $T = 25^\circ\text{C}$ $E_{\text{set}} = -315\text{mV}$

Init wt = 28.90293

Final wt = 28.89718g 8-28-98

Final Solution pH = 9.169 8-28-98

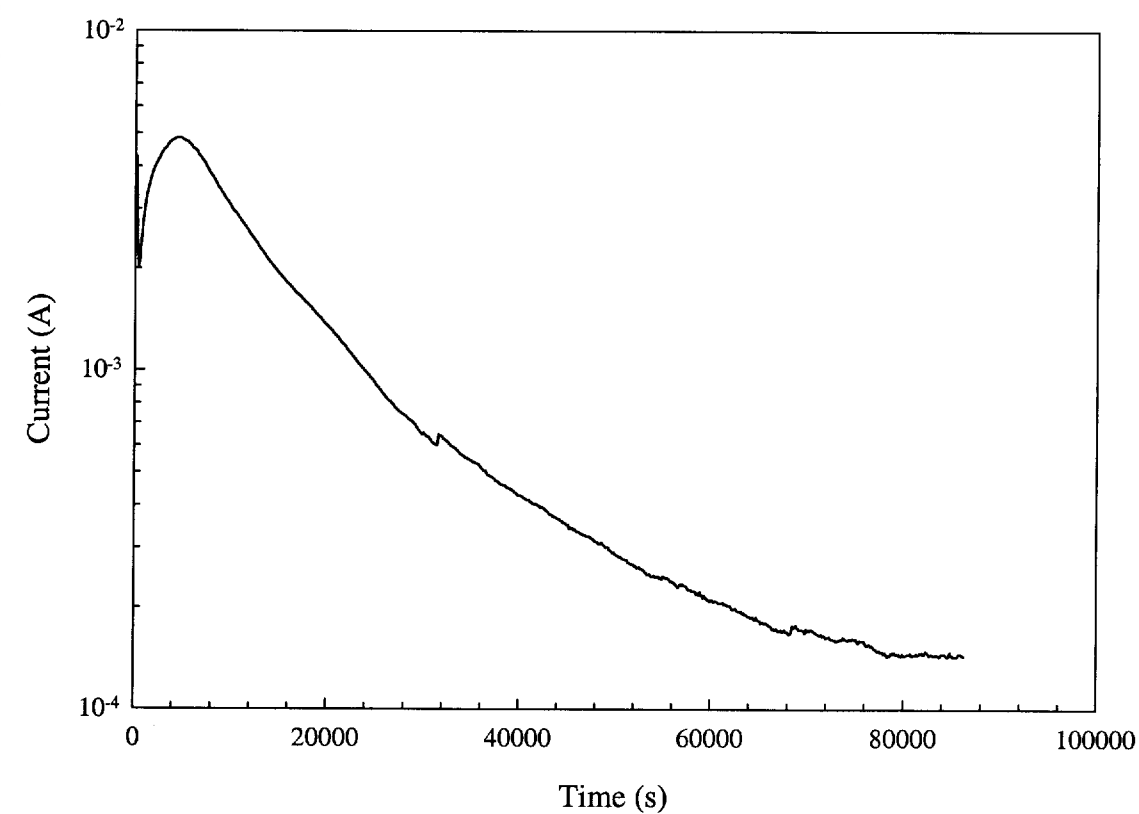
Observations

General corrosion on specimen

no pitting under feet

8-28-98

A516PS70



8-27-98

to 119

8-27-98

to 120

from 119

Cell 2

A516PS71.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -340\text{mV}$

Init wt = 28.79780

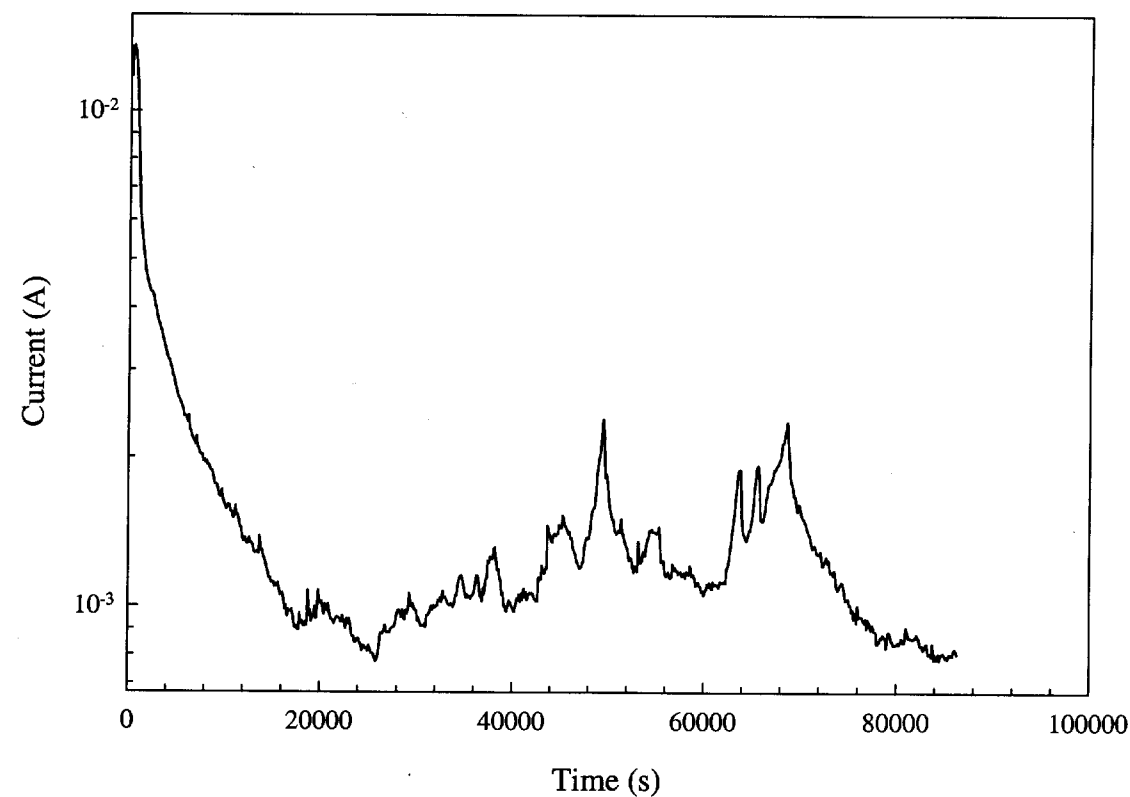
Final wt = 28.77355g 8-28-98

Final Solution pH = 9.821 8-28-98

Observations

General corrosion product on Spec 8-28-98
Micro pitting under crevice feet

A516PS71



8-27-98

to 121

from 120

Cell 3

A516PS72.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = -260\text{mV}$

Init wt = 28.87609g

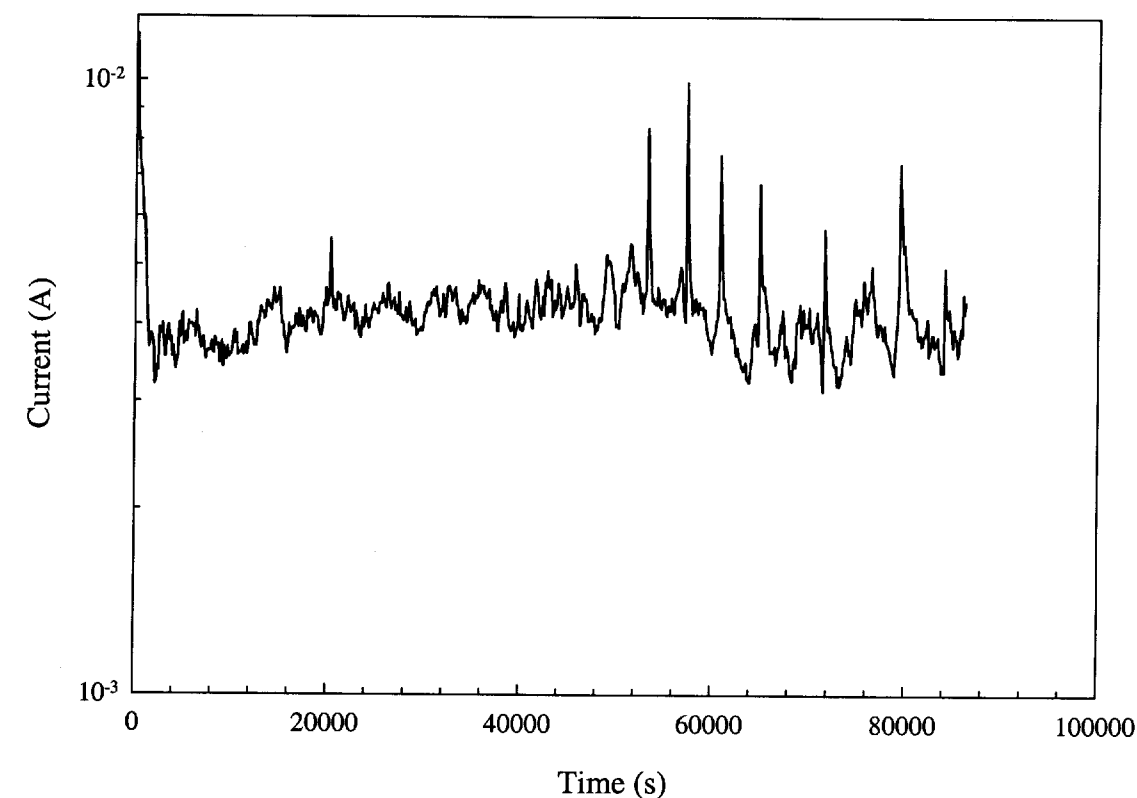
Final wt = 28.84266g 8-28-98

Final Solution pH = 10.077 8-28-98

Observations

General corrosion product on Spec 8-28-98
No pitting under feet

A516PS72



8-27-98

to 122

from 121

8-31-98

Stock Solution

 $\text{NaHCO}_3 \rightarrow 120\text{mM} \rightarrow 20.1624\text{g}/2\text{L}$ $\text{NaCl} \rightarrow 4.8\text{mM} \rightarrow 0.5610\text{g}/2\text{L}$

Start 9:46 AM

Fisher lot

897789*

972274

Init PH = 8.142

All specimens polished to 600 grit + ultrasonically cleaned in acetone
 Crevices ultrasonically cleaned in methanol

NOTE:

Power Failure occurred 9-1-98
 Data Acquisition Shutdown

8-31-98 to 123

from 122 Cell 1

A516PS73.DAT

T = 25°C

Eset = -305 mV

Init wt = 28.79218g

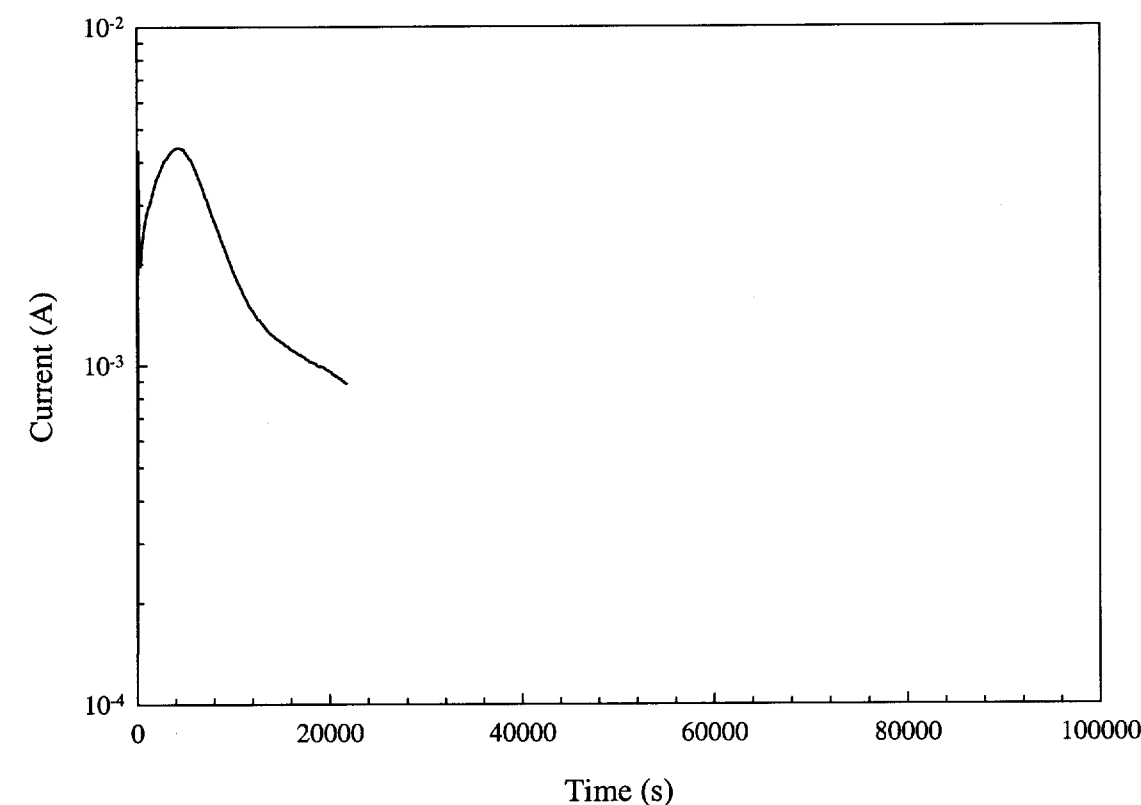
Final wt = 28.78509g 9-1-98

Final Solution Alt = 9.134 9-1-98

Observations

Some general corrosion, none under crevice fast 9-1-98

A516PS73



8-31-98 to 124

from 123

Cell 2

A516PS74.DAT

T = 65°C

Eset = -310 mV

Init wt = 28.73502 g

Final wt = 28.73270 g

9-1-98

Final Solution pH = 9.795

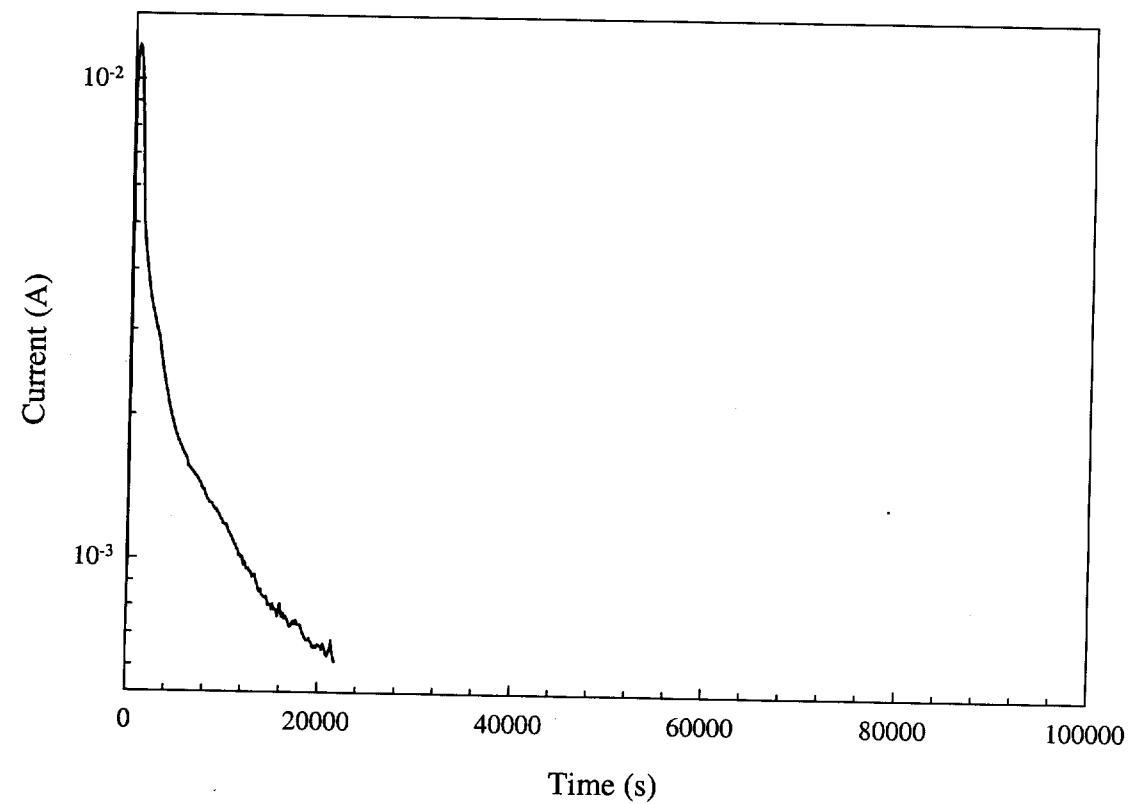
9-1-98

Observations

Some general corrosion, none under feet

9-1-98

A516PS74



8-31-98 to 125

from 124

Cell 3

A516PS75.DAT

T = 95°C

Eset = -230 mV

Init wt = 29.03454 g

Final wt = 29.02792 g

9-1-98

Final Solution pH = 10.526

9-1-98

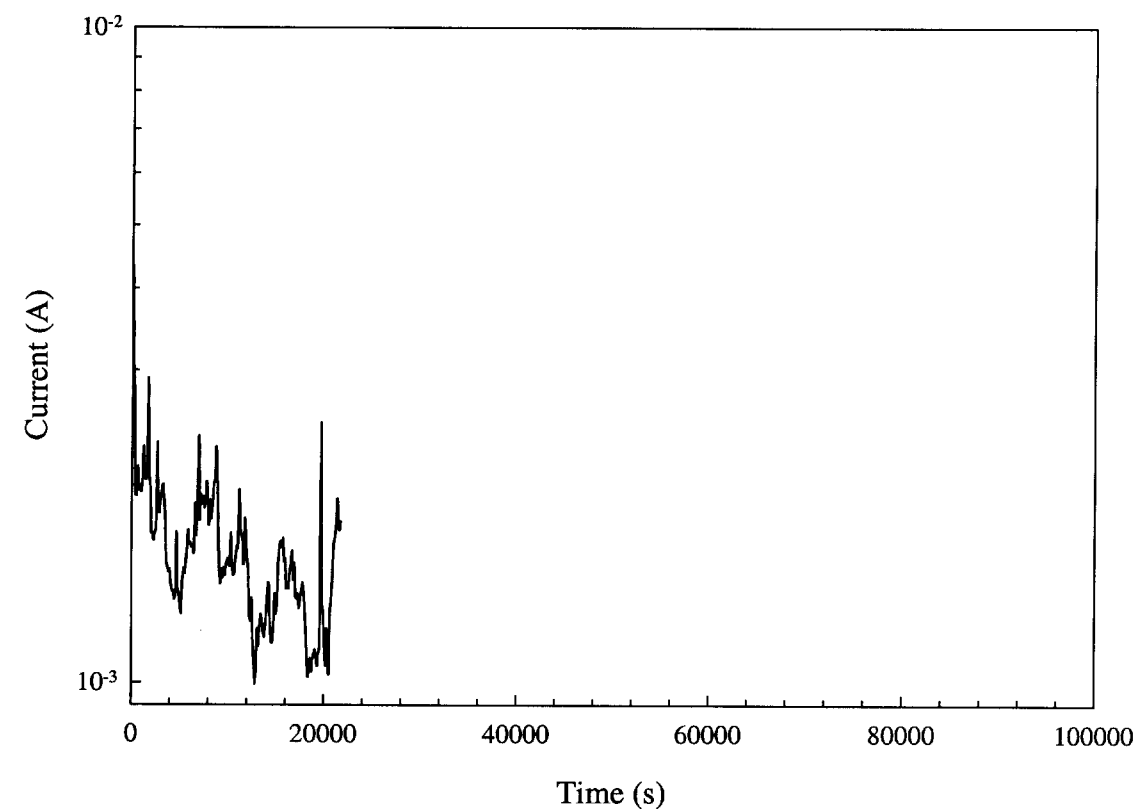
Observations

Some corrosion pitting on bottom of specimen

crevice pitting under feet and on edges of feet

9-1-98

A516PS75



8-31-98 to 126

from 125

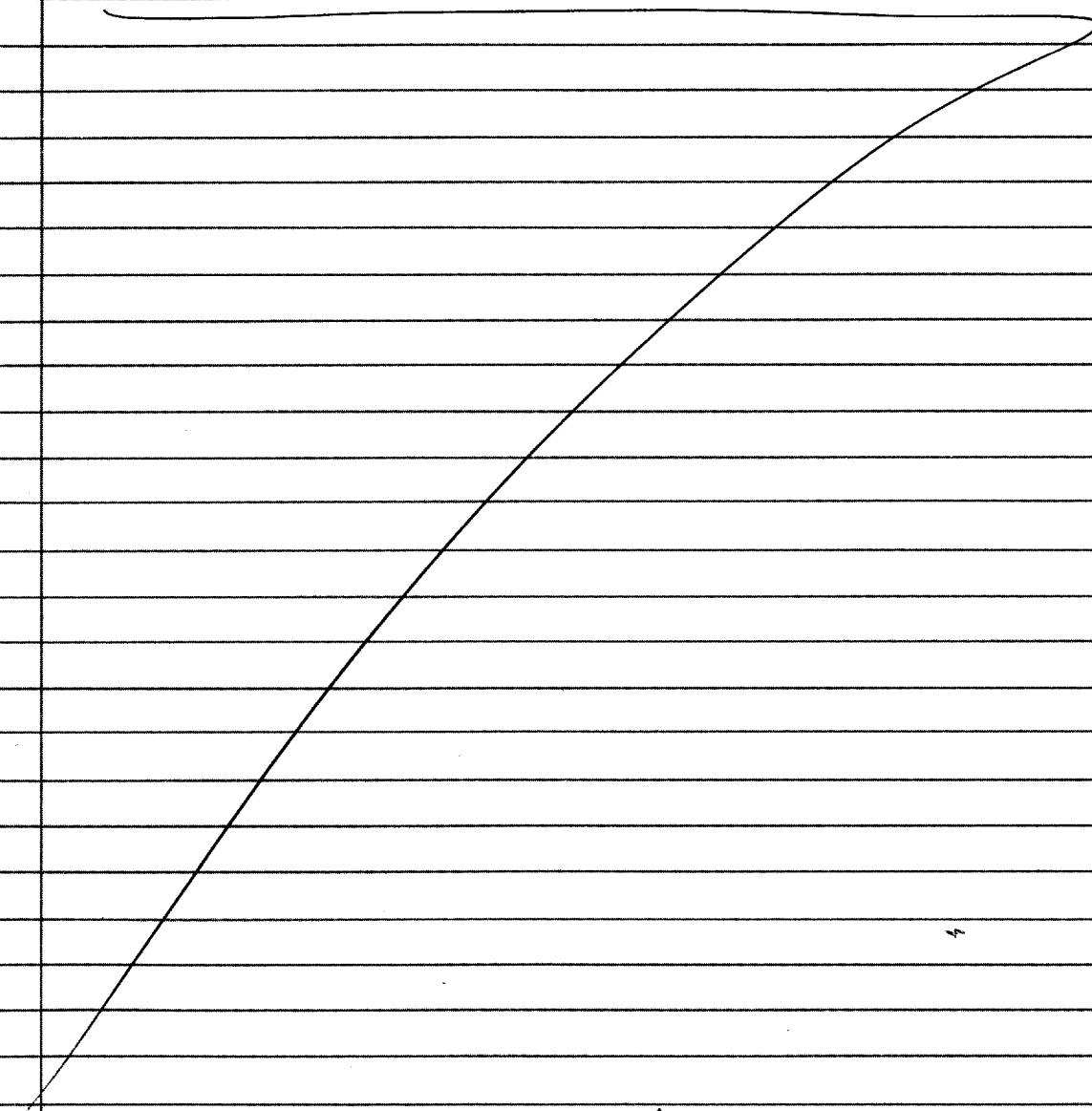
9-1-98

Stock Solution

 $\text{NaHCO}_3 \rightarrow 120 \text{ mM} \rightarrow 20.1624 \text{ g/L}$ Fish # 897789 $\text{NaCl} \rightarrow 4.8 \text{ mM} \rightarrow .5610 \text{ g/L}$ " 972274

Init pH = 8.149

All Specimens polished to 600 grit + ultrasonically cleaned in Acetone
 Crevas ultrasonically cleaned in Methanol



Signature
 9-1-98

to 127

from 126

Cell 1

A516PS76.DAT

T = 25°C

E_{set} = -305 mV

Init wt = 28.9624 g

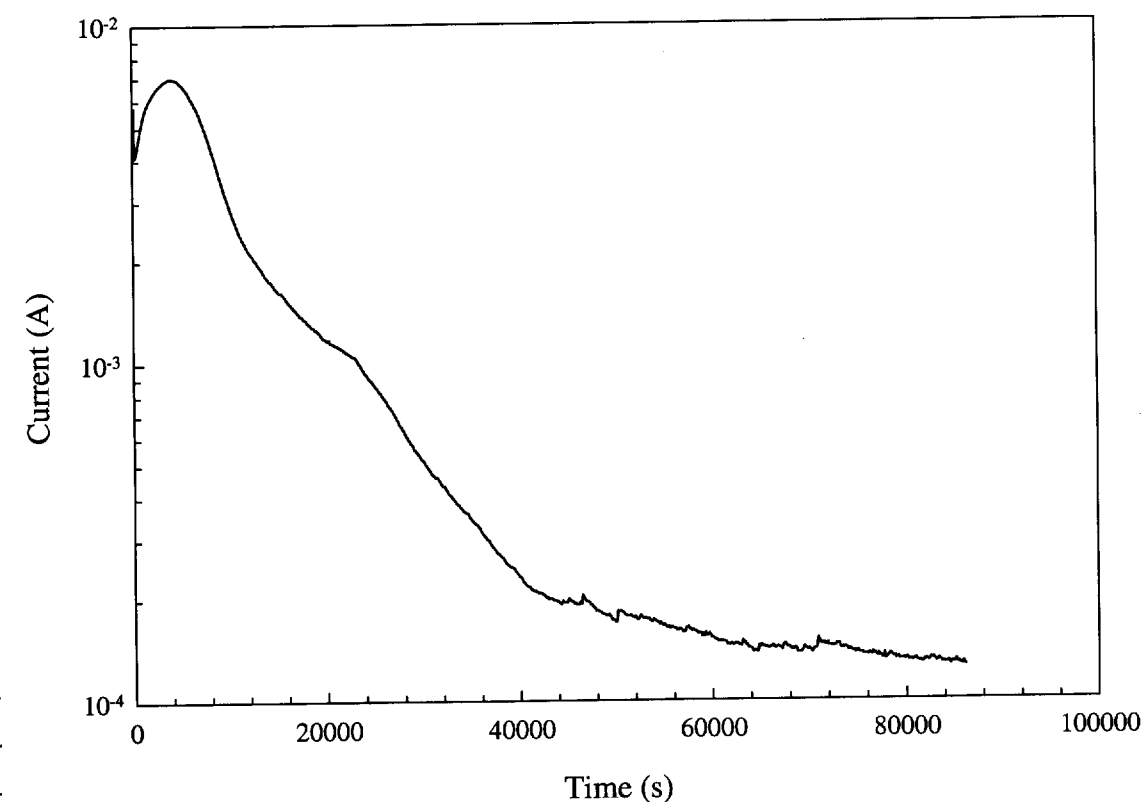
Final wt = 28.95584 g 9-2-98

Final Solution pH = 9.161 9-2-98

Observations

General Corrosion, none under feet 9-2-98

A516PS76



Signature

9-1-98

to 128

From 127

Cell 2 A516PS77.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -310\text{mV}$

Init wt = 28.81691g

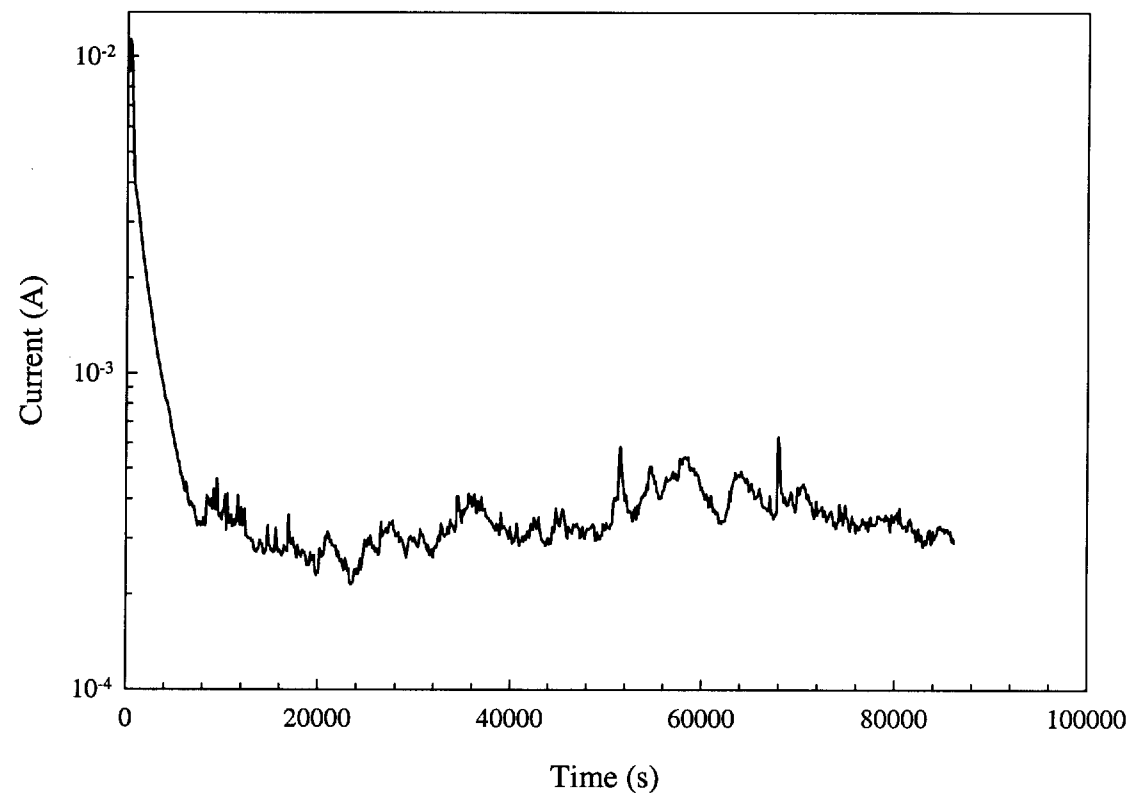
Final wt = 28.81041g 9-2-98

Final Solution pH = 9.947 9-2-98

Observations

Corrosion above vapor line, some pitting under crevice foot. 9-2-98

A516PS77



9-1-98

To 129

From 128

Cell 3 A516PS78.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = -230$

Init wt = 28.75483g

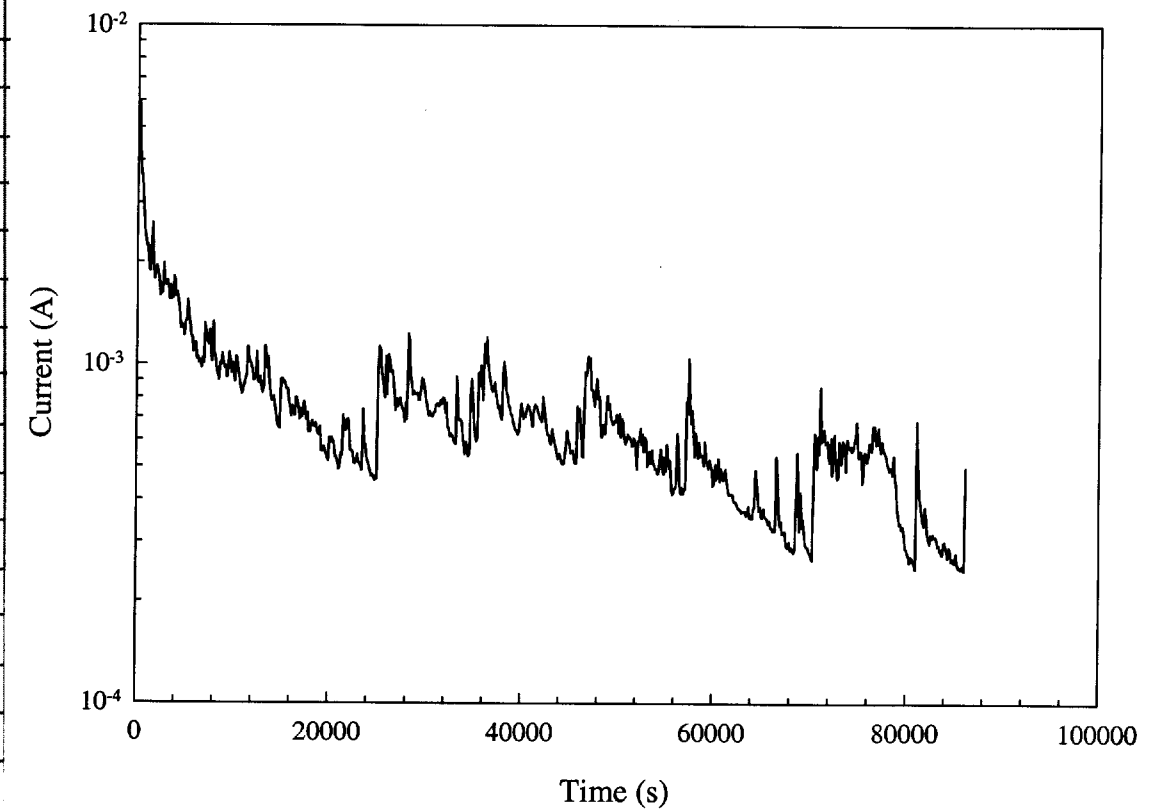
Final wt = 28.75318g 9-2-98

Final Solution pH = 11.223 9-2-98

Observations

Crevice pitting, some general corrosion 9-2-98

A516PS78



9-1-98 to 130

From 129

9-2-98

F. du Lot

Stock Solution

 $\text{NaHCO}_3 \rightarrow 120 \text{ mM} \rightarrow 20.1614 \text{ g / 2L}$ 897289 $\text{NaCl} \rightarrow 2.4 \text{ mM} \rightarrow 0.2805 \text{ g / 2L}$ 972274

Initial pH = 8.166

All specimens polished to 600 grit + ultra Sonically cleaned in Acet
 Cracks ultra sonically cleaned in Methanol

From 130

Cell 1

A516PS79. NAT

T = 25°C

Eset = -300 mV

Init wt 28.70445g

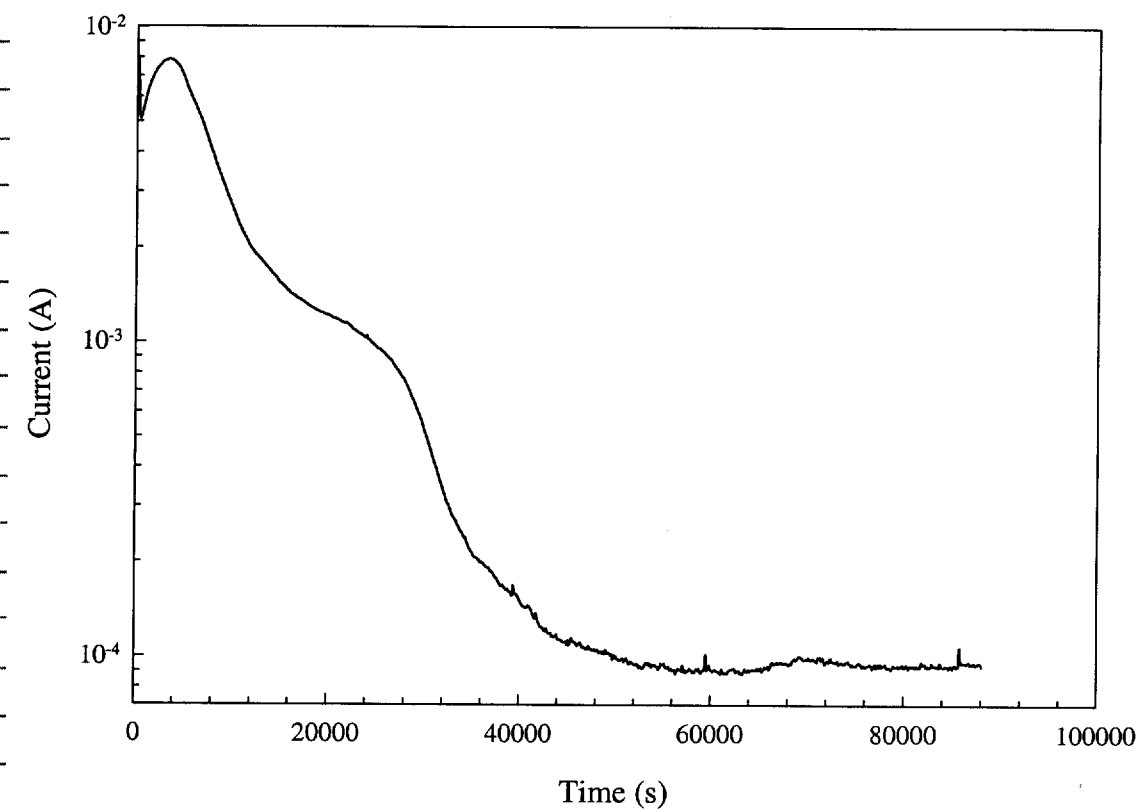
Final wt 28.69709g 9-3-98

Final pH 9.168 9-3-98

Observations

General corrosion, none under crevice coat 9-3-98

A516PS79



9-2-98

To 131

9-2-98

To 132

from 131

Cell 2

A516PS80.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -280\text{ mV}$

Init wt = 28.93610g

Final wt = 28.93348g

9-3-98

Final Solution = 9.983

9-3-98

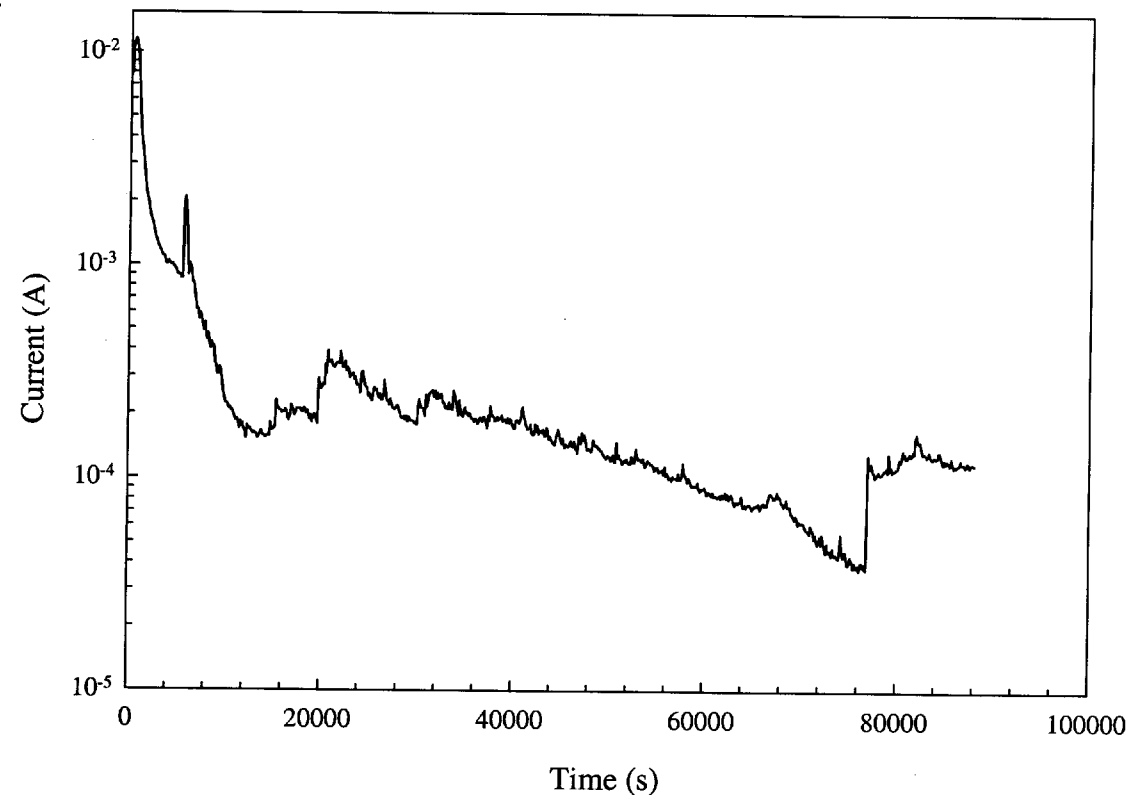
Observation:

Some general corrosion on shaft

minor crevice pitting

9-3-98

A516PS80



9-2-98

To 133

from 132

A516PS81.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = -210\text{ mV}$

Init wt = 28.60858g

Final wt = 28.60984g

9-3-98

Final pH = 11.030

9-3-98

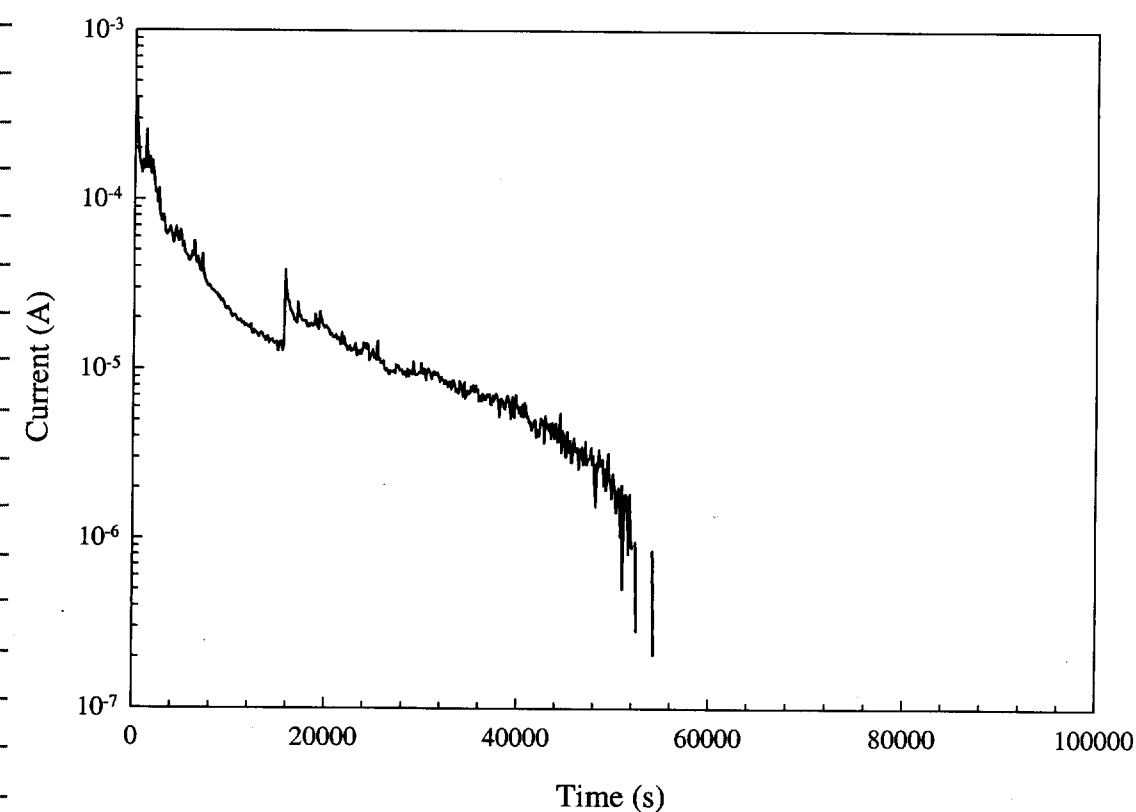
Observations:

No general corrosion fairly uniform

crevice pitting

9-3-98

A516PS81



9-2-98

To 134

from 133

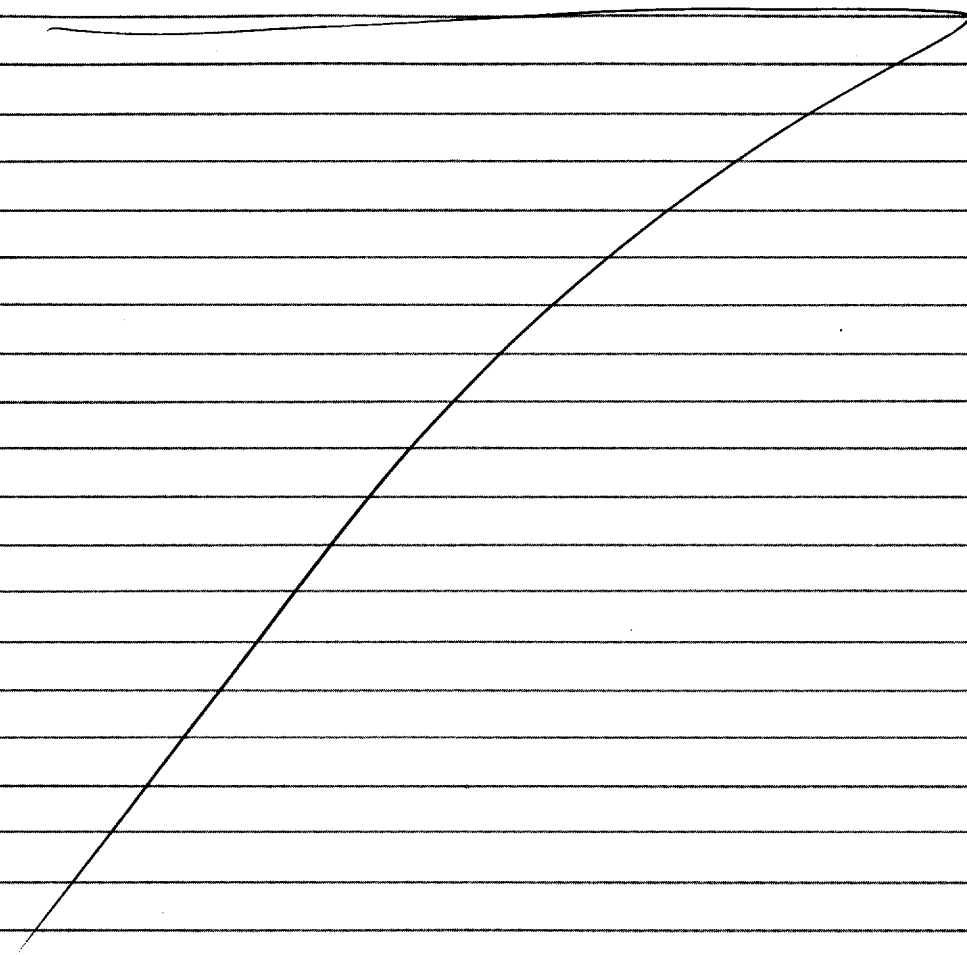
Stock Solution

Start 2:37 pm

 $\text{NaHCO}_3 \rightarrow 120 \text{ mM} \rightarrow 20.16 \text{ Ng/2L}$ Fisher # 897798 $\text{NaCl} \rightarrow 1.6 \text{ mM} \rightarrow 0.1870 \text{ g/2L}$ Fisher # 972274

Initial pH = 8.164

... All specimens polished to 600 grit + ultrasonically cleaned in Acetone
crevices cleaned in methanol ultrasonically



9-3-98

to 135

from 134

Cell 1

A516PS82, NAT

 $T = 25^\circ \text{C}$ $E_{\text{set}} = -290 \text{ mV}$

Init. wt = 28.9675 g

Final wt = 28.95940 g

9-4-98

Final Solution pH = 9.145

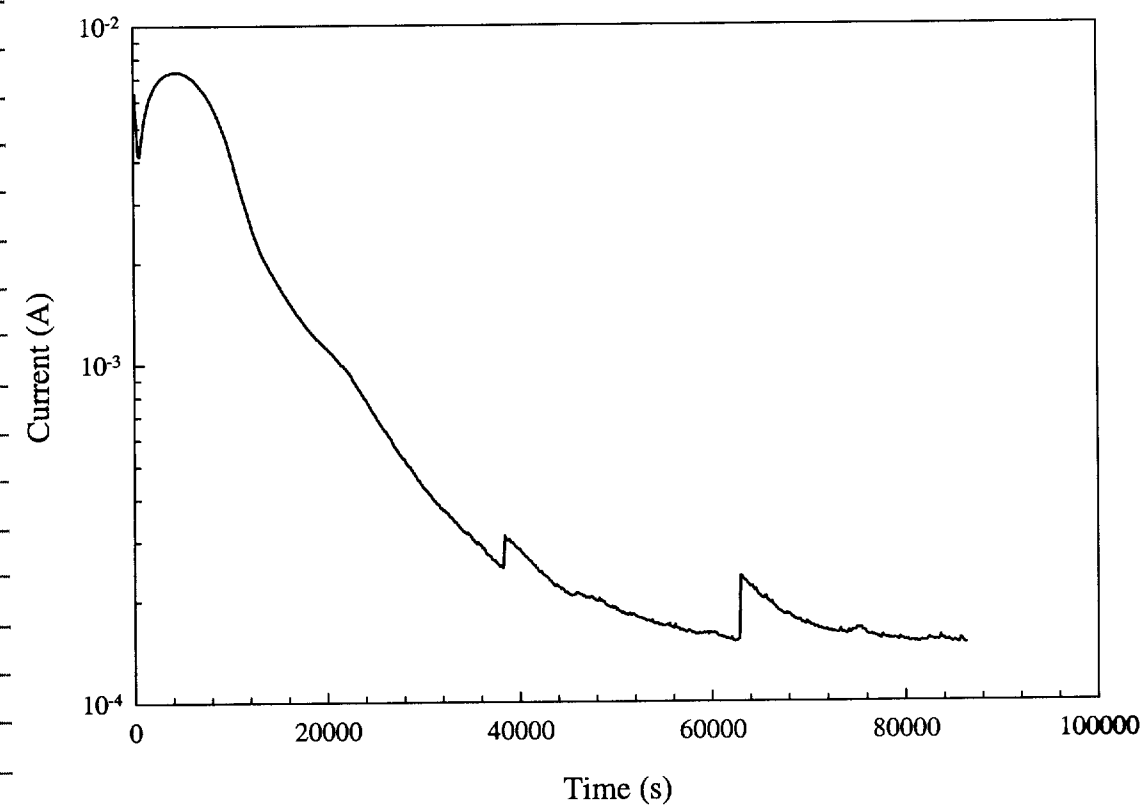
9-4-98

Observations

General corrosion, none under foot

9-4-98

A516PS82



9-3-98

to 136

from 135

Cell 2 A516PS83.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -270\text{ mV}$

Init wt = 28.88775g

Final wt = 28.88693g

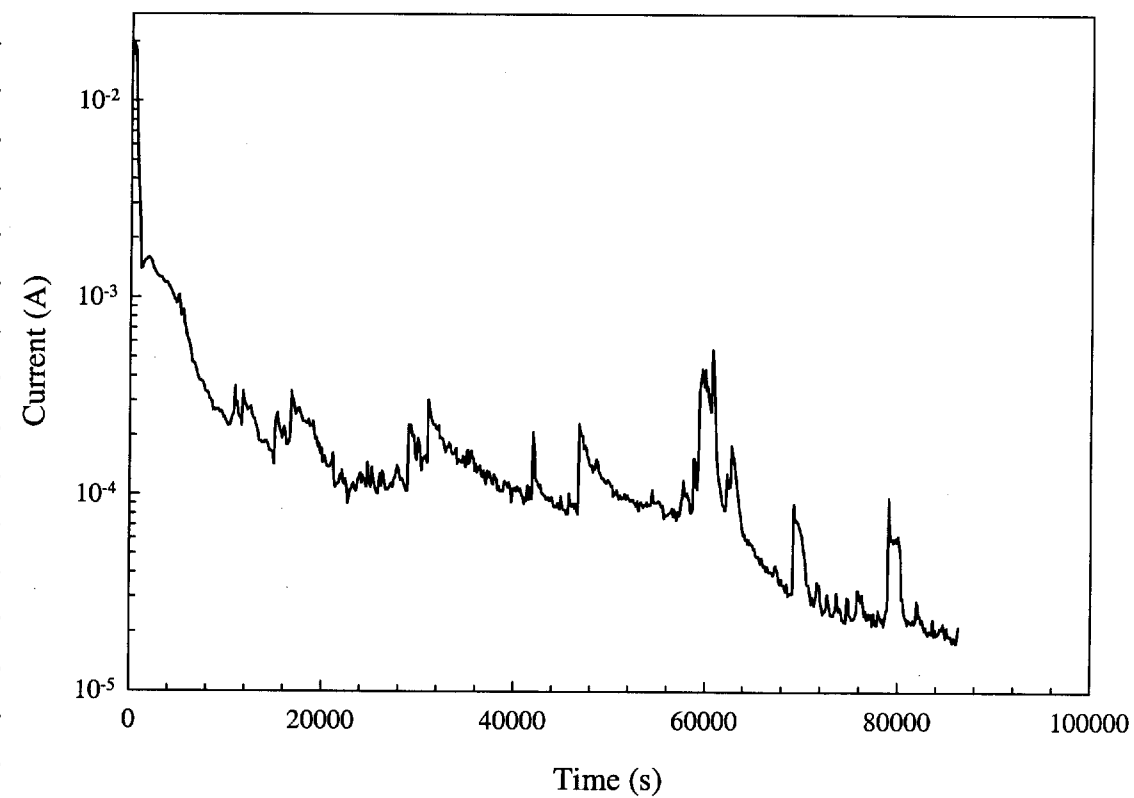
Final Solution pH = 9.858

Observations

Some corrosion above water line

minor pitting under crevice feet

A516PS83



9-3-98

To 137

from 136

Cell 3 A516PS84.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = -200\text{ mV}$

Init wt = 29.07900g

Final wt = 29.07920g

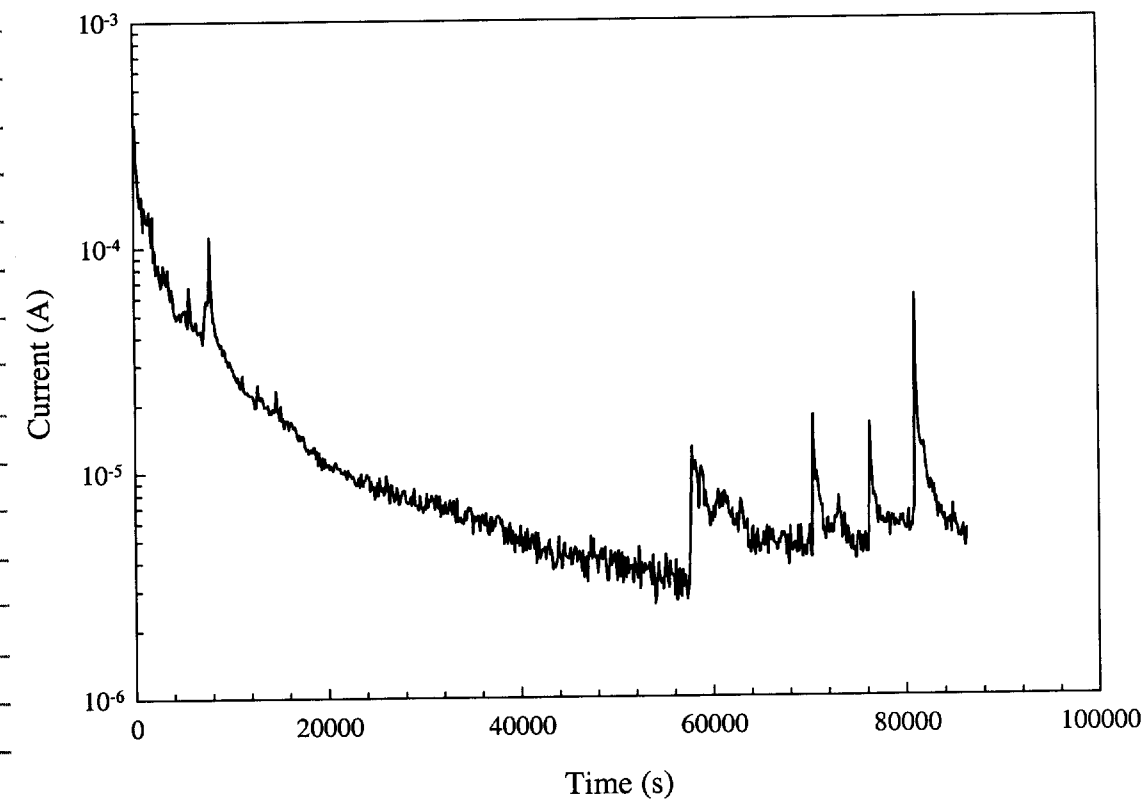
Final Solution pH = 10.685

Observations

crevice pitting under feet

no other corrosion noted

A516PS84



9-3-98

To 138

from 137

9-8-98

Stock Solution

 $\text{NaHCO}_3 \rightarrow 120 \text{ mM} \rightarrow 20.1624 \text{ g} / 2 \text{ Lt}$ $\text{NaCl} \rightarrow 1.2 \text{ mM} \rightarrow 0.1403 \text{ g} / 2 \text{ Lt}$

Start 9:50

Fisher #

897789

972274

Initial pH = 8.180

All specimens polished to 600grit & ultrasonically cleaned in Acetone
 All crevices ultrasonically cleaned in methanol

from 138

Cell 1

A516PS85.DAT

T = 25°C

Eset = -290mV

Init wt = 28.92722g

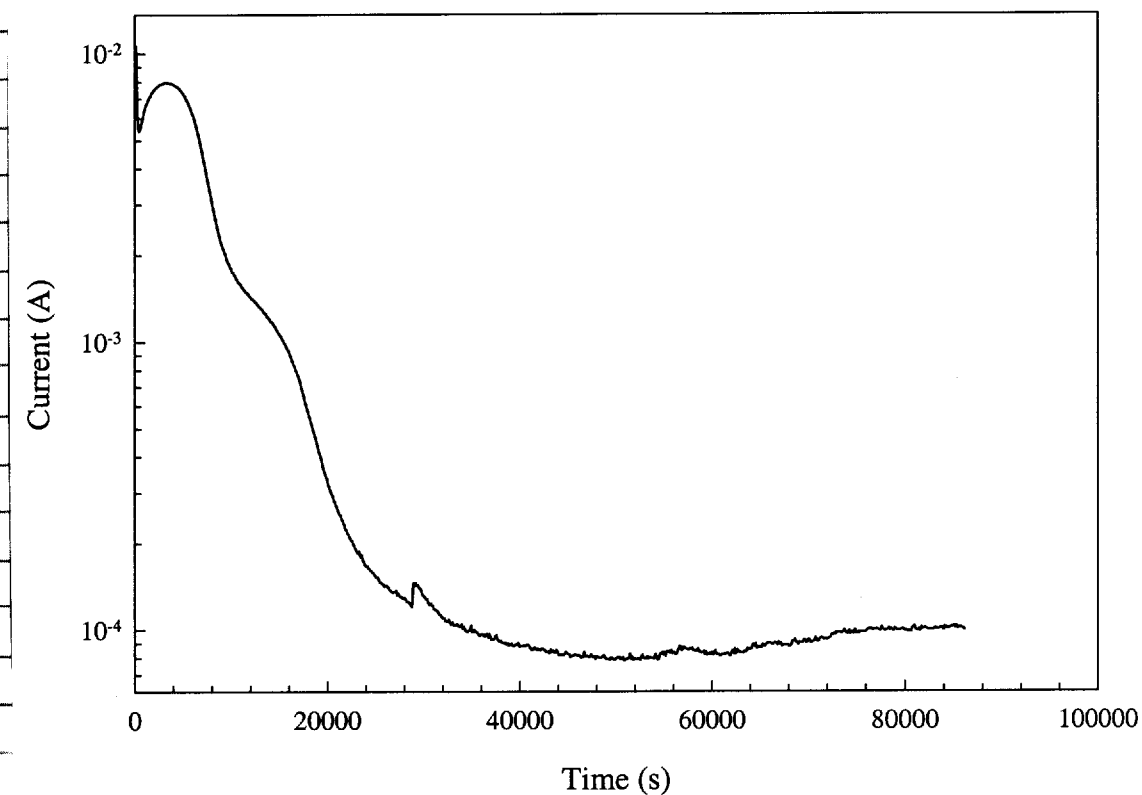
Final wt = 28.91933g

Final Solution pH = 8.958

Observations

General Corrosion, no crevice pitting

A516PS85



9-8-98 To 139

9-8-98

To 140

From 139

Cell 2 A516PS86.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -260 \text{ mV}$

Init wt = 28.79420g

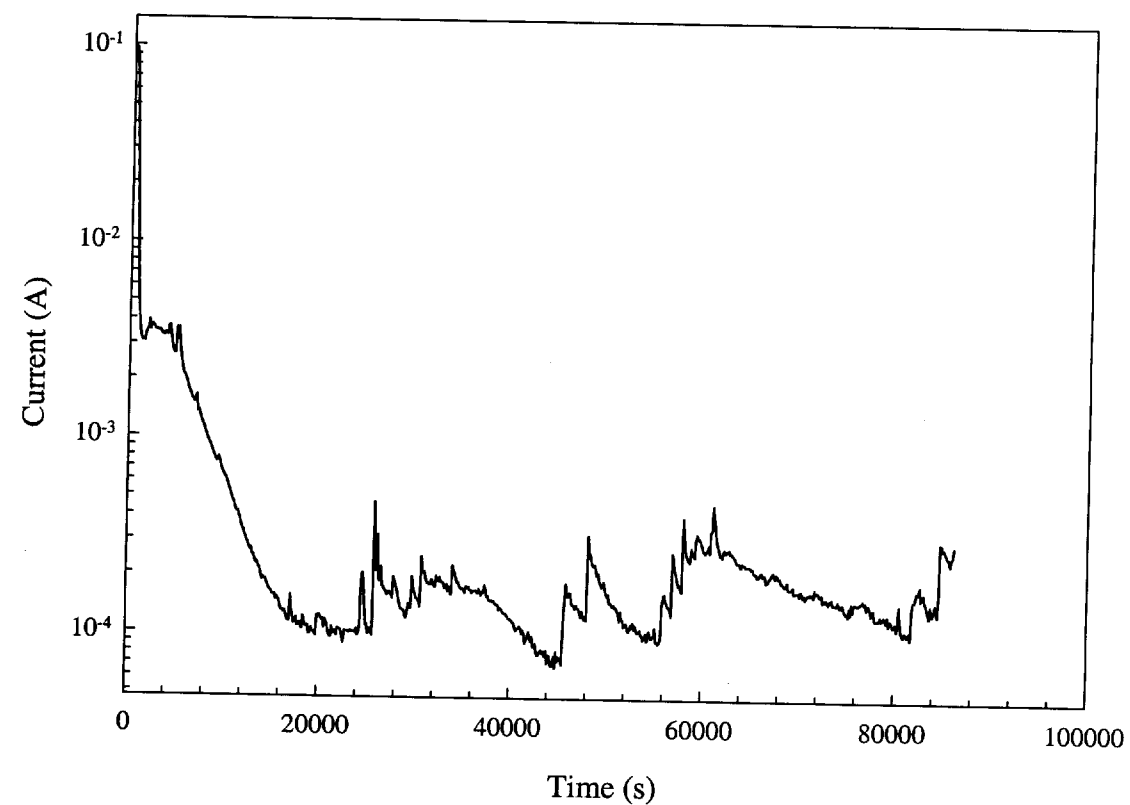
Final wt = 28.79300g

Final Solution pH = 9.465

Observations

General Corrosion, no crevice pitting

A516PS86



9-8-98 To 141

From 140

Cell 3 A516PS87.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = -190 \text{ mV}$

Init wt = 28.73913g

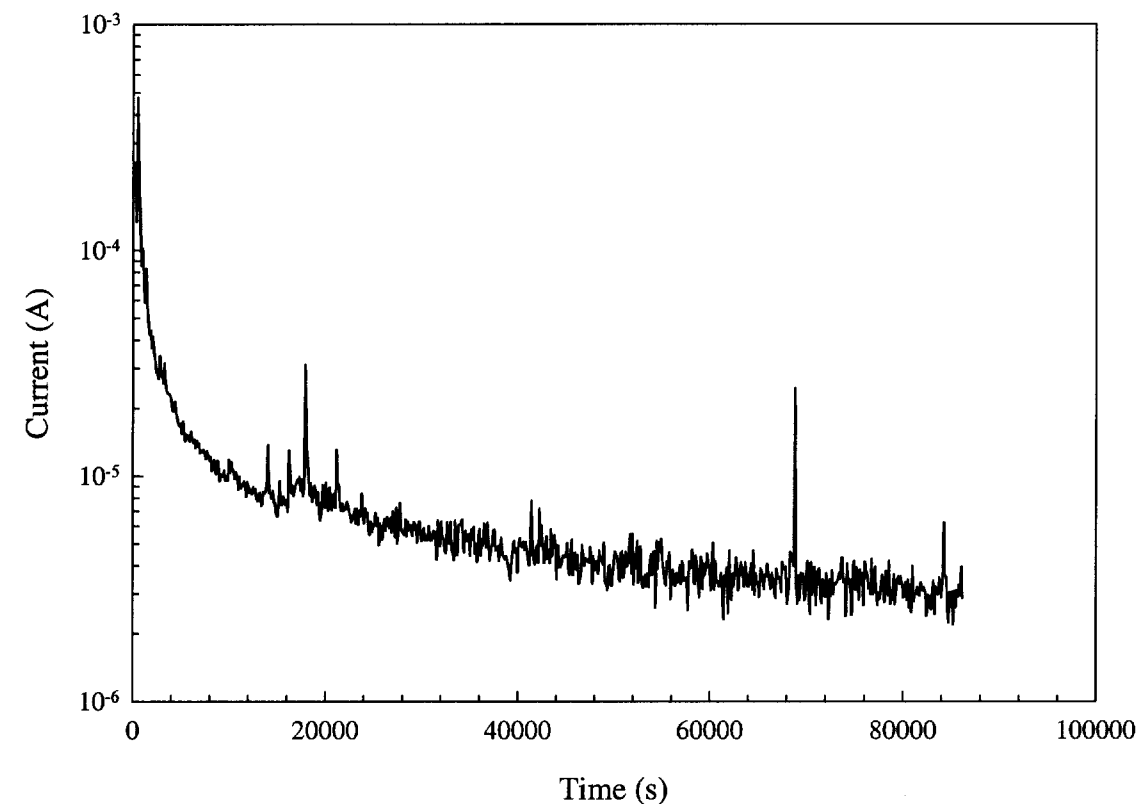
Final wt = 28.73965g

Final Solution pH = 10.961

Observations

No general Corrosion, minor crevice pitting

A516PS87



9-8-98 To 142

From 141

9-9-98

Stock Solution

 $\text{NaHCO}_3 \rightarrow 6\text{mM} \rightarrow 1.008\text{g}/2\text{L}$ Filter # 897789 $\text{NaCl} \rightarrow 1.2\text{mM} \rightarrow 0.1403\text{g}/2\text{L}$ " 972274

Init pH = 7.57 @ 1m 8.36 after 5m

All specimens polished to 600grit & ultrasonically cleaned in Acetone

All crevices ultrasonically cleaned in Methanol

From 142

Cell 1

A516PS88.NAT

T = 25°C

 $E_{\text{ref}} = -290\text{mV}$

Init wt = 28.92371g

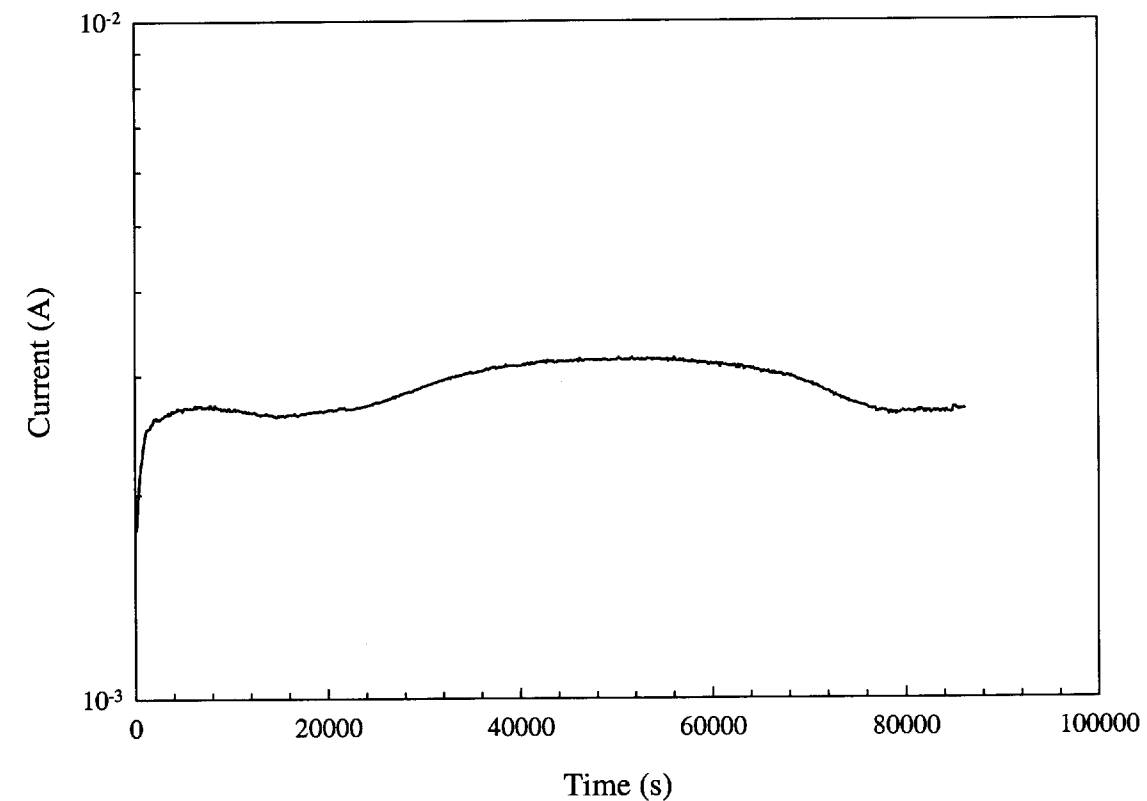
Final wt = 28.84964g 9-10-98

Final Solution pH = 9.428 9-10-98

Observations

General corrosion, crevice fact showed no pitting 9-10-98

A516PS88



9-9-98

To 143

9-9-98

To 144

From 143

Cell 2

A516 PS89.DAT

T = 65°C

Eset = -260 mV

Init wt = 28.78665g

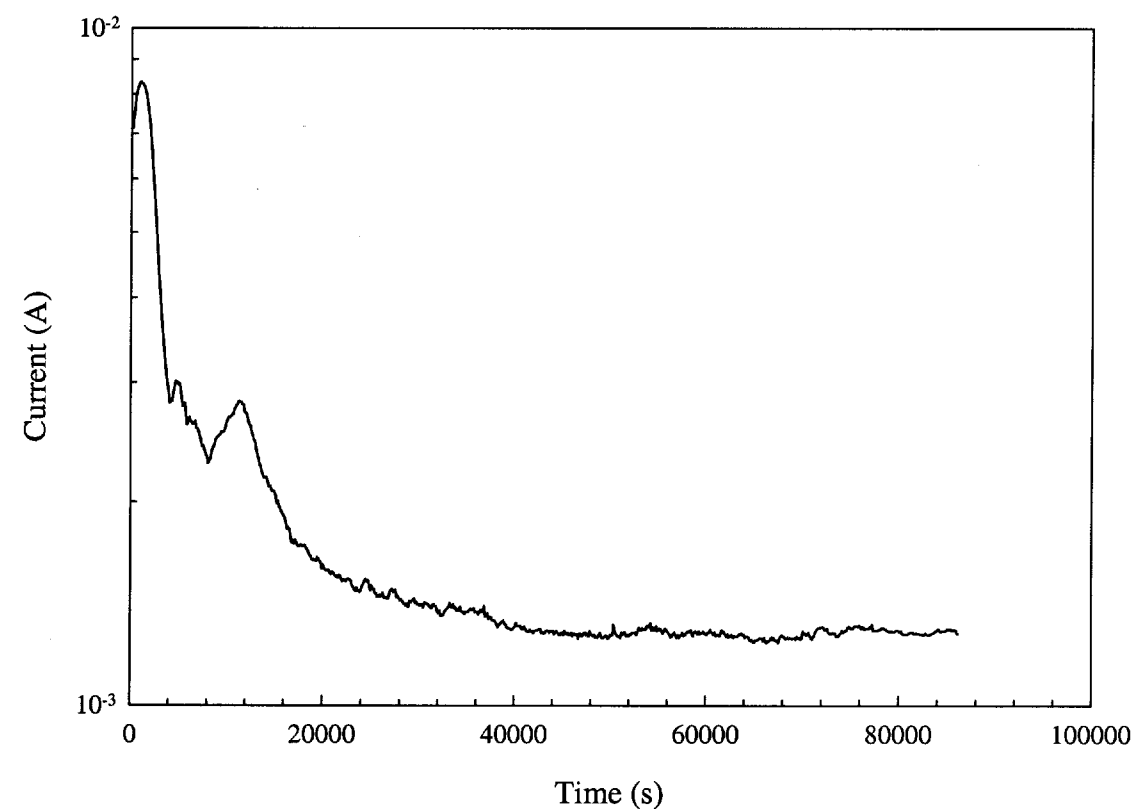
Final wt = 28.75611g 9-10-98

Final Solution pH = 9.625 9-10-98

Observations

General corrosion, no crevice pitting 9-10-98

A516PS89



9-9-98 To 145

From 144

Cell 3

A516 PS90.DAT

T = 98°C

Eset = -190 mV

Init wt = 29.00214g

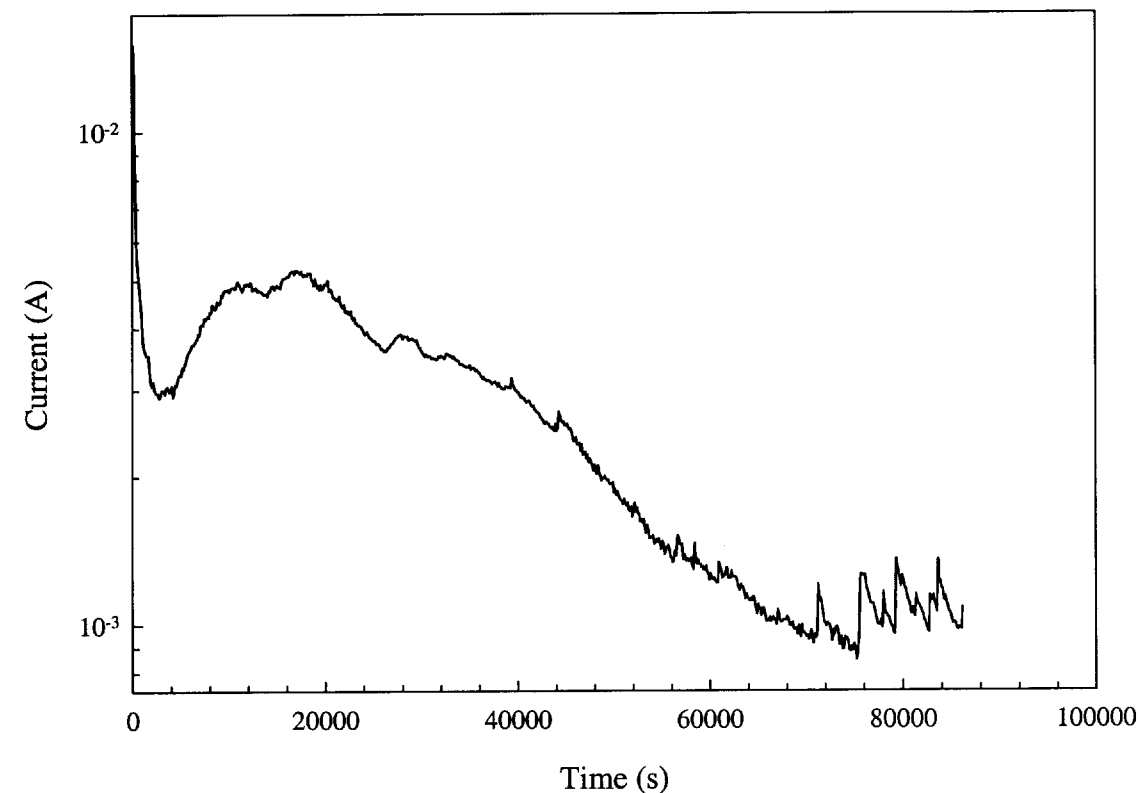
Final wt = 28.95150g 9-10-98

Final Solution pH = 10.842 9-10-98

Observations

Some general corrosion and start of pitting around crevice foot but not under foot 9-10-98

A516PS90



9-9-98 To 146

From 145

9-10-98

Start 1:20 pm

Stock Solution

 $\text{NaHCO}_3 \rightarrow 6 \text{ mM} \rightarrow 1.008 \text{ g/Lt}$ $\text{NaCl} \rightarrow .48 \text{ mM} \rightarrow .0561 \text{ g/Lt}$

Fish #

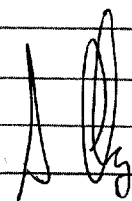
897789

972274

Init PH = 7.499 @ 1 min - 8.49 after 5

All specimens polished to 600 grit & ultrasonically cleaned in Acetone

All crevices ultrasonically cleaned in Methanol



9-10-98

To 147

From 146

Cell 1

A516PS91.DAT

T = 25°C

Eset = -270

Init wt = 28.80670g

Final wt = 28.68025g

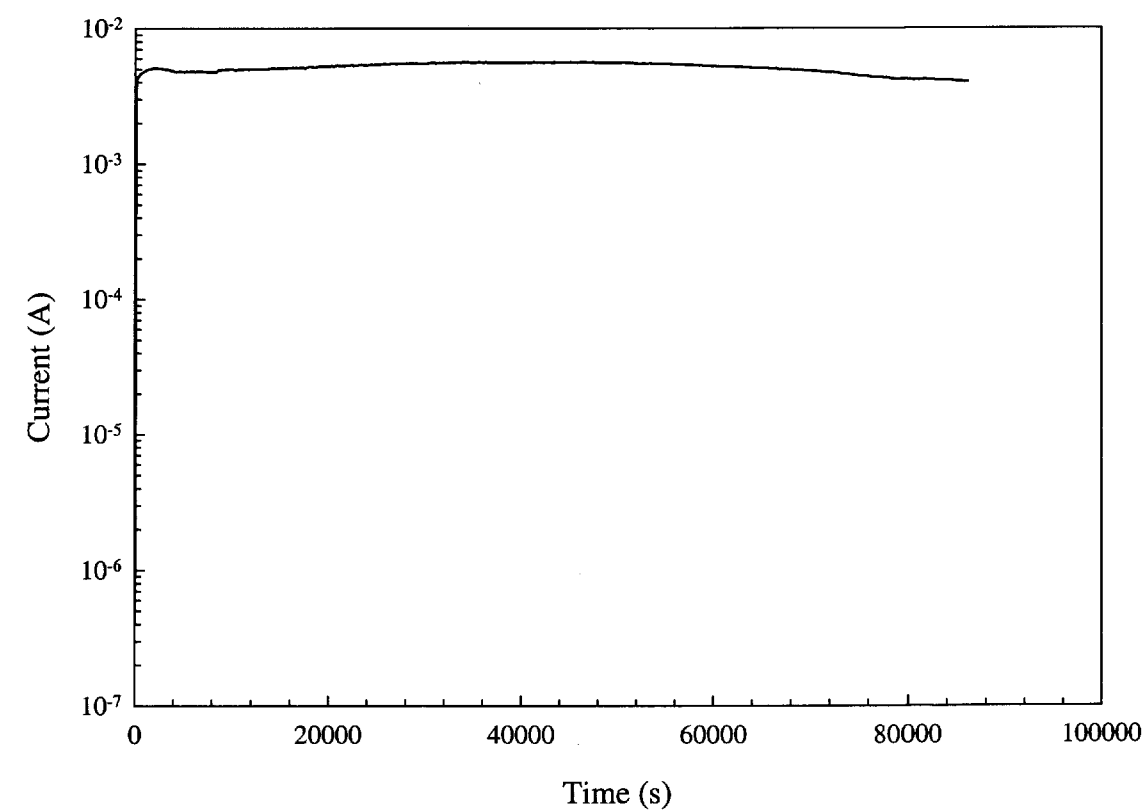
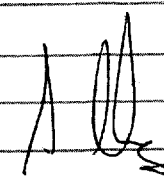
Final Solution PH = 10.082

Observations

Precipitate on specimen, general corrosion

No crevice pitting

A516PS91

9-10-98

To 148

From 147

Cell 2

A516PS92.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -250\text{ mV}$

Init. wt = 29.04890g

Final wt = 29.03300g

9-11-98

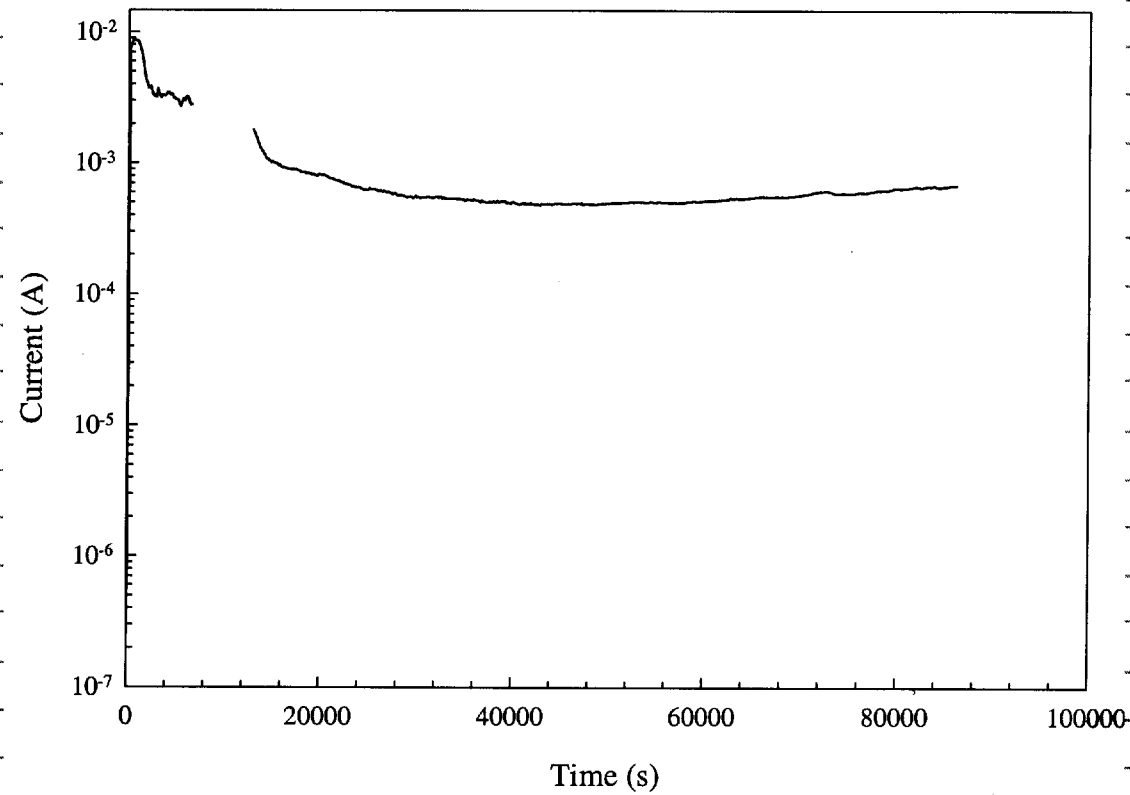
Final Solution pH = 9.756

9-11-98

Observations

General Corrosion, no crevice pitting 9-11-98

A516PS92



9-10-98

To 149

From 148

Cell 3

A516PS93.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = -170\text{ mV}$

Init. wt = 28.94460g

Final wt = 28.91372g

9-11-98

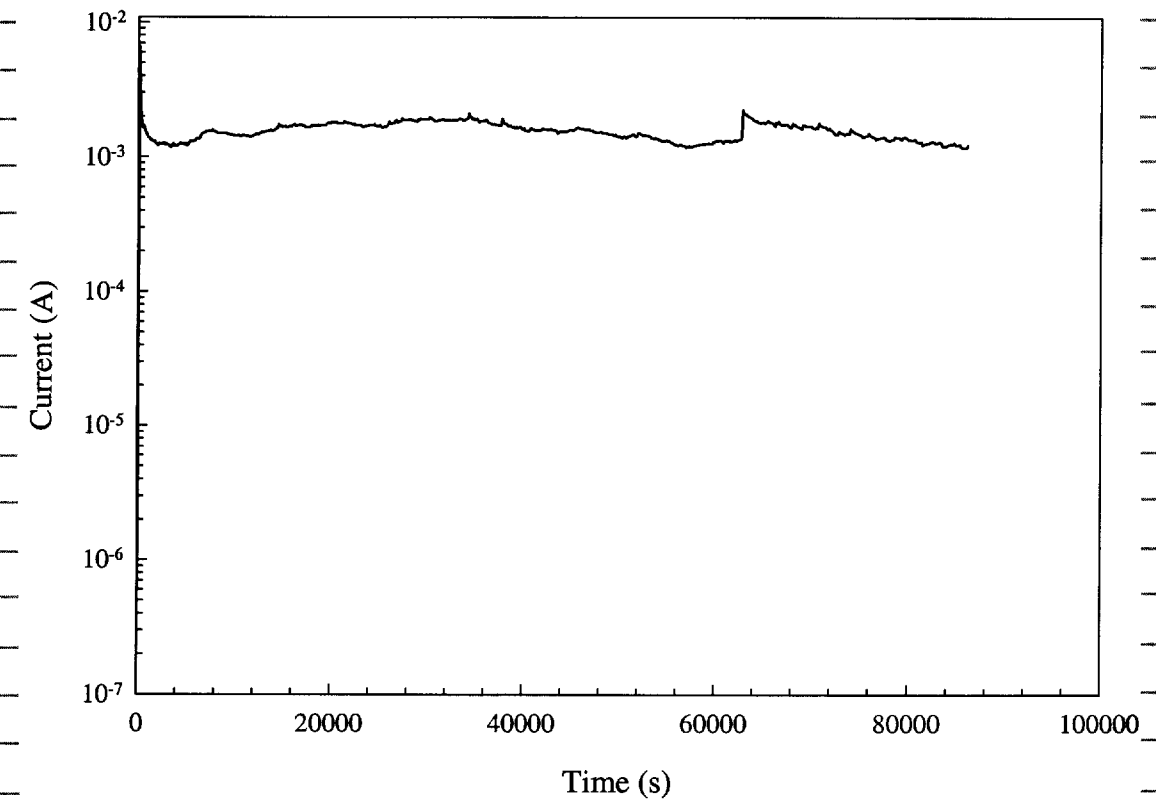
Final Solution pH = 9.743

9-11-98

Observations

Some minor general corrosion
crevice pitting 9-11-98

A516PS93



9-10-98

To 150

From 149

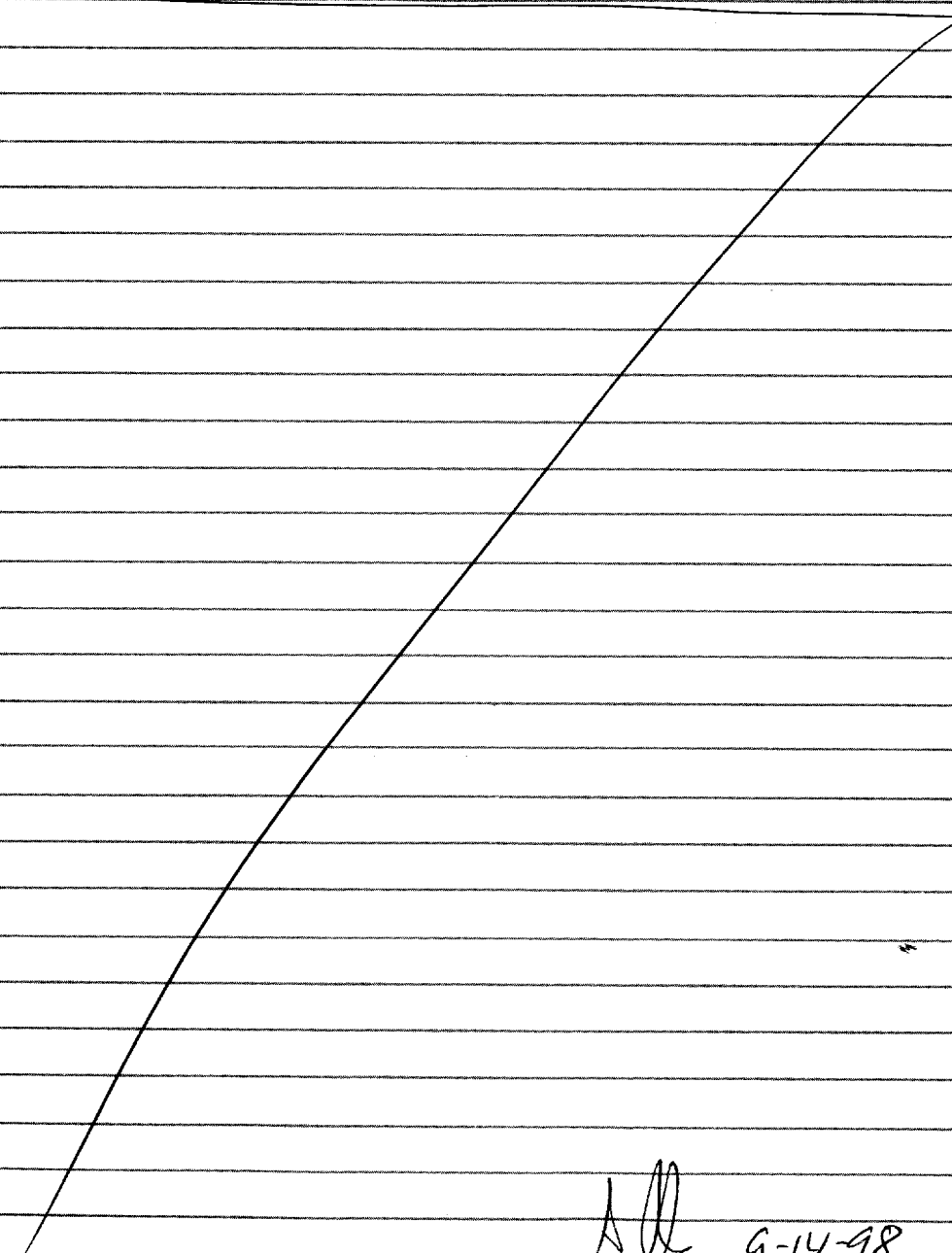
Stock Solution

9-14-98

 $\text{NaHCO}_3 \rightarrow 6\text{mM} \rightarrow 1.008\text{g}/2\text{L}$ Fisher # 897789 $\text{NaCl} \rightarrow .12\text{mM} \rightarrow .01403\text{g}/2\text{L}$ " # 972274

Initial pH = 8.428

All Specimens polished to 600grit + ultrasonically cleaned in Acetone
 Crevices cleaned ultrasonically in Meclona



9-14-98 To 151

From 150

Cell 1

A516PS94.DAT

T = 25°C

Eset = -250mV

Init wt = 28.90233g

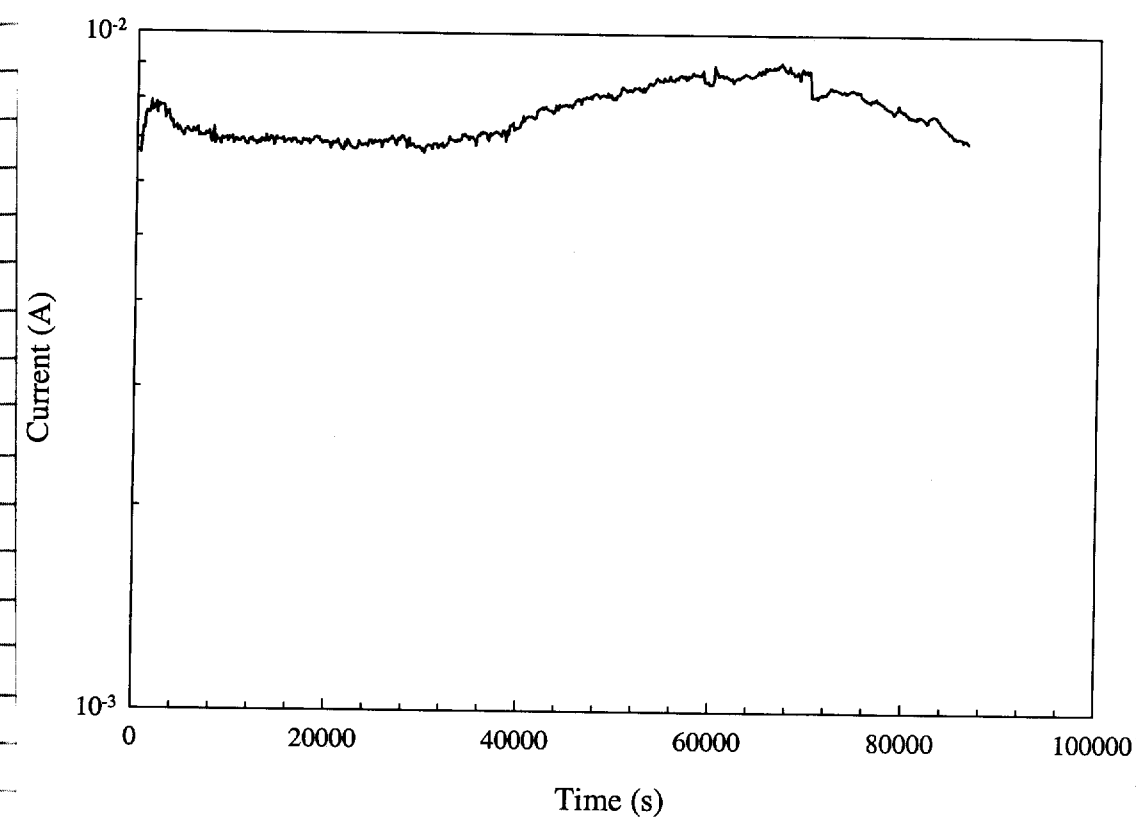
Final wt = 28.71316g 9-15-98

Final Solution pH = 10.247 9-15-98

Observations

General Corrosion, no crevice pitting 9-15-98

A516PS94



9-14-98 To 152

From 151

Cell 2 A516PS95.DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -220\text{ mV}$

Init wt: 29.01220g

Final wt: 29.00144g

9-15-98

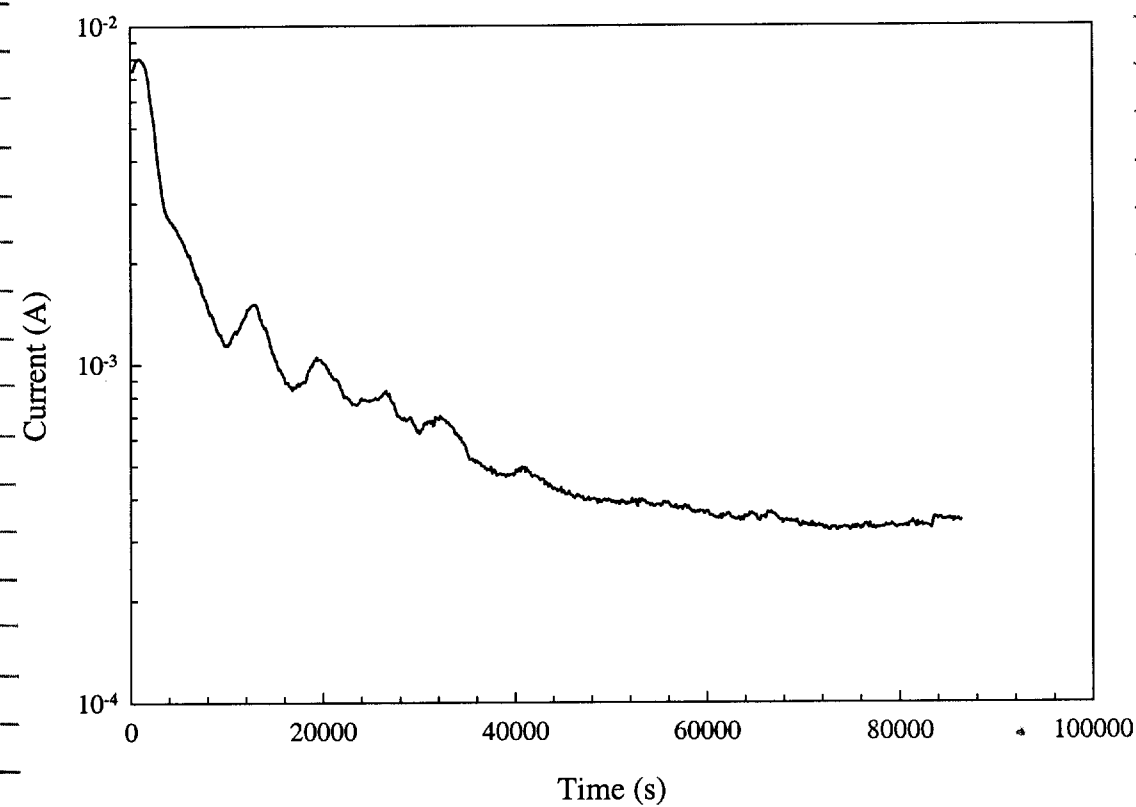
Final Solution pH: 9.598

9-15-98

Observations

General Corrosion, No crevice pitting 9-15-98

A516PS95



9-14-98

To 153

From 152

Cell 3 A516PS96.DAT

 $T = 95^{\circ}\text{C}$ $E_{\text{set}} = -150\text{ mV}$

Init wt: 29.00522g

Final wt: 28.99275g

9-15-98

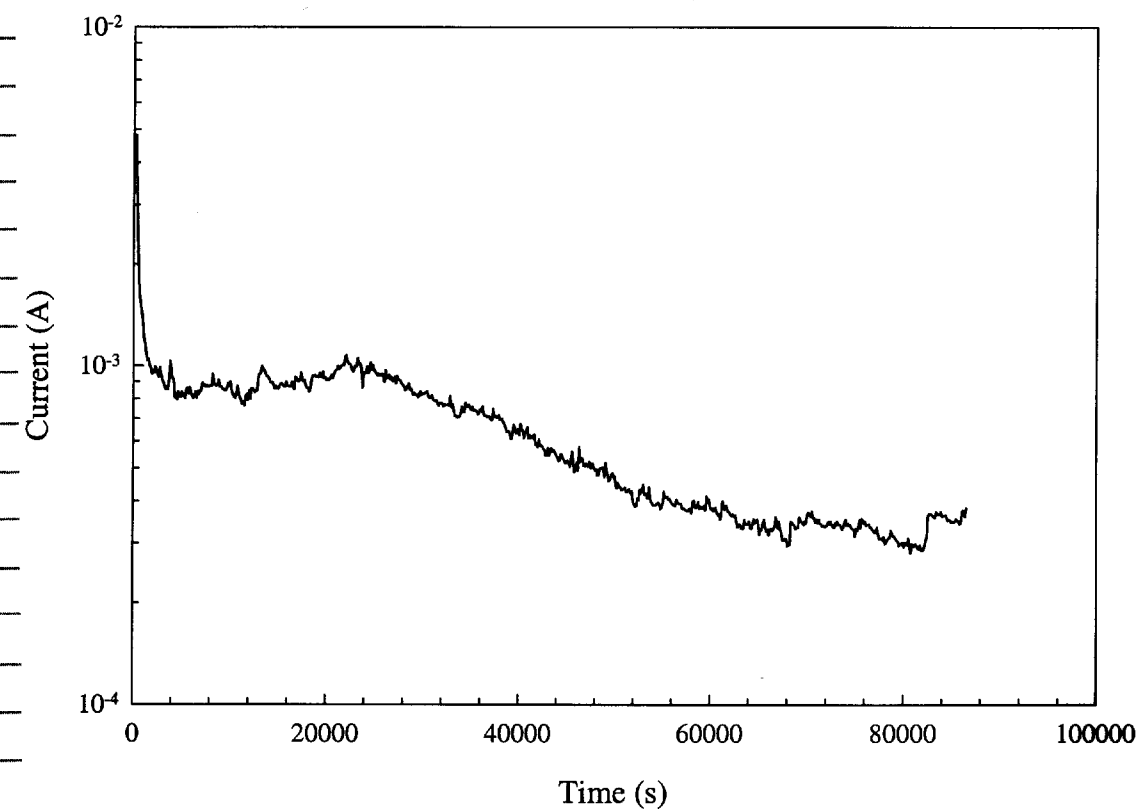
Final Solution pH: 10.504

9-15-98

Observations

One spot of pitting on sample bottom
crevice pitting around crevice edges 9-15-98

A516PS96



9-14-98

To 154

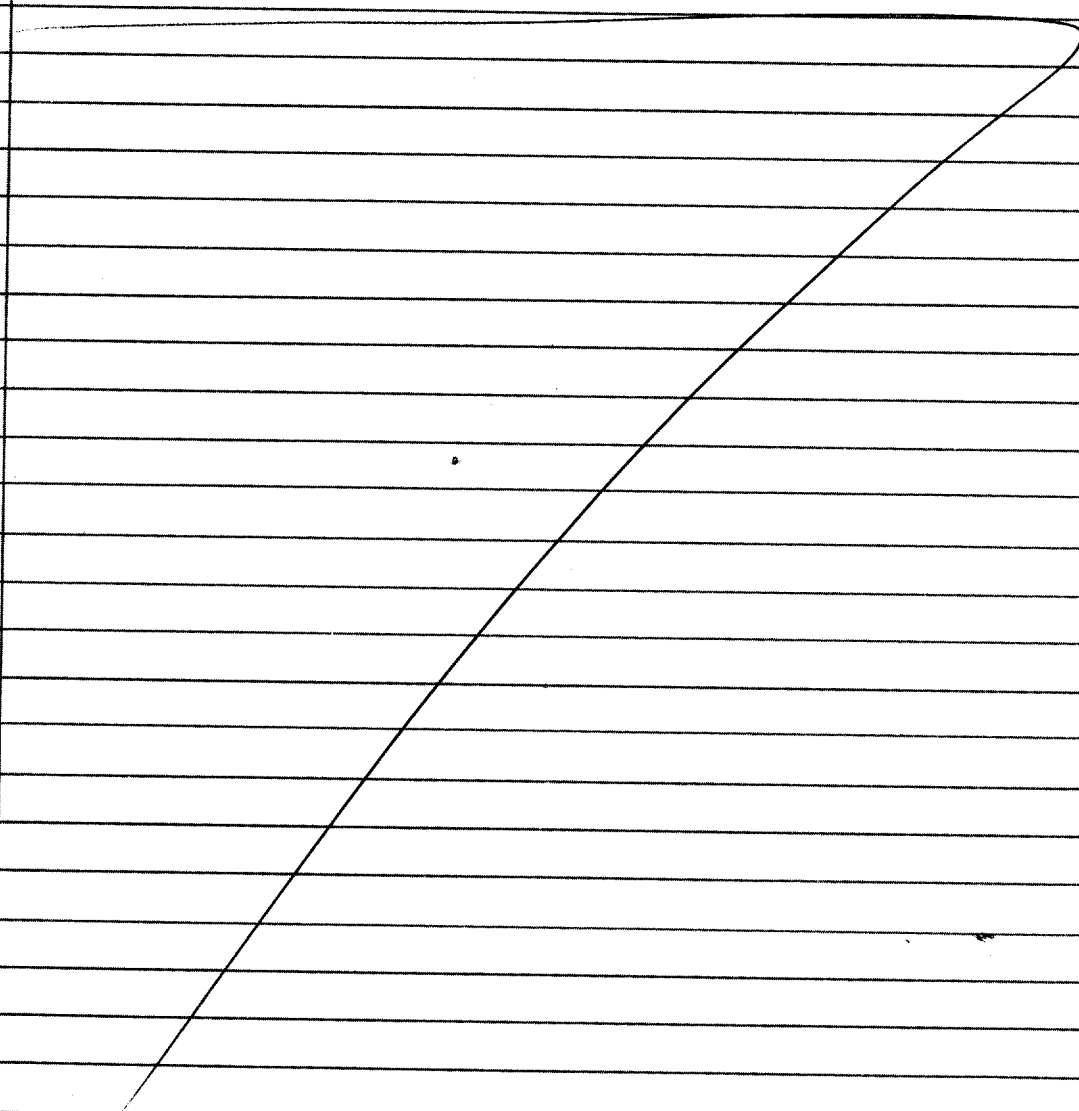
From 153

Stock Solution

 $\text{Na}_2\text{CO}_3 \rightarrow 3\text{M} \rightarrow .63594\text{g}/2\text{L} \text{ Fisher \# } 960685$ $\text{NaHCO}_3 \rightarrow 3\text{M} \rightarrow .50406\text{g}/2\text{L} \text{ " } 879789$ $\text{NaCl} \rightarrow 1.2\text{M} \rightarrow .1403\text{g}/2\text{L} \text{ " } 972274$

Solution pH = 10.159

All specimens polished to 600 grit & ultrasonically cleaned in acetone
 Crevices ultrasonically cleaned in Meclonal



[Signature] 9-15-98 To 155

From 154

Cell 1

A516 PS 97. DAR

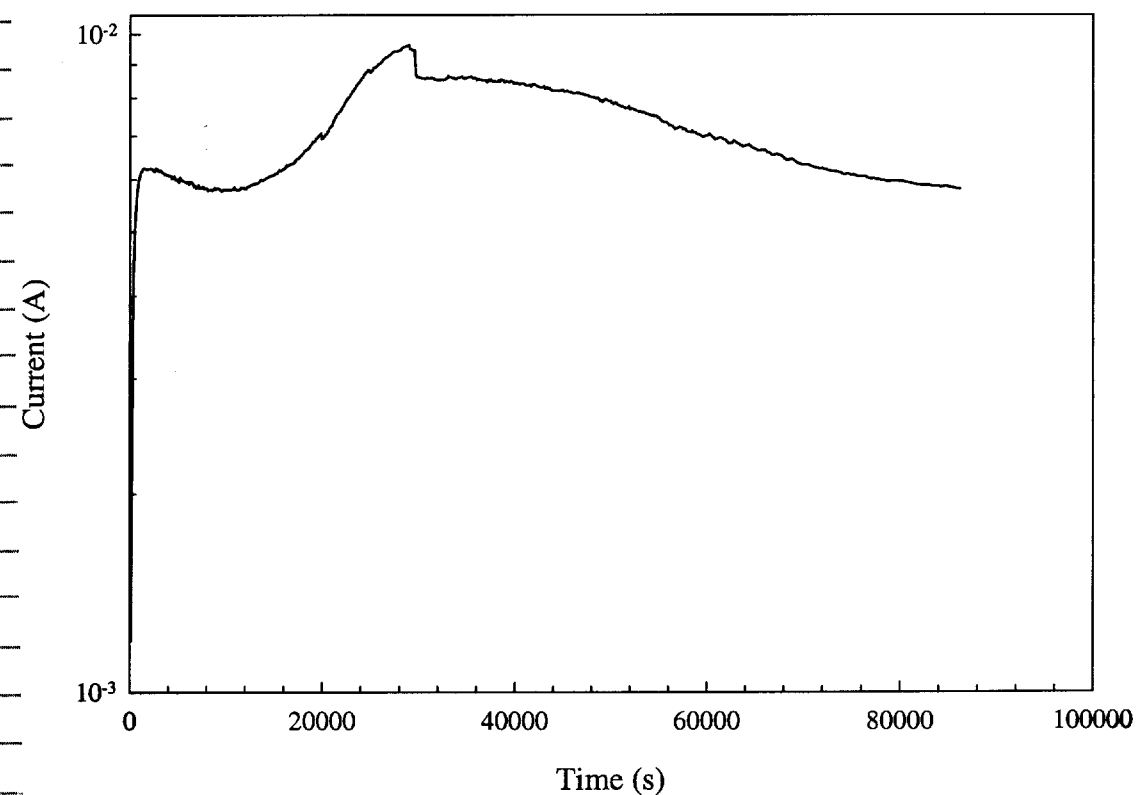
 $T = 25^\circ\text{C}$ $E_{\text{set}} = -290\text{mV}$ $I_{\text{init}} + I_{\text{wt}} = 28.81978\text{g}$ $I_{\text{final}} \text{ wt} = 28.63596\text{g}$ *[Signature]* 9-16-98Final Solution pH = ~~10.5~~ 11.012 *[Signature]* 9-16-98

Observations

Large amount of precipitate & general corrosion

No crevice pitting *[Signature]* 9-16-98

A516PS97



[Signature] 9-15-98

To 156

From 155

Cell 2 A516PS98.DAT

T=65°C

Eset = -260 mV

Init wt: 28.85600g

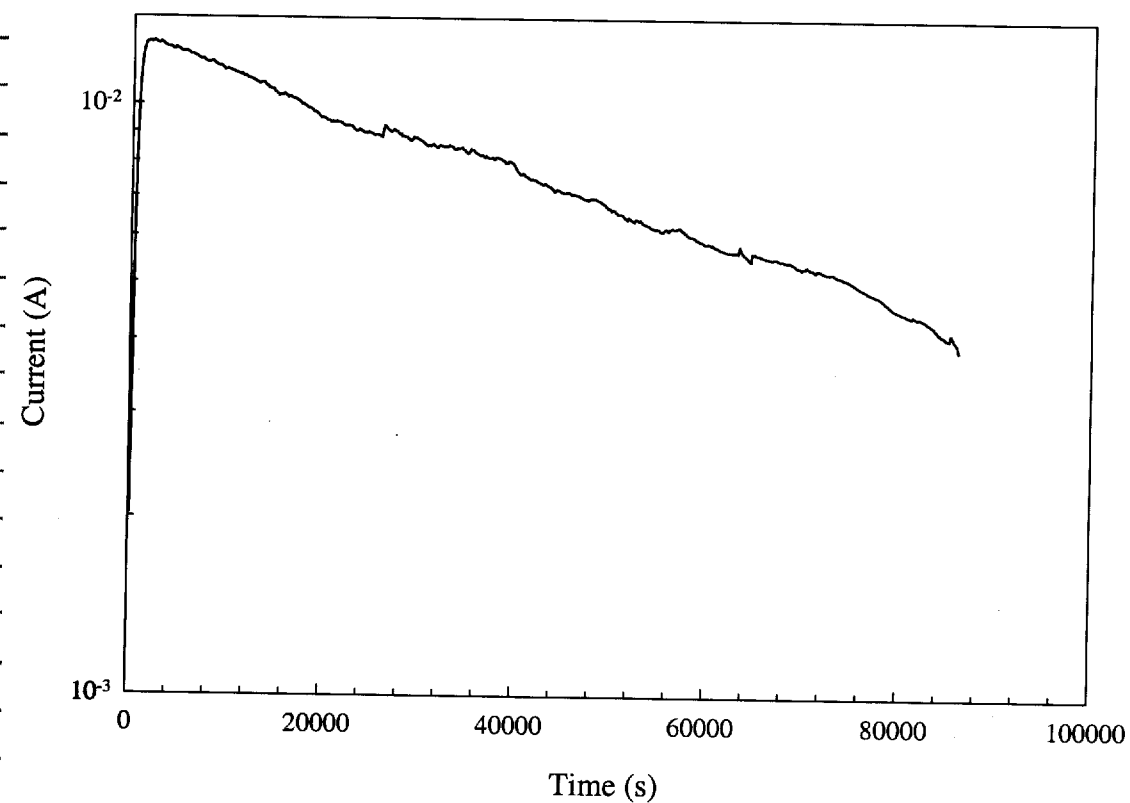
Final wt: 28.66316g 9-16-98

Final Solution pH: 10.762 9-16-98

Observations

Large amount of precipitate and general corrosion
No crevice pitting 9-16-98

A516PS98



9-15-98 To 157

From 156

Cell 3 A516PS99.DAT

T=95°C

Eset = -190 mV

Init wt: 28.83070g

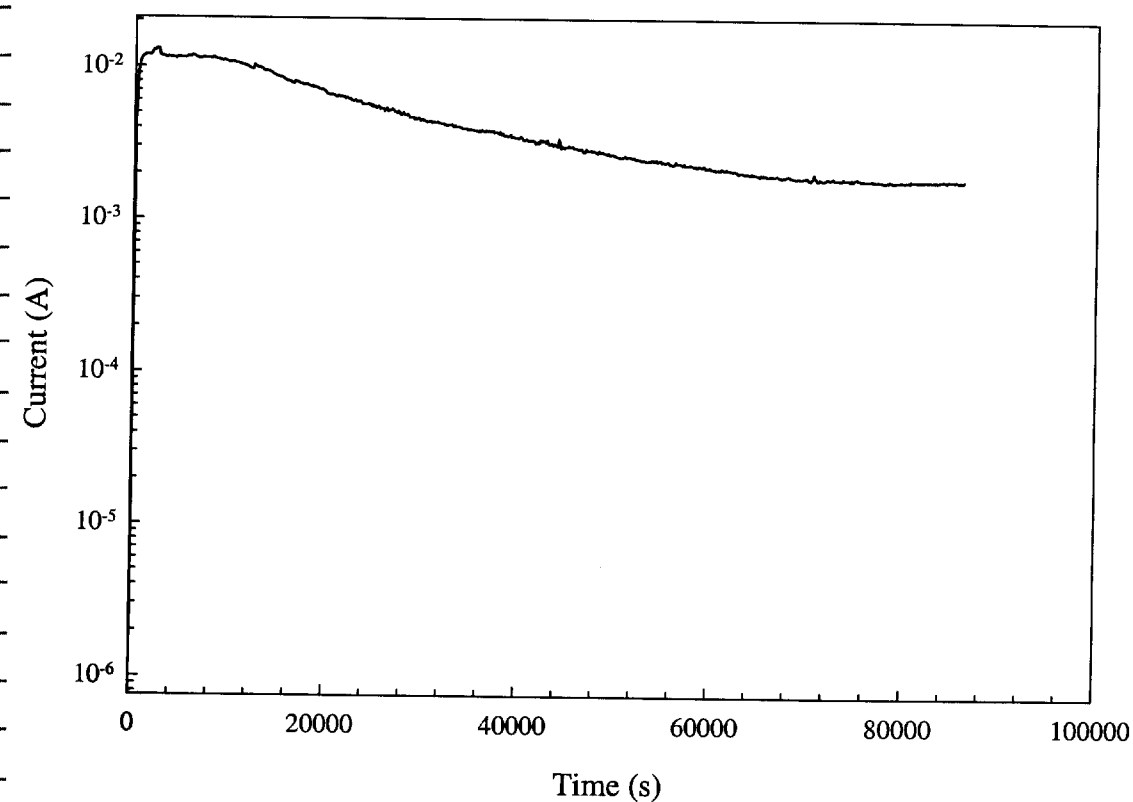
Final wt: 28.72598g 9-16-98

Final Solution pH: 10.743 9-16-98

Observations

Some general corrosion with precipitate
crevice pitting evident 9-16-98

A516PS99



9-15-98 To 158

From 157

9-16-98

Stock Solution

 $\text{Na}_2\text{CO}_3 \rightarrow 3\text{mM} \rightarrow .6359\text{g}/2\text{L} \text{ Fisher \# 960685}$ $\text{NaHCO}_3 \rightarrow 3\text{mM} \rightarrow .5040\text{g}/2\text{L} \text{ " 879789}$ $\text{NaCl} \rightarrow .48\text{mM} \rightarrow .0561\text{g}/2\text{L} \text{ " 972274}$

pH = 10.170

All specimens polished to 600grit + ultrasonically cleaned in acetone
 crevices ultrasonically cleaned in methanol



9-16-98

To 159

From 158 Cell 1 516PS100.DAT

T = 25°C

Eset = -270 mV

Init wt = 28.67141

Final wt = 28.52590 9-17-98

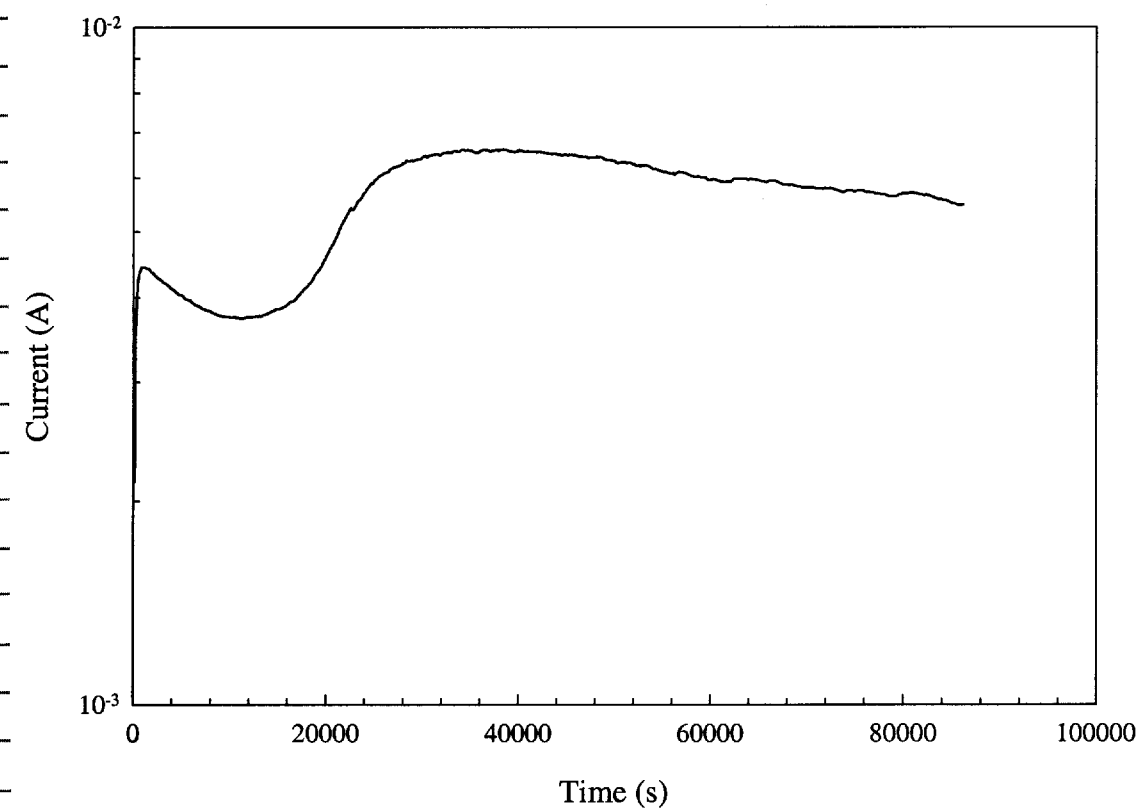
Final Solution pH = 10.882 9-17-98

Observations

large amount of precipitate + general corrosion

no crevice pitting 9-17-98

516PS100



9-16-98

To 160

Cell 2 516 PS101, DAT

 $T = 65^{\circ}\text{C}$ $E_{\text{set}} = -240\text{ mV}$

Init wt = 29.1726 g

Final wt = 29.0816 g 9-17-98

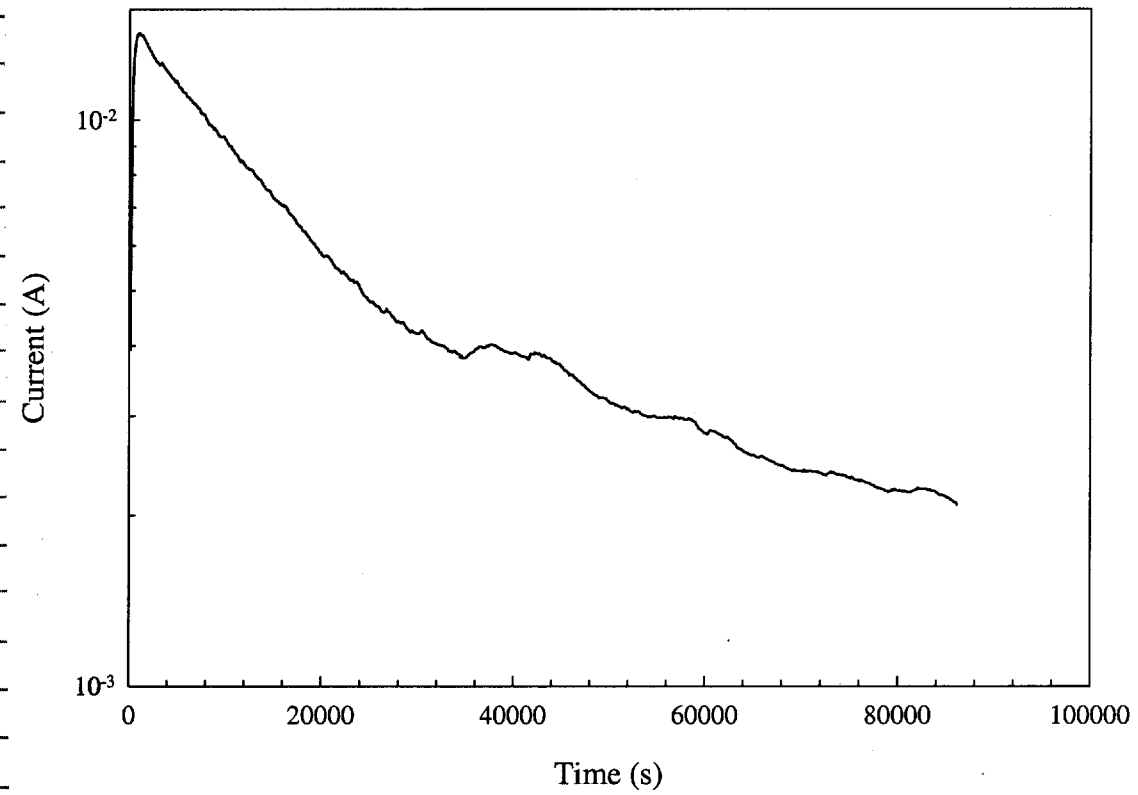
Final pH = 10.444 9-17-98

Observations

large amount of precipitate + general corrosion 9-17-98

No service pitting

516PS101



9-16-98

Cont on
Page 7
of Book 291

I have reviewed this 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.

N. S. H. 2/11/2005