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ORNL
CENTRAL FILES NUMBER

59-6-110

DATE: June 29, 1959

COPY NO. 7

SUBJECT: Corrosion Status: Sulfex-Thorex (Ni-o-nel) and Darex-Thorex
(Titanium) as of June 12, 1959

TO: F. L. Culler

FROM: W. E. Clark

ABSTRACT

Either system appears to be fairly satisfactory from a containment standpoint. Current results indicate probable over-all rates of about 0.2 mils/mo for titanium vs 1.5-3.0 mils/mo for Ni-o-nel. Tests are not 100% comparable due to changes made in flowsheet conditions, but have been of sufficient variation and length as to allow good predictions to be made. Both metals show some tendency toward local attack in Thorex solutions. These tendencies are increased by poor welding techniques.

There is a possibility that a Ni-o-nel dissolver could be used for interim Zirflex processing although the rates obtained in scouting tests are relatively high (6-8 mils/mo). Titanium shows no promise of usefulness in either Zirflex or Sulfex on the basis of scouting tests. It can be used for dissolution of U-Al fuels in 8 M HNO_3 - $\text{Hg}(\text{NO}_3)_2$ (rate 1 mil/mo).

If the choice between these two processes were made today on the basis of corrosion results alone, Darex-Thorex must be chosen.

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1.0 DATA SUMMARY

1.1 Cyclic Dissolution of Consolidated Edison Fuel Pins in Bench-Scale Dissolvers

Both will be run to 25 cycles, the dissolvers sectioned and examined metallographically.

1.11 Ni-o-nel. Cyclic Sulfex-Thorex dissolutions run as follows:

- (1) Decladding.* Boiling 6 M H_2SO_4 for 3 hours*
- (2) Rinse. Drain and rinse with 3 aliquots of cold water
- (3) Core Dissolution
 - 1st Pass - Boiling 13 M HNO_3 -0.04 M NaF-0.04 M Al^{+3} , 5 hours
 - 2nd Pass - Boiling 13 M HNO_3 -0.04 M NaF-0.04 M Al^{+3} , 3 hours
- (4) Rinse. Two successive rinses with cold water

Corrosion Rates (cf. Table 1)

From dissolver (25 cycles, over-all weight loss data) 2.9 mils/mo
From coupon specimens:

Vapor** (132 hours exposure)

- #1 4.5 mils/mo (heat-treated after welding)
- #2 1.5 mils/mo (as received)

Liquid** (198 hours exposure)

- #1 1.7 mils/mo (unwelded, heat treated)
- #2 2.2 mils/mo (heat treated after welding)
- #3 1.7 mils/mo (heat treated before welding)

1.12 Titanium. Darex-Thorex tests run as follows:

- (1) Decladding. Boiling 5 M HNO_3 - 2 M HCl for 2 hours
- (2) Rinse. Drain and rinse with 3 aliquots of cold water
- (3) Core Dissolution
 - 1st Pass-Boiling 13 M HNO_3 -0.09 M NaF-0.04 M Al^{+3} , 5 hours
 - 2nd Pass - Boiling 13 M HNO_3 -0.09 M NaF-0.04 M Al^{+3} , 3 hours
- (4) Rinse. Two successive rinses with cold water

* This procedure resulted in solids in the decladding solution which (1) hindered the core dissolution step and (2) resulted in very slow filtration of the declad solution. After ~12 cycles the decladding procedure was changed by diluting to 4 M $SO_4^{=}$ after 1/2 hours of dissolution.

** Data from the complete 25 cycles of exposure are not yet available.

Corrosion Rate (cf. Table 2)

From dissolver (25 cycles, over-all weight loss data) = 0.2 mils/mo
From coupon specimens:

Vapor 0.09 mils/mo maximum of 2 specimens

Liquid All specimens gained weight

Table 1. Ni-o-nel Corrosion Specimens From Sulfex-Thorex Dissolver

Specimen	Area, Sq. In.	Specimen Position	Corrosion Rate, mils per month					
			Number of Pins					
			1	7	9	10	15	17
			8 hr	80 hr	102 hr	121 hr	176 hr	198 hr
A (Unwelded, heat treated ^(a))	4.8	Liquid	3.1	1.9	1.8	1.9	1.7	1.7
B (Heat treated ^(a) after welding)	4.4	Liquid	4.7	2.8	2.6	2.7	2.4	2.2
C (Heat treated ^(a) before welding)	4.8	Liquid	3.8	2.1	1.9	2.1	1.8	1.7
D (Heat treated ^(b) after welding)	1.2	Vapor ^(c)	<u>11 hr</u> 2.5	<u>36 hr</u> 2.3	<u>55 hr</u> 3.4	<u>110 hr</u> 4.2	<u>132 hr</u> 4.5	
E (As-received)	1.4	Vapor ^(c)	2.0	1.4	1.7	1.5	1.4	

(a) Heat treated at 1950°F, 2 hr; air quenched, sandblasted, then pickled.

(b) Heat treated at 1850°F, 1/2 hr; air quenched, surface ground.

(c) Vapor specimens were put in after the sixth pin.

1.2 Corrosion in the Decladding Step

1.21 Ni-o-nel in H₂SO₄

Ni-o-nel is attacked rapidly (up to 7.3 mils/mo; Tables 3 and 4) by boiling 6 M H₂SO₄, but the rate is decreased to less than 1 mil/mo by the presence of dissolved stainless steel (Tables 3 and 5). This attack appears to be quite even. Cycling the specimen between decladding and

core dissolution solutions gives rates about 30% lower than are to be expected by adding the rates of specimens exposed to the separate solutions (Table 4).

1.22 Titanium in Boiling 2 M HCl - 5 M HNO₃

Maximum rates observed have been less than 1 mil/mo. The rate drops to less than 0.1 mil/mo in the presence of dissolved stainless steel. Vapor phase rates as high as 0.3 mils/mo have been reported.¹

1.3 Corrosion in the Core Dissolution Step

1.31 Ni-o-nel in boiling 13 M HNO₃-0.05 M NaF + Al⁺³

Unstabilized Ni-o-nel suffers rather severe intergranular corrosion in the Thorex dissolver solution. Attack is particularly severe in heat-treated areas near welds. When stabilized with titanium (Ti/C $\geq$ 20/1) this attack can be largely eliminated, but complete elimination of such attack is probably not possible. Table 6 lists the results of 1000 hour exposures of welded specimens heat-treated in the most effective ways (above 1850°F). When the apparent rate is 1.8 mils/mo the intergranular penetration is seen to be 4 mils/mo. These figures correspond to probably the most practical heat-treatment, namely heating to 1950°F for 2 hr followed by air quenching. Some decrease in corrosion can be obtained by water quenching, but this treatment will probably not be practical for equipment of this size and shape.

Table 2. Titanium 75A Corrosion Specimens from Darex-Thorex Dissolver

Specimen	Approximate Area, Sq. In.	Specimen Position	Weight Change, mg						
			Number of Pins						
			5	10	11	12	15	20	25
			36 hr	81 hr	91 hr	99 hr	126 hr	171 hr	216 hr
Butt Welded	1.2	Liquid	-0.7	-0.5	+0.2	+0.3	+0.6	+0.2	+1.0
Butt Welded	4.2	Liquid	+1.6	+2.9	+5.5	+6.7	+10.1	+9.9	+11.2
Plain	4.2	Liquid	+2.8	+4.4	+6.3	+4.9	+9.1	+9.2	+10.9
					18 hr	26 hr	53 hr	98 hr	143 hr
Lap Welded	1.4	Vapor ^(a)	-	-	-0.2	+0.3	-0.2	-1.0	-0.5
Butt Welded	1.2	Vapor ^(a)	-	-	-1.3	-1.2	-1.1	-1.9	-1.3 ^(b)

(a) Vapor specimens were put in after 9 cycles. Each complete dissolution cycle requires 9 hr.

(b) A weight loss of 1.3 mg at 143 hr equals 0.08 mil per month

Table 3. Corrosion of Nionel in Boiling Sulfex Solutions

(6 M H_2SO_4 , additions of Type 304 stainless steel)

Type 304, g/l	Specimen Position	Corrosion Rate, mils per month					
		Hr	Rate	Hr	Rate	Hr	Rate
0	Vapor	24	2.35	48	1.66	72	1.42
	Interface		7.23		6.27		4.86
	Liquid		7.26		5.95		4.69
5	Vapor	24	0.89	48	0.72	72	0.73
	Interface		0.35		0.36		0.32
	Liquid		0.42		0.42		0.38
35	Vapor	24	0.16	48	0.15	72	0.12
	Interface		0.36		0.38		0.34
	Liquid		0.36		0.36		0.33

It should be noted that both fluoride (0.05 M) and Al^{+3} (0.2 M) were higher in these tests than those used in the cyclic dissolutions in the Ni-o-nel dissolver (0.04 M F-0.04 M Al^{+3}).

1.32 Titanium in Boiling 13 M HNO_3 -0.04 M NaF + Al^{+3}

In boiling Thorex dissolver solution without Al^{+3} or other additives, titanium corrodes evenly at rates of from 5-10 mils/mo, the most rapid attack taking place in the vapor phase (Table 7). Much lower over-all rates are obtained in the presence of Al^{+3} and Th^{+4} , but at the higher concentrations of Al^{+3} some localized attack is observed in the vapor phase though the over-all rates are still low. It is not certain that the presence of 0.04 M Al^{+3} improves the performance of titanium over the dissolution cycle. The effect of cycling between decladding and core dissolver solutions has been investigated only in the cyclic dissolution experiments (Table 2). Maximum rates observed on coupon specimens are less than 0.2 mils/mo. Metallographic studies have not been completed.

Maximum short-term corrosion rates of Ni-o-nel and of titanium in boiling 13 M HNO_3 -NaF as a function of Al^{+3} concentration are presented graphically in Fig. 1.

1.33 Titanium in HNO_3 -HCl-HF

In tests on titanium in boiling HNO_3 containing up to 600 ppm of F^- and Cl^- simultaneously, International Nickel Company² has observed failure of titanium specimens. Their data is summarized in Table 8. Other experiments carried out (at International Nickel Company) in nitrate solutions of pH 0-5 containing varying amounts of U^{+6} , $PO_4^{=}$ and other ions gave very low rates on titanium.

Fig. 1. Maximum Corrosion Rates of Ni-o nel and Titanium in Boiling 13 M HNO₃-NaF Solutions with Various Al³⁺ Additions (24 hr exposures)

Table 4. Corrosion of Welded Ni-o-nel⁽¹⁾ in Boiling Sulfex-Thorex Solutions⁽²⁾

Solution	Exposure/Period, hr	Corrosion Rate, mils per month						
		Vapor ⁽³⁾	8 Periods		Liquid ⁽³⁾	10 Periods	15 Periods	16 Periods
			Interface	Interface		Interface	Interface	Interface
<u>Study 1</u>								
A, 6 M H ₂ SO ₄	3	0.47	2.95	8.27	2.33	2.23	2.65	
E, Final Thorex	5	0.64	0.66	0.79	0.61	0.57	0.55	
Weighted value for (A + B) ⁽⁴⁾	3 + 5	0.58	1.52	3.60	1.26	1.19	1.34	
Cycled A to B	3 + 5	0.43	1.25	1.59	1.04	1.01	0.96	
Cycled A to B	3 + 5	0.35	1.40	1.63	1.16	1.06	1.01	
Cycled, avg	3 + 5	0.39	1.33	1.61	1.10	1.04	0.99	
<u>Study 2</u>								
C, 4 M H ₂ SO ₄	3	0.59	4.51	4.36	3.58	2.84	2.66	
D, Initial Thorex	5	1.65	2.14	2.05	1.99	1.86	1.84	
Weighted value for (C + D)	3 + 5	1.25	3.03	2.92	2.58	2.23	2.15	
Cycled C to D	3 + 5	1.23	1.85	1.86	1.63	1.57	1.52	
Cycled C to D	3 + 5	1.17	1.84	1.94	1.61	1.53	1.64	
Cycled, avg	3 + 5	1.20	1.85	1.90	1.62	1.55	1.58	

(1) This stock of Ni-o-nel has a Ti to C ratio of 27 to 1.

(2) Solution compositions are: Initial Thorex - 13.0 M HNO₃, 0.05 M F⁻, 0.2 M Al(NO₃)₃.
Final Thorex - 8.5 M HNO₃, 0.05 M F⁻, 1.0 M Th(NO₃)₄, 0.2 M Al(NO₃)₃.

(3) These specimens were removed for heat-treatment studies following eight periods.

(4) The weighed value is calculated as follows: $(3 \times 0.47) + (5 \times 0.64) = 0.58$ mil per month

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Table 5. Corrosion Rates for Stabilized Ni-o-nel Exposed to Boiling Sulfex Solutions
Containing Dissolved Stainless Steel

(3.5 M H_2SO_4 , 50 g per liter dissolved Type 304 Stainless Steel)

Specimen Type	Stainless Addition	Specimen Position	Corrosion Rate, mils per month						
			24 hr	48 hr	72 hr	144 hr	312 hr	480 hr	648 hr
As-received sheared coupon	As salts (Solution S)	Vapor	g	0.02	0.01	0.00	0.01	0.01	0.01
		Interface	0.14	0.24	0.27	0.31	0.36	0.31	0.26
		Liquid	0.20	0.28	0.31	0.36	0.42	0.35	0.29
Welded, heat-treated coupon ^(b)	Ditto	Vapor	g	g	g	g	0.01	0.01	0.01
		Interface	0.10	0.28	0.23	0.30	0.35	0.36	0.36
		Liquid	0.10	0.24	0.30	0.33	0.41	0.43	0.42
As-received sheared	By Dissolution (Solution D)	Vapor	0.59	0.59	0.62	0.39	0.34	0.29	-
		Interface	2.0	1.3	1.1	1.0	0.69	0.53	-
		Liquid	1.1	0.80	0.77	0.73	0.47	0.44	-
Welded, heat-treated coupon ^(b)	Ditto	Vapor	0.43	0.43	0.45	0.29	0.28	0.32	-
		Interface	1.4	0.98	0.87	0.90	0.60	0.53	-
		Liquid	1.0	0.69	0.65	0.60	0.40	0.40	-

(a) Added as $FeSO_4$, CrO_3 , and $NiSO_4$

(b) Specimens heat-treated at 1850°F for 0.5 hr, air quenched after welding; surface ground prior to exposure.

Table 6. Corrosion Rates and Maximum Intergranular Penetrations After 1000 Hr of Exposure of Welded, Stabilized Ni-o-nel to Boiling Initial Thorex Solutions(a)
(0.20 M Al^{+3} , Liquid-Phase Exposure)

Heat Treatment (c)	Set A(b)					Set B				
	Corrosion Rate, mils per month		Intergranular Penetration,			Corrosion Rate, mils per month		Intergranular Penetration,		
	Weight Loss	<u>Metallography</u>	Surface	Weld	mils	Weight Loss	<u>Metallography</u>	Surface	Weld	mils
1850°F, 0.5 hr	6.6	9.2	16.	7.	14.	2.1	3.7	11.	3.	10.
1850°F, 0.5 hr, WQ	4.6	-	-	-	-	1.6	-	-	-	-
1850°F, 2.25 hr	6.2	9.5	18.	7.	20.	2.0	3.4	6.9	3.	10.
1850°F, 2.25 hr, WQ	4.4	-	-	-	-	1.5	2.6	0.44	3.	3.
1850°F, 10.0 hr	6.0	10.	15.	8.	20.	1.8	3.9	3.7	4.	5.
1950°F, 2.0 hr	5.7	9.7	13.	10.	18.	1.8	3.9	5.0	5.	4.

(1) Initial Thorex composition: 13.0 M HNO_3 , 0.050 M F^- .

(2) Set A of specimens were exposed mainly in pressure of Cr^{+6} , Set B in presence of Cr^{+3} .

(3) All heat treatments were after welding with filler strip. All specimens were air quenched except where noted as WQ (water quenched).

Table 7. Corrosion Rates for Welded Titanium 75A in Boiling Thorex Solutions

Solution ^(a)	Addition	Specimen Position	Corrosion Rate, mils per month					Remarks (Observations at 756 hrs)
			240 hr	363 hr	501 hr	756 hr	1000 hr	
Initial	-	Vapor	7.2	10. ^(b)	9.1	8.1	7.3	Shiny, corroded evenly
		Interface	8.1	8.4 ^(b)	7.8	6.5	5.8	
		Liquid	8.1	7.7 ^(b)	7.2	5.9	5.1	
Initial	0.04 M Al ⁺³	Vapor	1.4	1.8	1.7	1.7	1.6	Black, no localized attack
		Interface	0.71	0.67	0.63	0.50	.43	
		Liquid	0.81	0.67	0.61	0.45	.36	
Initial	0.09 M Al ⁺³	Vapor	0.73	0.89	0.77	0.53	.39	Pitting in vapor phase
		Interface	g ^(c)	g	g	g	g	
		Liquid	g	g	g	g	g	
Initial	0.15 M Al ⁺³	Vapor	0.0	1.2	1.15	0.98	.75	Pitting in vapor phase
		Interface	g	0.04	0.07	0.03	.01	
		Liquid	g	g	g	g	g	
Initial	0.20 M Al ⁺³	Vapor	2.0	2.8	2.0	3.4	3.4 ^(d)	Knife-line attack in heat-affected zone
		Interface	0.19	0.29	0.20	0.29	.40	
		Liquid	g	g	g	g	g	
Initial	0.04 M Th ⁺⁴	Vapor	9.5	9.0	10.	6.9	7.2	Corroded evenly
		Interface	3.8	3.6	4.0	2.8	2.6	
		Liquid	2.5	2.6	2.3	1.8	1.7	
Middle	0.04 M Al ⁺³	Vapor	3.1	2.0	2.8	2.1	2.7	Localized attack in vapor phase
		Interface	0.28	0.41	0.37	0.59	.61	
		Liquid	0.09	0.10	0.19	0.10	.19	
Middle	-	Vapor	g ^(e)					
		Interface	g					
		Liquid	0.07					
Final	-	Vapor	0.03 ^(f)					
		Interface	0.06					
		Liquid	0.08					

(a) Thorex solution compositions: Initial - 13.0 M HNO₃, 0.04 M F⁻
Middle - 10.8 M HNO₃, 0.04 M F⁻, 0.5 M Th⁺⁴
Final - 8.5 M HNO₃, 0.04 M F⁻, 1.0 M Th⁺⁴

(b) 360 hr

(c) g indicates a small gain in weight

(d) Exposed for only 915 hours

(e) Exposed for only 168 hrs; figures listed are maximum obtained from 2 specimens

(f) Exposed for 336 hrs; figures listed are maximum obtained from 2 specimens

Table 8. INCO-Fernald Data on Titanium in HNO₃ Recovery⁽²⁾

Solution Composition			Ti Designation	T, °C	Exp. Time (days)	Aeration	Agitation	Average Corrosion Rate (mils/yr)	Remarks
Wt % HNO ₃	ppm F ⁻ Cl ⁻								
55	600	500	RC55	88 (min)	120	Nil	High	48	Sample corroded away
20-60	40 to 200	10 to 600	RC55	82 (min)	175	Moderate	Moderate	32	"
1-12	10-95	10-105	RC55	66-68	50	Not given	Considerable	110	"
1-47	10-350	10-460	RC55	67-80	50	Not given	Not given	110	"
1-7	10-30	10-45	RC55	67-69	50	Not given	Not given	48	Heavily corroded

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At Battelle after 500 hours of exposure to boiling 2 M HCl - 5 M HNO₃ + 100 ppm F⁻, the maximum rate shown by titanium was 0.2 mil/mo. In boiling 13 M HNO₃-0.04 M F-0.1 M Al- 100 ppm Cl⁻ maximum over-all rates of 0.3 mils/mo were observed with pits around edges and weldments representing local rates as high as 7 mils/mo. Since pitting of titanium by AlCl₃ has been observed previously³, the effects of Cl⁻ should be studied in the absence of Al⁺³. Tests in Darex solutions with higher F⁻ concentrations will be run at ORNL.

2.0 RELATED DAREX CORROSION DATA

2.1 Corrosion of Stainless Steel in Darex Solutions

2.11 Corrosion of Type 304 Stainless Steel in Darex Feed Solution

A study was conducted to determine if an existing Type 304 ELC stainless steel pipeline at ORNL can be used to transfer solution from the Darex dissolver. Welded and machined Type 304 ELC stainless steel specimens were stirred at 3 and 6 linear feet per second in a synthetic solution at 125°F. The solution in question is 1.75 M HCl, 1.2 M HNO₃, 0.68 M Fe⁺³, 0.21 M Cr⁺³, 0.09 M Ni⁺², and 100 g per liter U⁺⁶ (all salts added as nitrates).

An active-passive condition was found to exist with Type 304 ELC in this solution. Catastrophic attack occurred on several specimens, while little or no attack occurred on others. This attack occurred at a velocity of 6 linear feet per second and at as low a temperature as 106°F. It appears that the parameters of temperature, velocity, and chloride concentration are important to this active-passive state. Use of this pipeline for handling the solution under consideration is not recommended.

2.12 Corrosion of Type 347 Stainless Steel in Chloride-Contaminated Purex Acid Tests

Since the Darex chloride-stripping operation may not always be completely efficient, it is possible that the chlorides which remain might lead to stress-corrosion cracking of the Type 347 stainless steel from which the extraction columns would normally be built.

Aqueous solutions were arbitrarily chosen which were: (1) high in the ions from stainless steel dissolution and low in uranium content, and (2) low in stainless steel and high in uranium. Chloride was added to give a concentration range from 3 up to 10,000 ppm. One part of this aqueous phase was mixed with 3 parts, by volume, of an immiscible organic phase consisting of 1 part tributyl phosphate to 2 parts, by volume, purified kerosene. Unstressed specimens of Type 347 stainless steel and specimens stressed both to 90 percent of the yield strength and in excess of the yield strength in the form of a "U" were submerged in the chloride-bearing aqueous phase. This phase was mixed with the organic phase by occasional shaking.

After 2 years of exposure of these specimens at room temperature, there has been no sign of stress-corrosion cracking nor has any pitting or other noticeable corrosion attack been observed even upon metallographic examination. Numerical data on the weight changes observed with unstressed specimens after 639 hours of exposure are listed in Table 9.

3.0 POSSIBLE USE OF NI-O-NEL AND TITANIUM AS CONTAINERS FOR OTHER PROCESSES

3.1 Ni-o-nel in Zirflex

Scouting tests on welded, heat-treated Ni-o-nel specimens in boiling 6 M NH_4F -1.0 M NH_4NO_3 showed a maximum rate of 7.7 mils/mo for 500 hours exposure as compared to 6.1 mils/mo for a specimen exposed in a similar solution containing 0.05 M B_4O_7 and 0.05 M SiO_3 . In boiling 10 M HNO_3 -0.05 M HF -0.01 M Zr^{+4} -0.02 M Al^{+3} the maximum corrosion over a 72 hour exposure was 3.8 mils/mo.

These scouting data present the possibility that Ni-o-nel could be used as a container for Zirflex dissolutions on an interim basis. Serious consideration for such use will necessitate much more extensive corrosion tests.

3.2 Titanium in Zirflex

In boiling 6 M NH_4F -1 M NH_4NO_3 titanium corroded at the unacceptably high rate of 419 mils/mo over a 24 hour exposure.

3.3 Titanium in Sulfex

Titanium is catastrophically attacked by boiling 6 M H_2SO_4 . One hour exposure rates were on the order of 2000-4000 mils/mo.

3.4 Titanium in HNO_3 - $\text{Hg}(\text{NO}_3)_2$ (for Al Fuel Elements)

In boiling 8 M HNO_3 -0.05 M $\text{Hg}(\text{NO}_3)_2$ titanium corroded at a maximum rate of 0.8 mils/mo over an exposure time of 456 hours. Specimens will be sectioned for metallographic examination after 1000 hrs exposure. It appears probable that titanium can be used for processing conventional Al fuel by existing flowsheets.

4.0 ACKNOWLEDGMENT

Most of the work reported herein was performed by members of the Corrosion Research Division of the Battelle Memorial Institute under the direction of C. L. Peterson and P. D. Miller. The work on titanium in HNO_3 - $\text{Hg}(\text{NO}_3)_2$, sulfuric acid, and in middle and final Thorex solutions was carried out at ORNL under the direction of J. C. Griess and E. S. Snavely. The author is indebted to F. H. Meyer of the National Lead Company and to R. M. Fuller and A. J. Marron of International Nickel for the data appearing in Table 8.

Table 9. Partial Results of Chloride-Contaminated Purex-Acid Tests

(February 21, 1957)
(Room Temperature)

Chloride, ppm	Weight Loss, mg			
	Low U*	High U**	Low U*	High U**
	304 hr		639 hr	
3	0.1	0.0	0.1	+0.1
50	0.1	+0.1	0.2	0.0
500	+0.1	0.1	0.0	0.2
1000	0.0	0.4	0.0	0.4
5000	+0.2	0.6	+0.2	0.6
10000	0.1	0.6	0.0	0.8

* 60 g/l stainless steel ions, 5 g/l U^{6+} , 2 M HNO_3

** 27 g/l stainless steel ions, 320 g/l U^{6+} , 2 M HNO_3

NOTES: Unstressed round specimens (1.0-in. diameter x .25-in. thick) of Type 347 stainless steel, weighing about 24 g, are used.

As of May 6, 1957 unstressed specimens had been exposed for 13 weeks and stressed specimens had been exposed for 9 weeks. Neither had shown any sign of stress-corrosion cracking or other attack.

5.0 REFERENCES

1. Miller, P. D., Peterson, C. L., White, E. W., and Fink, F. W., "Evaluation of Container Materials for Zircex and Darex Nuclear Fuel Recovery Processes," BMI-1242, Dec. 11, 1957; cf. Peterson, C. L., Miller, P. D., White, E. W., and Clark, W. E., Ind. Eng. Chem. 51 32-7 (1959).
2. Meyer, F. H. (National Lead Company) and Fuller, R. M., (International Nickel Company) private communication.
3. Stough, D. W., Fink, F. W., and Peoples, R. S., "The Corrosion of Titanium," TML-57, Oct. 29, 1956.

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