

Mill Creek

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HRI Project 4697
Copy No. 4

PRELIMINARY URANIUM
PROCESSING CRITERIA
Moore Ranch

for

Continental Oil Company
555-17th Street
Denver, Colorado 80202

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TABLE OF CONTENTS

	<u>Page No.</u>
Introduction and Summary	1
Description of Samples	2
Leaching Studies	7
Thickening and Filtration Tests	14
Solvent Extraction Studies	22
Process Criteria	32

INTRODUCTION AND SUMMARY

In April, 1979, Mr. C. J. Schick of Continental Oil Company authorized a test program to determine the process criteria for leaching and solvent extraction of uranium from the Moore Ranch ore. Splits of core from six drill holes were received by Hazen Research, Inc., for the program.

The ore is a typical Powder River ore in that it is free of deleterious impurities, responds to relatively mild leaching conditions, and thickens readily.

Leaching tests indicated 96% solubilization of the uranium from a 0.097% U_3O_8 feed when leached for eight hours, 50% solids, 30°C, with additions of 75 lb/ton sulfuric acid and 2 lb/ton sodium chlorate. The uranium was transferred readily to a 3% tertiary amine solvent and subsequently stripped by a 150-g/l ammonium sulfate solution controlled at 4.2 pH by ammonia. No significant impurities were solubilized by the leaching or transferred through the solvent extraction.

In brief, the ore is ideal for processing. All components of the process can be operated at maximum design rates without concern for reduced recovery.

DESCRIPTION OF SAMPLES

Core splits from six drill holes were used in the test program. Initially, a composite was prepared from four of the cores. When it was discovered that not all of the cores had been shipped for the test program, the additional two cores were shipped and included in a later composite of all six holes.

The mineralized intervals from each core were crushed to 6-mesh and a head sample split out. Table 1 lists the analyses of the various core composites, including the two test composites, No. 9 and 12. The analyses do not indicate the presence of significant amounts of any impurities which might affect the processing of leach solutions.

Pieces of core were selected from each mineralized interval to determine the core density. Table 2 lists the core densities which range from 12.6-17.3 ft³/ton dry ore with an average of 15.6 ft³/ton dry ore. The specific gravity of the composite ore from the six holes was 2.46.

A sample of the four-hole composite was ground to pass 20-mesh and was wet screened to determine the weight and uranium distributions in the various fractions. Table 3 and Figure 1 show the data for both the raw ore and a leached residue. The screen analyses indicate a typical sandstone ore with a nominal grain size of 65-mesh. Considerable concentration of the uranium occurs in the portions of ore finer than 200-mesh. Comparison of the two weight distribution curves on Figure 1 indicates that leaching significantly reduced the portion of the material coarser than 65-mesh.

Table I
Analysis of Moore Ranch Samples

Hole No. Interval Composite No.	894 178-196 1	894 208-221 2	895 211-220 3	895 240-252 4	1818 216-225 5	1818 247-253 6	1819 157-180 7	1819 191-196 8	1813 189-210 10	1814 183-204 11	9 9	12 12
U ₃ O ₈ , %	0.060	0.235	0.054	0.172	0.072	0.124	0.049	0.088	0.045	0.111	0.108	0.097
CO ₂ , %	0.30	0.96	0.23	0.33	0.12	0.05	0.37	3.75	0.97	0.39	0.59	0.56
XRF	-	-	-	-	-	-	-	-	-	-	-	-
Cu	0.008	0.007	0.004	0.003	0.003	0.007	0.003	0.005	0.010	0.011	0.002	0.002
Zn	0.009	0.018	0.009	0.015	0.009	0.011	0.006	0.006	0.008	0.014	0.011	0.012
Pb	0.003	0.011	0.008	0.007	0.008	0.006	0.010	0.005	0.017	0.010	0.005	0.008
Fe	1.1	0.96	0.80	0.77	0.68	0.80	0.91	0.89	1.6	1.4	1.0	1.4
Rb	0.012	0.021	0.007	0.008	0.014	0.009	-	0.007	0.021	0.024	0.007	0.023
Ba	0.099	0.091	0.11	0.11	0.081	0.090	0.080	0.085	0.10	0.10	0.098	0.74
Sr	0.013	0.010	0.012	0.012	0.009	0.012	0.009	0.008	0.016	0.014	0.013	0.015
Ti	0.049	0.049	0.049	0.097	-	0.064	0.064	0.079	0.033	0.050	0.048	0.066
Zr	0.016	0.017	0.013	0.014	0.009	0.010	0.018	0.020	0.026	0.022	0.018	0.023
Mo	0.003	0.010	0.003	0.005	0.004	0.007	0.004	0.005	0.001	0.006	0.007	0.006
U	0.042	0.19	0.041	0.13	0.067	0.11	0.023	0.058	0.040	0.013	0.078	0.090
Mn	0.023	0.015	0.017	0.013	0.009	0.011	0.019	0.077	0.030	0.020	0.013	0.014
Y	0.002	0.002	0.002	0.003	0.002	0.001	0.002	0.002	0.006	0.003	0.002	0.004
V	-	-	-	0.015	-	-	-	-	-	-	0.015	-
Th	-	-	-	-	0.003	-	-	-	-	-	-	-
Se	-	-	-	-	-	-	0.005	-	-	-	-	-
Ni	-	-	-	-	-	-	-	-	0.006	0.061	-	0.007

Table 2
Moore Ranch Core Densities

Hole	Interval	Specific Gravity	Density ft ³ /ton	% Moisture
894	178-196	2.17	14.8	15.5
	208-221	2.54	12.6	2.6
895	211-220	2.21	14.5	13.7
	240-252	2.21	14.5	12.0
1818	216-225	1.95	16.4	16.3
	247-253	1.96	16.3	14.4
1819	157-180	2.17	14.7	14.7
	191-196	1.85	17.3	17.3
1813	189-210	1.86	17.2	15.5
1814	183-204	1.85	17.3	10.4

Table 3

Size and Uranium Distribution in 20-mesh Moore Ranch Ore Leached Residue

Size, Mesh		Raw Ore					Leach Residue				
		Weight %	Cumulative Weight, % Passing	U ₃ O ₈ %	Uranium Distribution %	Passing %	Weight %	Cumulative Weight, % Passing	U ₃ O ₈ %	Uranium Distribution %	Passing %
Passing	Retained										
	20	3.0		0.166	6.2			1.05	1.05		
20	28	16.1	97.0	0.181	16.3	93.8		9.00	10.05	98.95	
28	35	19.8	81.0	0.055	13.6	77.5		15.03	25.08	89.35	
35	48	17.6	61.2	0.069	15.2	63.8		14.54	39.62	74.92	
48	65	18.6	43.6	0.055	12.8	48.7		18.94	58.56	60.38	
65	100	13.2	25.0	0.071	11.7	35.9		16.39	74.96	41.44	
100	150	3.4	11.8	0.074	3.1	24.2		5.27	80.22	25.04	
150	200	4.7	8.4	0.110	6.5	21.0		7.15	87.37	19.78	
200	270	1.4	3.7					2.06	89.43	12.63	
270	400	0.5	2.4	0.306	21.0	0		1.53	90.97	10.57	
400		1.9	1.9					9.03	100.00	9.03	

Weight and Uranium Distribution in 20-mesh Moore Ranch Ore

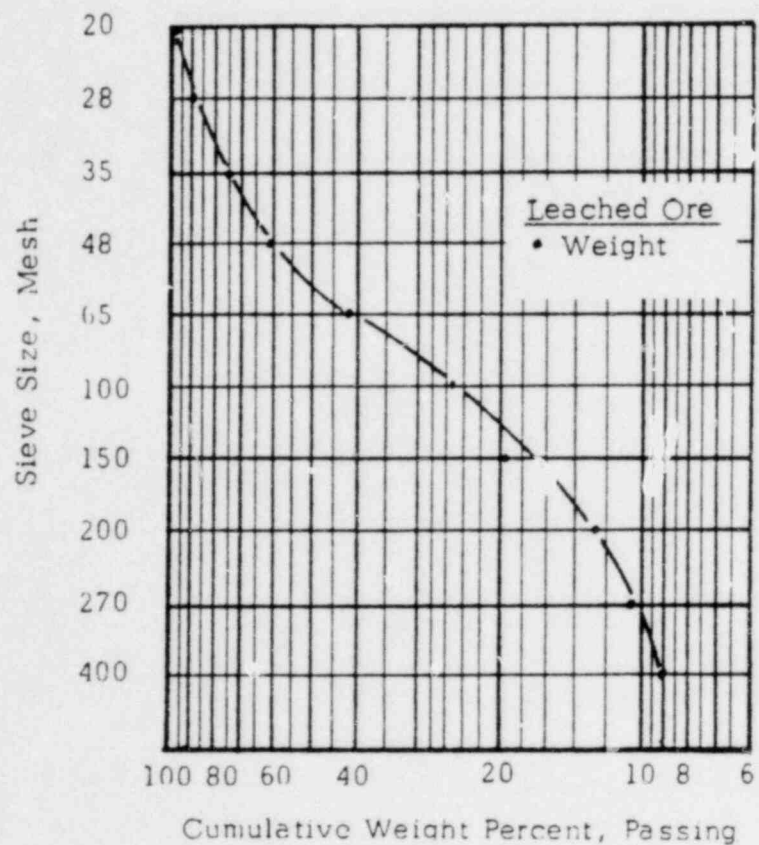
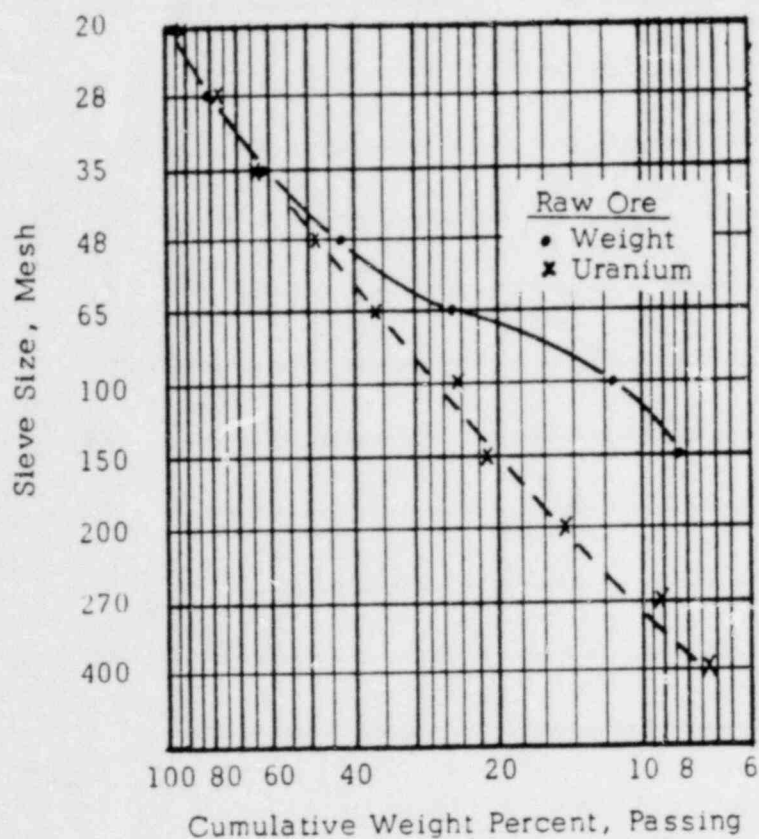


Figure 1

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LEACHING STUDIES

Two series of leaching tests were performed. The first 15 tests used the four-hole composite, 1141-19-9, whereas, the remaining 25 tests used the composite containing all six cores, 1141-19-12. Data from the first series of tests are tabulated in Table 4 and shown graphically in Figure 2. Detailed test data are included in Appendix A.

The first 15 tests evaluated the effect of temperature, leaching time, and sulfuric acid and sodium chlorate additions on the uranium dissolution. The data show little difference in the responses to temperature (30, 40, and 50°C). The residual U_3O_8 showed good correlation with the sulfuric acid addition, approximately 0.000025% U_3O_8 per lb H_2SO_4 (20 tons H_2SO_4 /lb U_3O_8). The response to increased sodium chlorate addition was negative, probably due to higher chlorate additions at the tests with less acid and low chlorate additions in the tests with high acid. No effect from the leach time was noted within the 6 to 14-hour range tested.

The second series evaluated temperature, leaching time, and sulfuric acid and sodium chlorate additions in ranges narrower than in the first series. Data from these tests, utilizing the six-hole composite, 1141-19-12, are summarized in Table 5 and Figure 3. Detailed data sheets are included in Appendix A.

The data show an improvement in the leaching at 40°C versus 30°C at retention times less than eight hours. Little or no difference was noted at times longer than eight hours. Increasing the acid addition from 60 to 75 lb/ton solubilized an additional 0.0012% U_3O_8 (625 lb H_2SO_4 /lb additional U_3O_8). Little difference was noted in the effect of the sodium chlorate addition. A linear curve through the 30°C data

indicates an additional 0.0011% U_3O_8 solubilized when the sodium chlorate addition was increased from 1 to 2 lb/ton. This amounted to an addition of 45 lb sodium chlorate for each addition pound of U_3O_8 dissolved.

Two power curves were fitted through the leaching time data. These curves (60 and 75 lb/ton H_2SO_4) had reasonably good fits to the data, indicating significant benefit by increasing the leaching time up to eight hours. Little improvement is gained by leaching longer than eight hours. The curves had the following formulae:

$$\text{At } 60^\circ \text{ } U_3O_8 \% = 0.02 (\text{hours})^{-0.84}$$

$$\text{At } 75^\circ \text{ } U_3O_8 \% = 0.0059 (\text{hours})^{-0.35}$$

An evaluation of the leaching data indicates that the most economic conditions are $30^\circ C$, 75 lb/ton H_2SO_4 , 2 lb/ton $NaClO_3$ and 8 hours.

Table 4

Moore Ranch Leaching Tests
(Composite 894-5, 1818-9, (1141-19-9), 0.108% U_3O_8)

Test No. 1141- Composite No. 1141-	20 19-9	22 19-9	24 19-9	26 19-9	28 19-9	30 19-9	32 19-9	33 19-9	34 19-9	36 19-9	38 19-9	41 19-9	42 19-9	44 19-9	46 19-9
Conditions:															
Temperature, °C	40	40	40	40	40	40	50	40	50	50	50	30	30	30	30
Time, hour	6	6	10	10	10	14	14	6	14	6	10	10	6	10	6
H ₂ SO ₄ , lb/ton	116.6	70.0	146.6	93.3	63.3	116.7	83.3	115.0	66.7	85.0	135.0	95.0	80.0	75.0	120.0
NaClO ₃ , lb/ton	1.0	1.5	1.0	1.0	2.0	1.7	1.5	1.0	2.3	1.0	1.5	1.5	2.0	2.0	2.0
Filtrate:															
U ₃ O ₈ , g/l	1.017	0.992	1.080	1.053	1.030	0.990	1.040	0.862	0.982	0.871	0.920	0.871	0.900	0.74	0.78
H ₂ SO ₄ , g/l	21.2	10.0	39.3	18.0	3.7	23.0	8.3	24.4	4.8	9.8	27.3	17.3	10.0	11.1	31.1
Residue, % U ₃ O ₈ :															
Plus 150-mesh	0.0007	0.0013	0.0009	0.0009	0.0006	0.0003	0.0005	0.0016	0.0019	0.0020	0.0024	0.0014	0.0013	0.0009	0.0008
Minus 150-mesh	0.0033	0.0043	0.0014	0.0019	0.0035	0.0044	0.0067	0.0028	0.0041	0.0025	0.0018	0.0017	0.0037	0.0032	0.0019
Total	0.0013	0.0021	0.0011	0.0013	0.0014	0.0016	0.0023	0.0017	0.0026	0.0021	0.0023	0.0015	0.0025	0.0020	0.013
Solubilization:															
Uranium, %	98.8	98.0	99.1	98.9	98.7	98.5	97.7	98.4	97.4	98.0	97.9	98.5	97.7	97.8	98.6
Acid consumption:															
H ₂ SO ₄ , lb/ton	74	50	68	57	56	72	68	60	57	63	74	56	58	50	50

Table 5

(1 of 2 pages)

Moore Ranch Leaching Tests
(Composite 894-5, 1813-4, 1818-9; (1141-19-12, 0.097% U₃O₈)

Test No. 1141- Composite No. 1141-	48 19-12	50 19-12	52 19-12	54 19-12	56 19-12	58 19-12	60 19-12	62 19-12	64 19-12	68 19-12	71 19-12	73 19-12
Conditions:												
Temperature, °C	40	40	40	40	30	30	30	30	30	30	30	30
Time, hour	6	6	6	6	6	6	6	6	6	10	10	10
H ₂ SO ₄ , lb/ton	60	60	75	75	60	60	75	75	75	60	70	60
NaClO ₃ , lb/ton	1.	2	1	2	1	2	1	2	2	0.5	0.5	1
Filtrate:												
U ₃ O ₈ , g/l	0.63	0.64	0.60	0.62	0.65	0.88	0.75	0.94	1.10	0.326	0.400	0.400
H ₂ SO ₄ , g/l	1.5	2.4	4.5	3.9	5.4	4.8	6.6	8.4	-	4.6	4.9	3.1
Residue, % U ₃ O ₈ :												
Plus 150-mesh	0.0043	0.0015	0.0015	0.0020	0.0077	0.0025	0.0035	0.0018	-	-	-	-
Minus 150-mesh	0.0052	0.0028	0.0027	0.0028	0.017	0.0031	0.0069	0.0028	-	-	-	-
Total	0.0045	0.0018	0.0017	0.0022	0.0092	0.0026	0.0040	0.0020	0.0039	0.0054	0.0073	0.0036
Solubilization:												
Uranium, %	95.9	98.3	98.3	97.9	90.7	97.3	96.1	98.1	≈96	97.5	92.2	95.9
Acid consumption:												
H ₂ SO ₄ , lb/ton	55	52	61	63	46	50	58	58	-	53	58	59

Table 5

(2 of 2 pages)

Test No.	75	77	78	79	80	81-b	82-a	82-b	100	101	102	103
Composite No. 1141-	19-12	19-12	19-12	19-12	19-12	19-12	19-12	19-12	19-12	10-12	19-12	19-12
Conditions:												
Temperature, °C	30	30	30	30	30	30	30	30	30	30	30	30
Time, hour	10	6	6	6	6	2	4	4	4	2	2	4
H ₂ SO ₄ , lb/ton	60	60	60	65	60	60	60	60	75	75	75	75
NaClO ₃ , lb/ton	1.5	1.75	1.5	1.5	2	2	2	2	2	2	2	2
Filtrate:												
U ₃ O ₈ , g/l	0.451	0.763	0.669	0.558	0.820	0.648	0.736	0.756	0.843	0.829	0.843	0.839
H ₂ SO ₄ , g/l	3.2	4.0	4.8	5.9	3.8	4.4	3.5	4.5	10.5	11.0	8.6	10.5
Residue, % U ₃ O ₈ :												
Plus 150-mesh	-	-	-	-	-	-	-	-	-	-	-	-
Minus 150-mesh	-	-	-	-	-	-	-	-	-	-	-	-
Total	0.0015	0.0065	0.0130	0.0125	0.0121	0.0084	0.0076	0.0064	0.0056	0.0033	0.0050	0.0050
Solubilization:												
Uranium, %	98.5	93.2	86.5	83.7	88.6	96.7	98.1	98.3	94.6	96.6	94.9	95.2
Acid consumption:												
H ₂ SO ₄ , lb/ton	58	51	-	-	52	-	-	-	51	51	56	51

Effect of Temperature, Time, and Sulfuric Acid and Sodium Chlorate Addition on Leaching Uranium from Moore Ranch Ore
(Composite 1141-19-9, 0.108% U_3O_8)

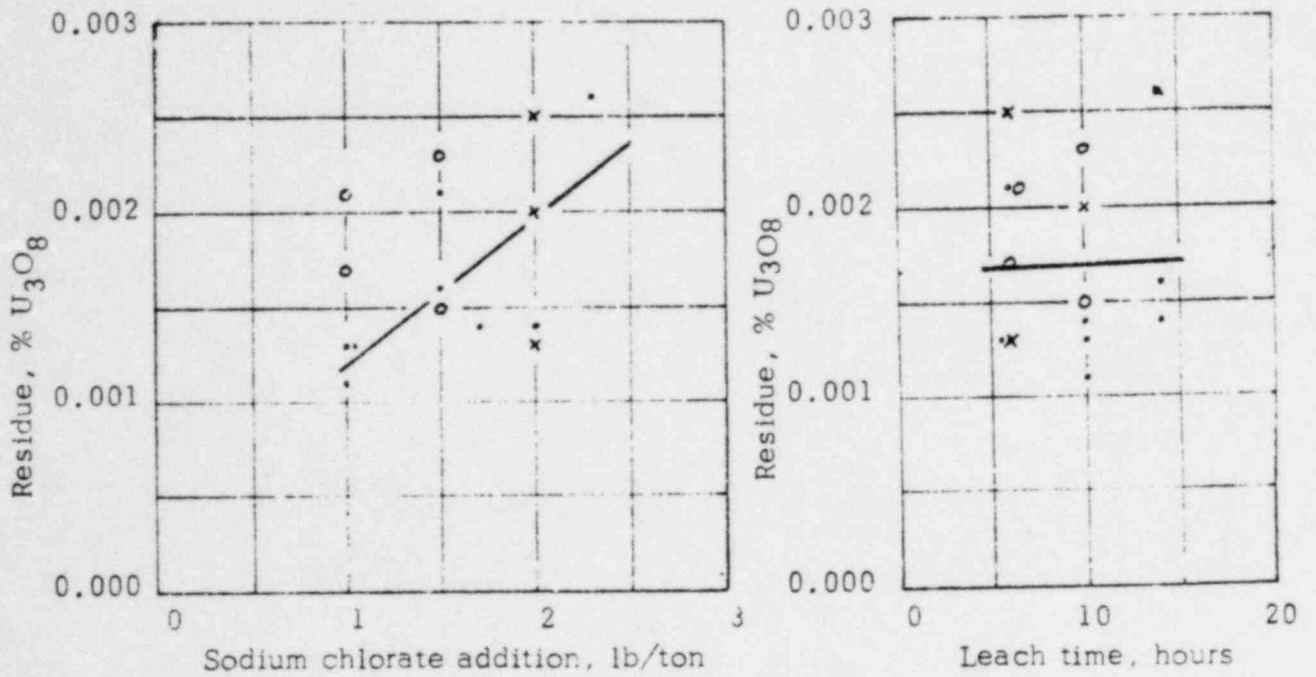
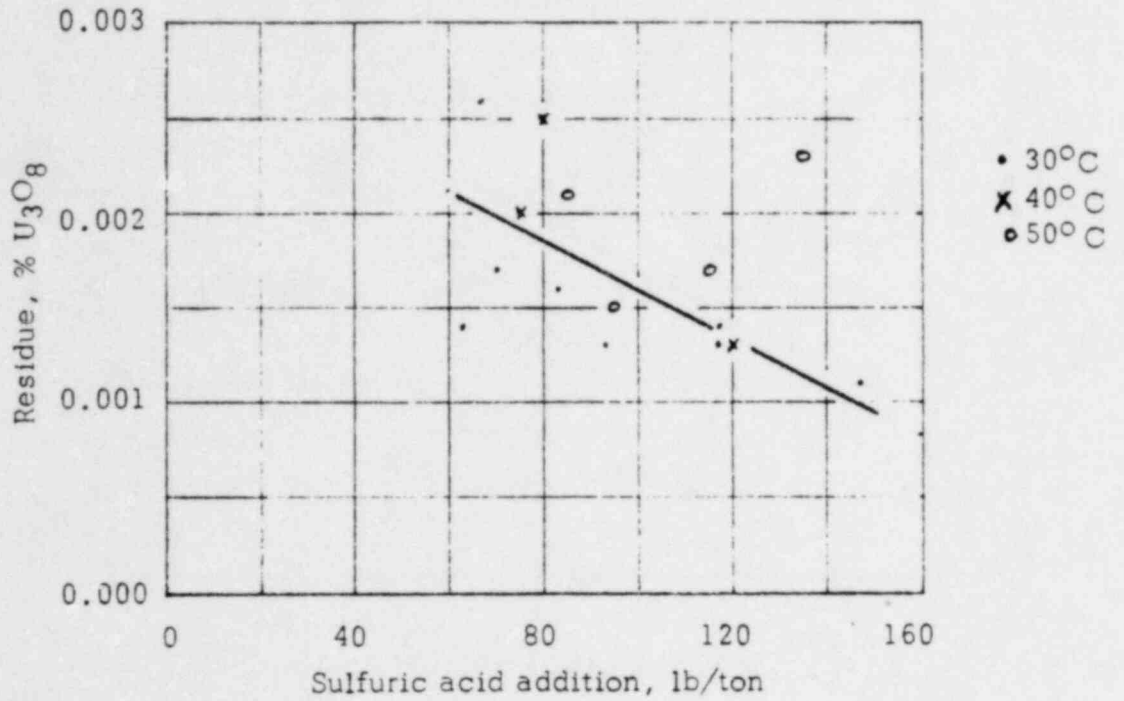


Figure 2

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Effect of Temperature, Time, and Sulfuric Acid and Sodium Chlorate Addition on Leaching Uranium from Moore Ranch Ore
(Composite 1141-19-2, 0.097% U_3O_8)

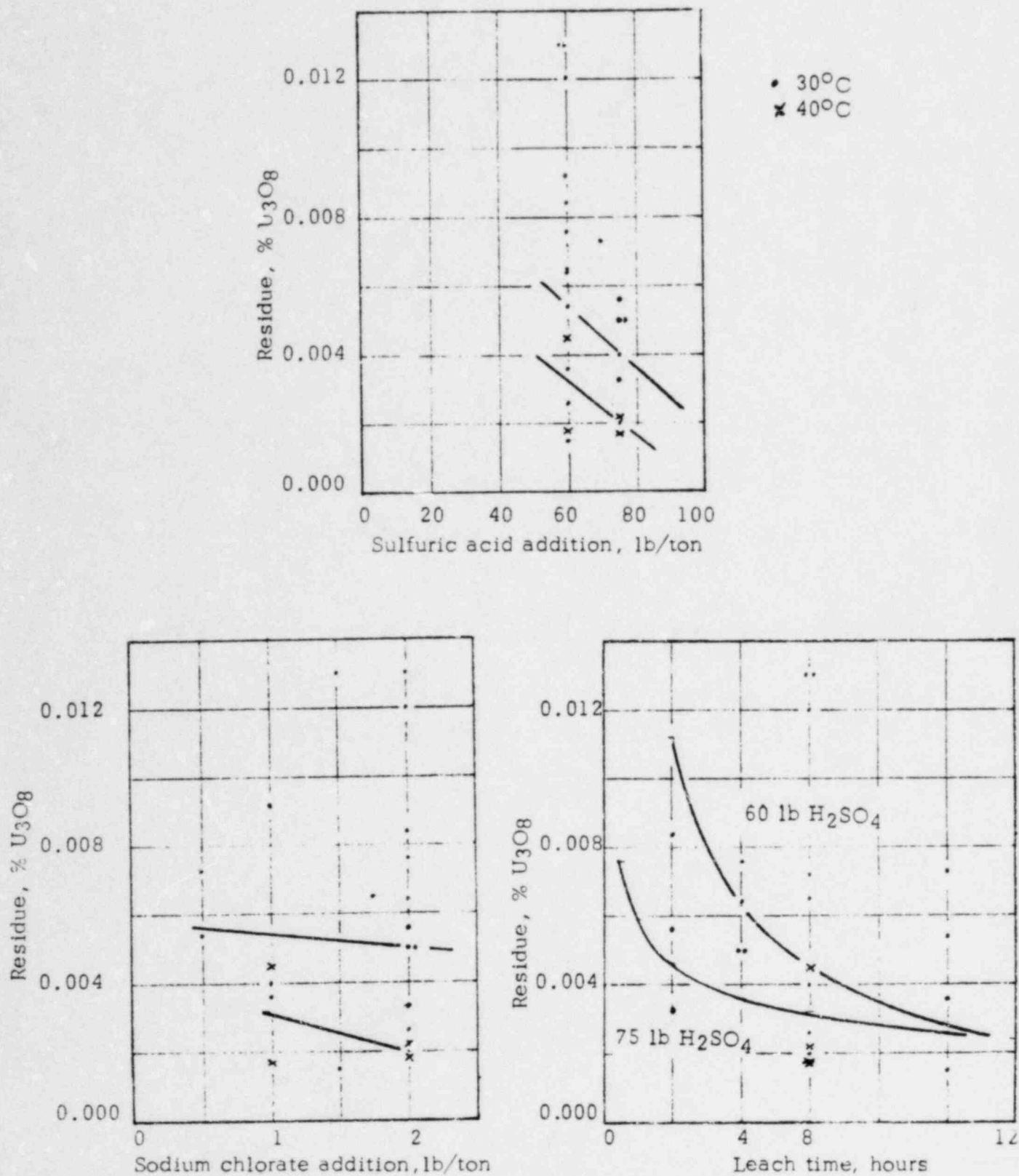


Figure 3

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THICKENING AND FILTRATION TESTS

A number of Kynch-type thickening tests were performed using leach pulps derived from both composites. The data from these tests are summarized in Table 6. Figure 4 shows the unit areas required for thickening using various additions of a number of flocculants. These data indicated that Superfloc 127 and Polyhall 1080, and 1041 were superior.

The effect of the feed pulp density on the thickening rate is shown in Figure 5. Unit areas of less than 1 ft²/ton/day were obtained when the pulp was diluted below 10% solids, indicating good amenability to high capacity thickeners or to conventional thickeners having a supernatant recycle.

Figure 5 also shows the effect of the flocculant addition on the thickening rate of 17% solids leach pulps. The optimum addition was 0.04 lb flocculant per ton. Terminal densities of 55-60% solids were obtained during most of the tests.

Two leach pulps were subjected to top feed (horizontal belt) filtration tests. The data from these tests are detailed in Appendix B, summarized in Table 7, and graphed in Figure 6. Filtration rates were fairly good with all four flocculants tested. Dewatering rates averaged 74 lb/hr/ft² at flocculant additions of 0.07 lb/ton. The dewatering rate increased to a maximum of 720 lb/hr/ft² with an addition of 0.25 lb Polyhall 1041 per ton. The wash rates were proportional to the dewatering rates.

Table 6
Moore Ranch Thickening Tests

(1 of 3 pages)

Test No. 1141-	21	23	25	27	29	31	35-A	35-B	37-A	37-B	39
Leach conditions:											
Temperature, °C	40	40	40	40	40	40	50	50	50	50	50
H ₂ SO ₄ , lb/ton	70.0	70.0	146.6	146.6	93.3	93.3	115.0	115.0	85.0	85.0	135.0
Filtrate:											
H ₂ SO ₄ , g/l	1.6	1.6	6.7	6.7	3.0	3.0	2.8	2.8	1.1	1.1	6.6
Flocculant:											
lb/ton	PH 1080 0.070	PH 1080 0.105	Percol 351 0.074	MG 200 0.072	SF 127 0.068	SF 16 0.075	PH 1080 0.106	SF 127 0.105	PH 1080 0.049	SF 127 0.058	PH 1080 0.052
Caustalg, lb/ton	2	-	-	-	-	-	-	-	-	-	-
Initial, % solids	13.9	14.0	13.3	13.6	12.5	13.0	8.8	8.9	9.7	8.1	17.1
Terminal % solids	49.7	46.7	43.9	41.0	36.9	44.6	42.4	42.3	48.5	38.5	56.0
Unit area ft ² /ton/day	3.4	3.5	5.5	5.6	3.3	3.8	1.5	1.7	2.0	1.9	1.7
Free settling:											
Rate, ft/hr	22	18	9	3	28	15	64	59	62	60	24

(2 of 3 pages)

Table f.

Test No. 1141-	40	43	45	47	49	51	53	55	57	59
Leach conditions:										
Temperature, °C	50	30	30	30	40	40	40	40	30	30
H ₂ SO ₄ , lb/ton	95.0	80.0	75.0	120.0	60	60	75	75	60	60
Filtrate:										
H ₂ SO ₄ , g/l	4.1	2.4	2.7	7.6	0.5	0.8	1.3	1.3	1.8	1.6
Flocculant:										
lb/ton	SF 127 0.052	PH 1080 0.053	PH 1080 0.053	PH 1080 0.079	PH 1080 0.052	PH 1080 0.039	PH 1080 0.052	PH 1041 0.039	PH 1080 0.042	PH 1080 0.026
Caustalg, lb/ton	-	-	-	-	-	-	-	-	-	-
Initial, % solids	17.2	17.2	17.2	17.0	16.9	17.0	17.0	16.9	20.4	24.1
Terminal, % solids	56.4	49.7	61.0	49.4	58.8	58.9	58.9	60.0	56.5	59.8
Unit area ft ² /ton/day	2.1	1.6	2.0	1.0	2.0	2.2	1.8	1.8	2.0	3.3
Free settling:										
Rate, ft/hr	23	43	42	51	42	38	46	44	16	3

Table 6

(3 of 3 pages)

Test No., 1141-	61	63	69	70	72	74	76	93	95	97	99
Leach conditions:											
Temperature, °C	30	30	30	30	30	30	30	30	30	30	30
H ₂ SO ₄ , lb/ton	75	75	60	60	70	60	60	60	60	60	60
Filtrate:											
H ₂ SO ₄ , g/l	2.2	2.8	4.6	4.6	4.9	3.1	3.2	-	-	-	-
Flocculant:											
lb/ton	PH 1041 0.041	PH 1041 0.026	PH 1041 0.028	PH 1041 0.026	PH 1041 0.027	PH 1041 0.041	PH 1080 0.027	PH 1041 0.027	PH 1041 0.027	PH 1041 0.026	PH 1041 0.026
Caustalg, lb/ton	-	-	-	-	-	-	-	-	-	-	-
Initial, % solids	21.1	23.9	8.6	17.4	24.3	24.1	24.5	9.2	12.9	17.3	21.3
Terminal, % solids	59.7	56.6	50.1	58.4	55.7	62.3	55.4	66.5	57.5	55.4	59.0
Unit area ft ² /ton/day	2.0	2.0	1.0	2.1	3.3	1.9	4.1	0.4	3.3	2.0	1.7
Free settling:											
Rate, ft/hr	16	10	77	27	2.5	17.0	1.8	216	29	35	22

Effect of Flocculant Types and Dosages
on Thickening Moore Ranch Ore
(Feed, 14-17% Solids)

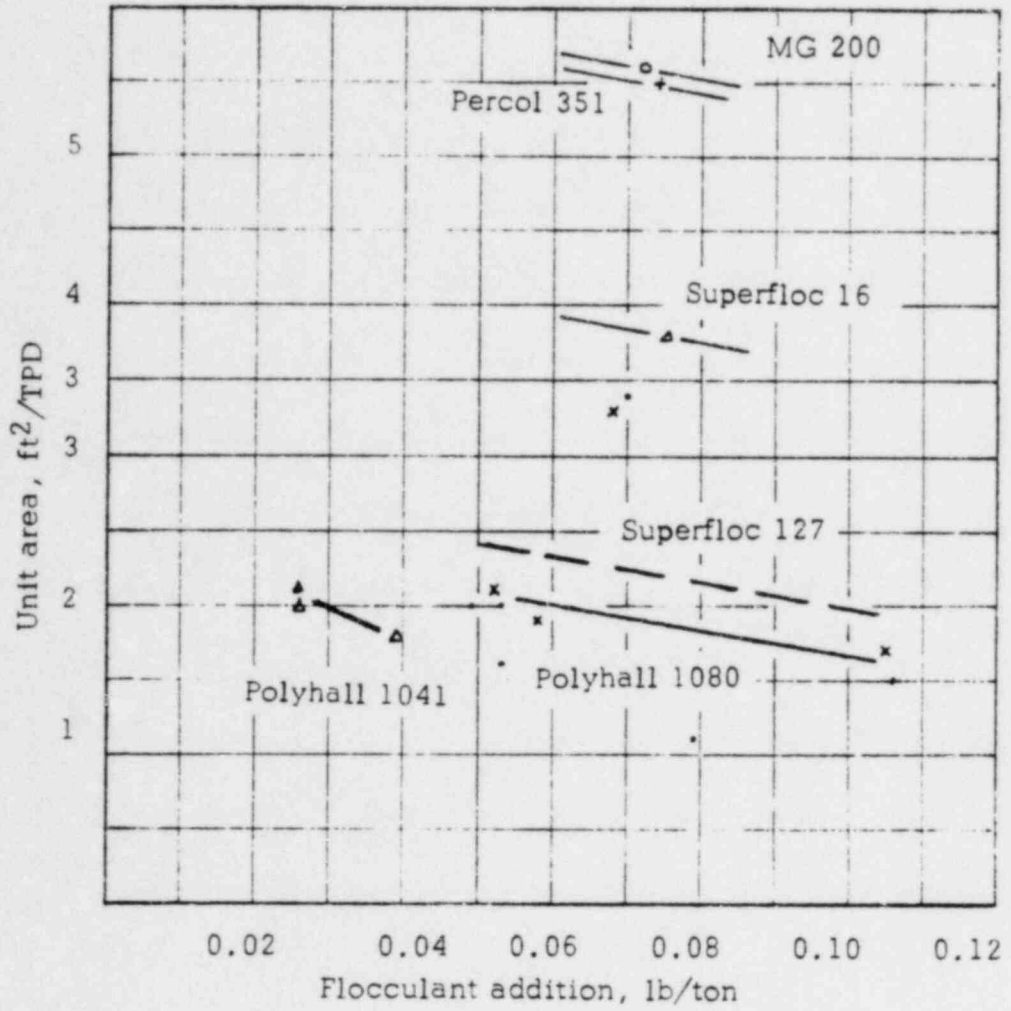


Figure 4

Effect of Initial Pulp Density and Flocculant Addition
on Settling Moore Ranch Leach Residue

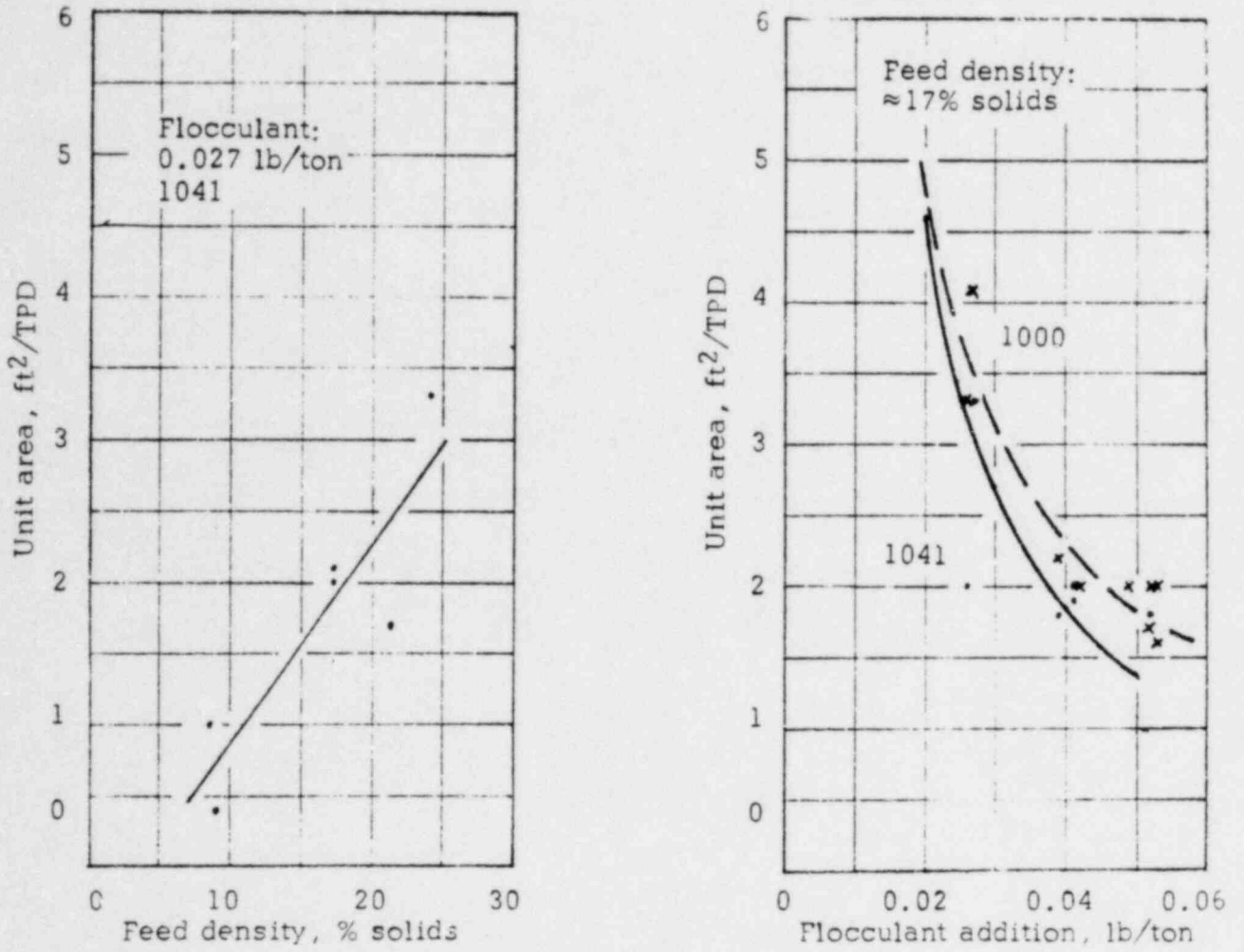


Figure 5

Table 7
Horizontal Belt Filtration Tests
(Popr 873 cloth, $\approx 15''$ Hg Vacuum)

Floculant:	Polyhall 1041				Jaguar 333			
	0.07	0.15	0.25	0.25	0.07	0.15	0.25	0.25
lb/ton	0.07	0.15	0.25	0.25	0.07	0.15	0.25	0.25
Cake, inches	1/4	1/4	5/16	9/16	1/4	1/4	1/4	1/4
% Moisture	19	22	22	25	23	22	21	24
Rates:								
Wash gal/hr/ft ²	3.3	12.	67	23	3.7	7.2	10	15
Dewater, lb/hr/ft ²	85	182	720	410	84	130	170	220
Total, lb/hr/ft ²	26	53	93	130	28	41	50	58
Floculant:	Jaguar MDD				Polyhall 1080			
	0.07	0.15	0.25	0.25	0.07	0.15	0.25	0.25
lb/ton	0.07	0.15	0.25	0.25	0.07	0.15	0.25	0.25
Cake, inches	5/16	1/4	1/4	9/16	1/4	1/4	3/16	1/2
% moisture	24	22	22	28	24	23	23	25
Rates:								
Wash, gal/hr/ft ²	2.2	12	39	8.5	2.1	5.3	20	8.4
Dewater, lb/hr/ft ²	59	170	340	160	67	140	300	180
Total, lb/hr/ft ²	20	51	150	94	21	47	120	97

Effect of Flocculant Addition on Filtration Rate
of Moore Ranch Leach Residue
(Popr 873 cloth, $\approx 15''$ Hg Vacuum)

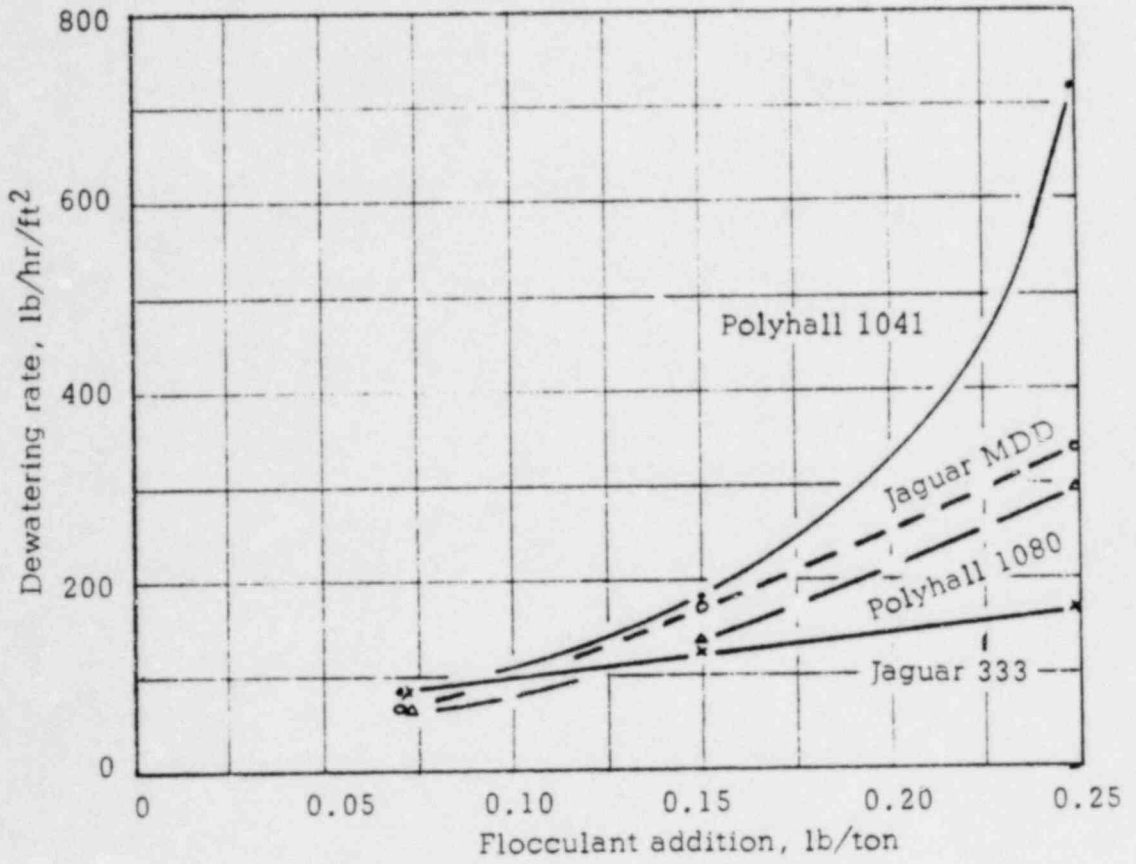


Figure 6

SOLVENT EXTRACTION STUDIES

Solutions produced during the leaching tests were composited to provide feed for solvent extraction studies. Tables 8, 9, and 10 and Figures 7 and 8 show the extraction isotherms for leach solutions of varying free acid content. The solvent used (3% Alamine 336, 2% Isodecanol, 95% kerosene) showed good extraction up to free acid concentrations of 16 g/l H₂SO₄.

A portion of the solvent loaded by the above and other extraction tests was stripped of its uranium using 150 g/l ammonium sulfate adjusted to ≈ 4.2 pH with ammonium hydroxide. Table 11 and Figure 9 show the data from the stripping isotherm. Efficient stripping was achieved and all phase separations were rapid.

Tests were performed to obtain design criteria for the extraction mixing and settling. Mixing times were varied from 10 to 80 seconds. Table 12 and Figure 10 show that the extraction by the solvent is very rapid. A contact of 10 seconds is adequate for transfer of 99% of the uranium. Phase separation data from a continuous test are listed in Table 13 and plotted on Figure 11. The test results indicate that at 2 gpm/ft² the dispersion band width is only 1-1/2 inches.

Tests also were performed to obtain design criteria for the strip mixing and settling. Mixing times were varied from 60-240 seconds. The data listed in Table 14 and plotted in Figure 10 show that the mixing time should approach or exceed 240 seconds. Data from phase separation tests are shown in Table 15 and Figure 11. At 2 gpm/ft² total flow the dispersion band width was less than 2 inches.

Table 8

Extraction Isotherm
(Test No. 1141-65)

Contact 120 seconds
Organic continuous 20°C
Solvent 3% Alamine 336
2% Isodecanol
95% Kerosene
Aqueous Mixture of 1141-28-1 and
1141-34-1, 3.9 g/l H₂SO₄,
1.10 g/l U₃O₈

pH	Aqueous Phase g/l	Solvent Phase g/l
1.66	0.0009	0.002
1.67	0.0033	1.10
1.73	0.014	2..
1.72	0.038	3.24
1.68	0.258	4.09

Table 9

Extraction Isotherm
(Test No. 1141-66)

Contact 120 seconds
Organic continuous 20°C
Solvent 3% Alamine 336
2% Isodecanol
95% Kerosene
Aqueous All of 1141-32-1 plus 1141-64-1
to make 650 ml. 11.5 g/l H₂SO₄,
0.96 g/l U₃O₈

pH	Aqueous Phase g/l	Solvent Phase g/l
1.44	0.0011	0.002
1.47	0.0041	0.96
1.48	0.012	1.90
1.49	0.041	2. 2.82
1.50	0.227	3.56

Table 10

Extraction Isotherm
(Test No. 1141-67)

Contacts 120 seconds
 Organic continuous 20°C
 Solvent 3% Alamine 336
 2% Isodecanol
 95% Kerosene
 Aqueous All of 1141-30-1 plus 1141-88-1
 to make 650 ml. 16.4 g/l H_2UO_4
 0.91 g/l U_3O_8

pH	Aqueous Phase g/l	Solvent Phase g/l
1.44	0.0015	0.003
1.43	0.0055	0.91
1.43	0.017	1.81
1.42	0.046	2.69
1.41	0.171	3.43

Table 11

Stripping Isotherm
(Test No. 1141-89)

Contact 300 seconds
 Organic continuous \approx 4.2 pH
 Solvent 3% Alamine 336
 1.5% Isodecanol
 95.5% Kerosene
 Aqueous 150 g/l $(NH_4)_2SO_4$, plus
 7N NH_4OH to adjust pH

pH	Aqueous Phase g/l	Solvent Phase g/l
4.8	4.4	0.033
4.1	6.7	0.17
4.1	10.7	0.44
4.1	12.6	0.34

Table 12

Effect of Mixing Time on Extraction
(Test No. 1141-87)

Contact 80, 40, 20, and 10 seconds
 Solvent 3% Alamine 336
 1.5% Isodecanol
 95.5 Kerosene
 Aqueous 1141-87-0 primary filtrate
 1141-77/82, 3.9 g/l H₂SO₄

Mixing Time Seconds	Aqueous Phase g/l	Percent Transferred
80	0.0014	99.8
40	0.0091	98.8
20	0.0070	99.1
10	0.032	95.7

Table 13

Extraction Phase Separation
(Test No. 1141-88)

Solvent phase 3% Alamine 336
 1.5% Isodecanol
 95.5% Kerosene (470B)
 Aqueous phase Leach solution
 Ratio 1.4 solvent/1.0 aqueous

Band Width Inches	Flow gpm/ft ²	Area ft ² /gpm
1/2	1.44	0.70
1	1.81	0.55
1-1/2	2.03	0.49
2	2.25	0.44
2-1/2	2.36	0.42
3	2.47	0.40

Table 14

Effect of Mixing Time on Stripping
(Test No. 1141-89)

Contact Organic continuous, ≈ 4.2 pH
Solvent 3% Alamine 336
 1.5% Isodecanol
 96.5% Kerosene (470B)
Aqueous 150 g/l $(\text{NH}_4)_2\text{SO}_4$ plus
 7N $(\text{NH}_4)\text{OH}$ to control pH

Mixing Time	Aqueous Phase g/l	Solvent Phase g/l	Percent Transferred
4	4.38	0.033	98.7
2	3.24	0.52	79.2
1	2.28	0.76	69.4

Table 15

Stripping Phase Separation

Solvent phase 3% Alamine 336
 1.5% Isodecanol
 96.5% Kerosene (470B)
Aqueous phase 150 g/l $(\text{NH}_4)_2\text{SO}_4$
Ratio 1.4 solvent/1.0 aqueous

Band Width Inches	Flow gpm./ft ²	Area ft ² /gpm
1/2	0.85	1.18
1	1.37	0.73
1-1/2	1.77	0.56
2	2.21	0.45
2-1/2	3.14	0.32
3	3.51	0.29

Uranium Extraction Isotherms

Solvent 3% Alamine 336
 1.5% Isodecanol
 95.5% Kerosene

Aqueous Moore Ranch Leach Solution
 0.9-1.1 g/l U_3O_8

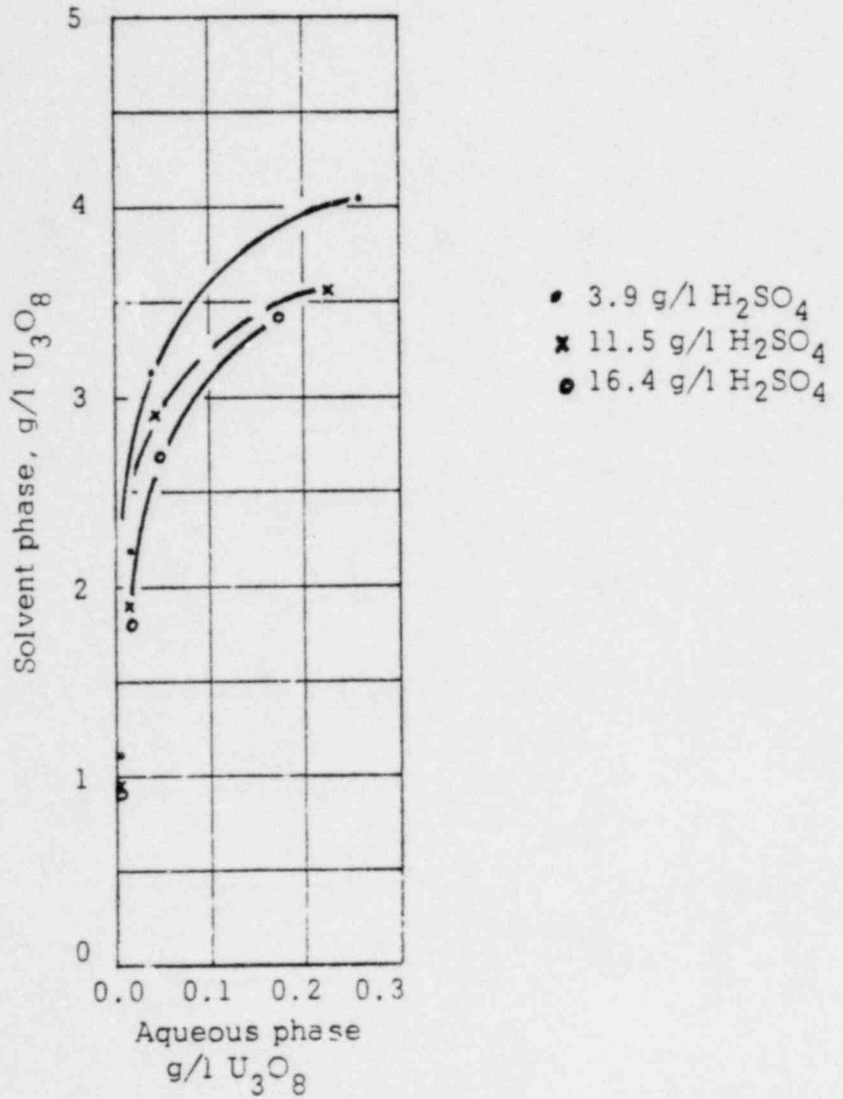


Figure 7

Uranium Extraction Isotherms

Solvent: 3% Alamine 336, 1.5% Isodecanol, 95.5% Kerosene

Aqueous: Moore Ranch Leach Solution, 0.9-1.1 g/l U_3O_8

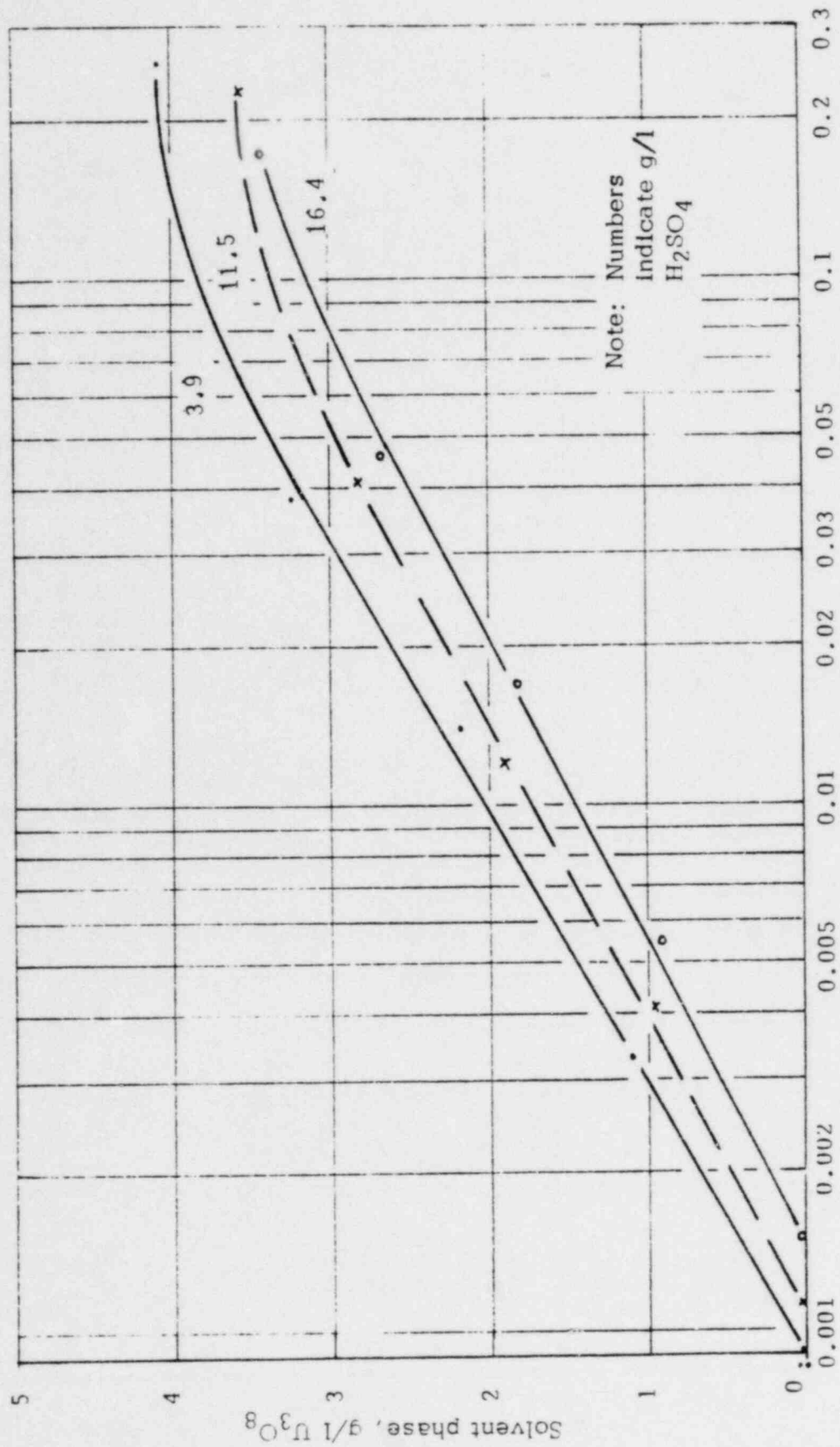


Figure 8

b.t.

Uranium Stripping Isotherm

Solvent: Loaded (2.5 g/l U_3O_8), 3% Alamine 336,
1.5% Isodecanol, 95.5% Kerosene

Aqueous: 150 g/l $(NH_4)_2SO_4$, ≈ 4.2 pH

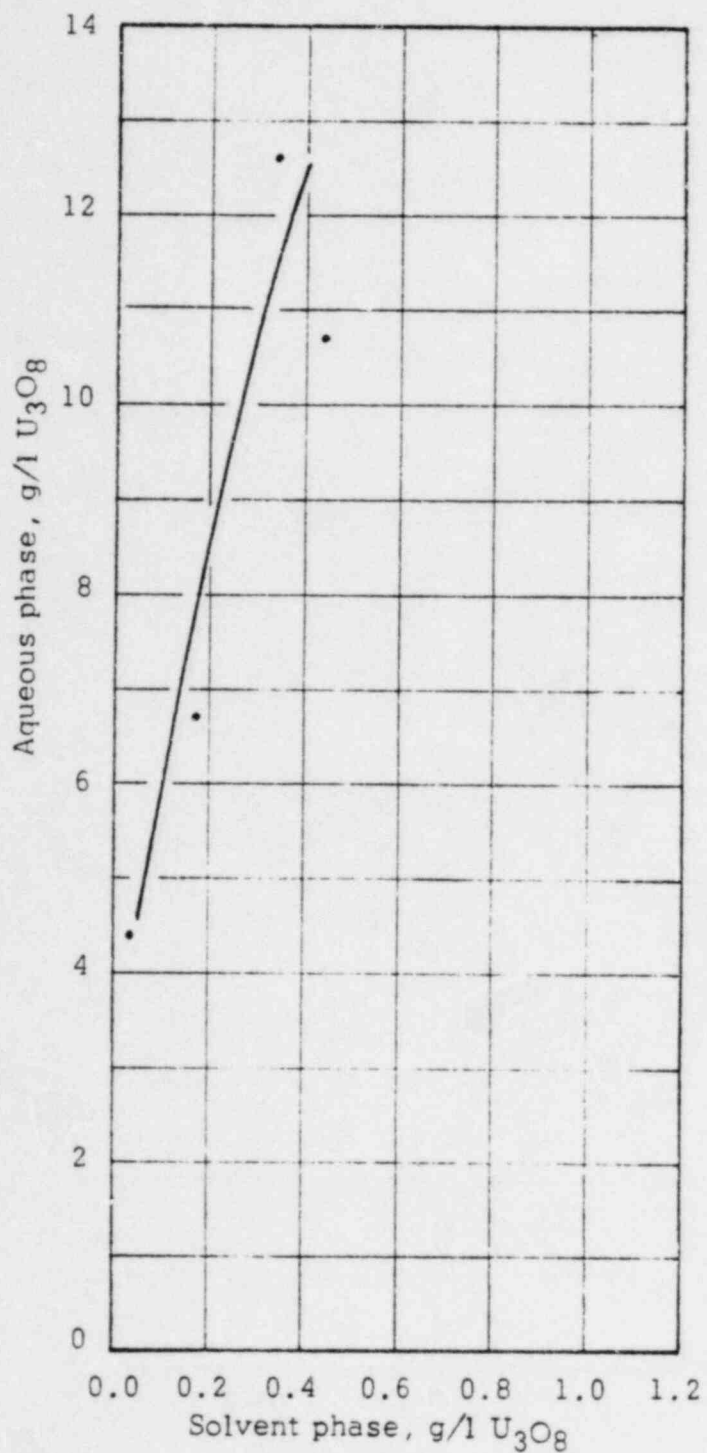


Figure 9

hri

Effect of Mixing Time on Transfer of Uranium
During Loading and Stripping

Solvent: 3% Alamine 336, 1.5% Isodecanol, 95.5% Kerosene
Extraction Aqueous: Moore Ranch Leach Solution
Stripping Aqueous: 150 g/l $(\text{NH}_4)_2\text{SO}_4$, ≈ 4.2 pH

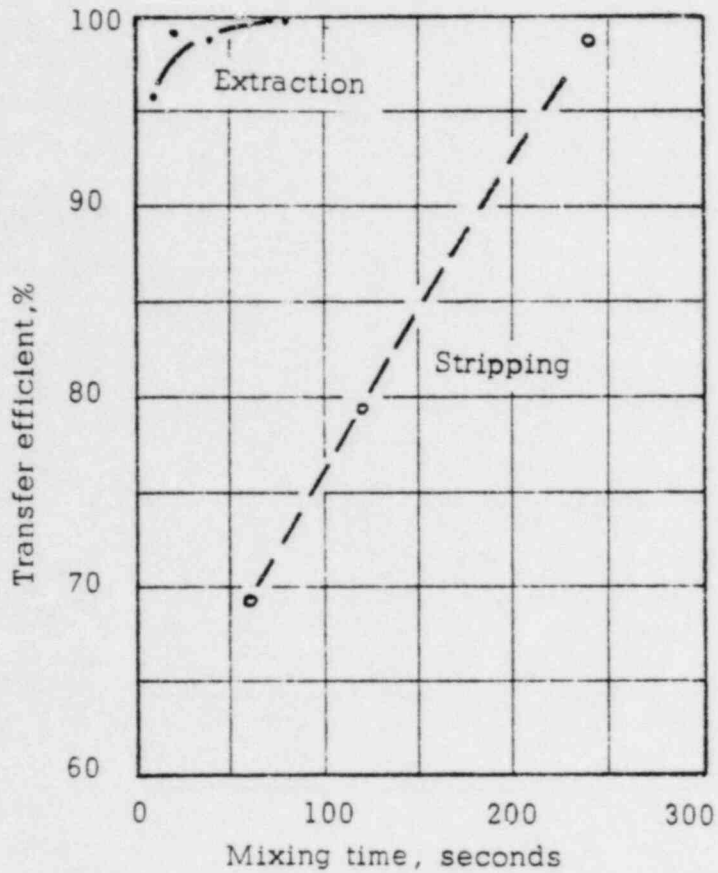


Figure 10

Effect of Total Flow on Dispersion Band Width
During Extraction and Stripping of Uranium

Solvent: 3% Alamine 336, 1.5% Isodecanol, 95.5% Kerosene
Extraction aqueous: Moore Ranch Leach Solution
Stripping aqueous: 150 g/l $(\text{NH}_4)_2\text{SO}_4$, ≈ 4.2 pH

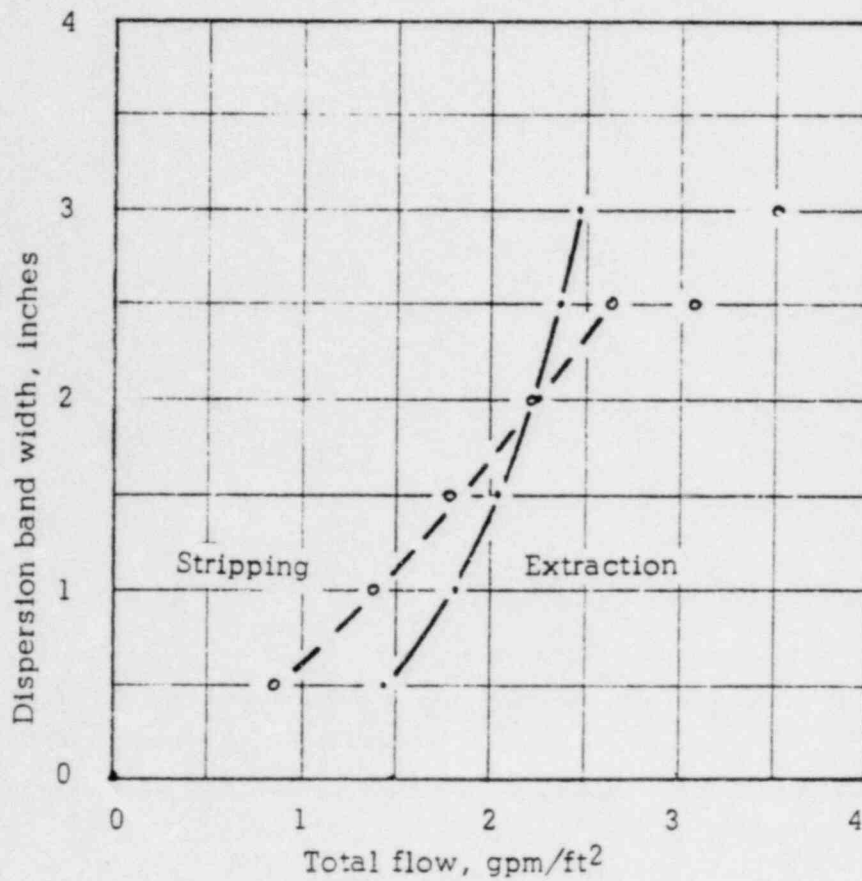


Figure 11

PROCESS CRITERIA

On the basis of the limited testing performed during this program, we suggest the following as preliminary criteria for a process to treat the Moore Ranch ores.

Grinding

To 100% minus 14-mesh, 5% plus 20-mesh
Grinding solution, mill water
Classification, cyclones
Cyclone advance, 55% solids
Material of construction, mild steel or rubber lined

Leach Circuit

Percent solids, 55%
Retention time, 8 hours (10 hours with allowance for shortcircuiting)
Temperature, 30°C (86°F)
Acid addition, 75 lb 100% H₂SO₄/ton dry ore
Oxidant addition, 2 lb NaClO₃/dry ton ore as 40% solution
Heating, none or by direct steam injection if required
Weight loss, 4%
Discharge acidity, 1.1 pH (11 g/l H₂SO₄)
Material of construction, rubber lined mild steel with brick wear plates

Countercurrent Decantation

Stages, 6
Flocculant, 0.04 lb Polyhall 1041/thickener
Design area, 0.3 ft²/TPD high capacity (2 ft²/TPD conventional)
Underflow solids, 55%
Wash ratio, 3-ton wash, per ton of dry ore

Tailings Pond

Percent solids feed, 25% (diluted with raffinate)
Settled density, 70% solids with excess solution decanted to CCD

Pregnant Solution Clarification

Feed solids, 400 ppm
Clarified solids, 50 ppm
Clarifier, same size as conventional CCD thickener
Filtration rate, 1.5 gpm/ft²

Precoat: wood flour, 0.05 lb/ton ore
diatomaceous earth, 0.05 lb/ton ore

Body feed, diatomaceous earth, 0.7 lb/ton ore
Solids in filtrate, <5 ppm

Uranium Solvent Extraction

Solvent, Amine 3%, Alamine 336 or Adogen 364
Modifier 1.5%, decyl or iso-decyl alcohol
Diluent, kerosene, AMSCO 460, Napolum 470
or equivalent

Extraction Circuit

Stages, 4
Mixer retention, 20 seconds
Solvent/aqueous ratio 1.2 (solvent recycle)
Settler area, 0.5 ft²/total gpm

U₃O₈ in feed, 0.3 g/l
U₃O₈ in raffinate, 0.001 g/l
U₃O₈ in loaded solvent, 3.2 g/l

Wash Circuit

Stages, 1
Mixer retention, 30 seconds
Solvent/aqueous ratio, 2.0 (aqueous recycle)
Settler area, 0.5 ft²/total gpm
Water flow, 5% of solvent flow

Strip Circuit

Stages, 4

Mixer retention, 5 minutes

Solvent/aqueous ratio, 2.0 (aqueous recycle)

Settler area, 0.5 ft²/total gpm

U₃O₈ in loaded strip, 25 g/l

U₃O₈ in barren organic, 0.06 g/l

Strip solution, 150 g/l (NH₄)₂SO₄ controlled at 4.2 pH by NH₃

APPENDIX A

LEACH DATA

Uranium Acid Leach Amenability
No. 1141-20

Sample No. 1141-19-9 0.108% U_3O_8
Moore Ranch Comp 0.59% CO_2
854-5, 1818-9

Conditions: 40°C, 6 hr, 60% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H_2SO_4 Cum lb/ton	$NaClO_3$ Cum lb/ton	Cum lb/ton
		Read	Adjusted				
0	40		1.00		47		
1	40	2.01	0.90	320	80	0.7	
2	40	1.07	0.83	425	100	1.0	
3	40	0.90	0.81	456	117		
4	40	0.75		430			
6	40	0.90		440			

	Weight/ Volume	Metallurgical Balance				
		Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe Fe^{2+}
Leach head						
%		0.108				
Gram	600	0.648	35.8			
Filtrate						
g/l		0.337	7.0			
Gram	1450	0.489	10.2			
Wash						
g/l		0.097				
Gram	1250	0.121	2.5			
Residue						
6-hour						
+150-mesh, %	426.7	0.0007				
-150-mesh, %	141.7	0.0033				
Total		0.0013				
Gram	568.4	0.007				
Percent solubilized						
hour						
hour						
hour						
6 hour		98.8				
Calculated head, %		0.103				
Acid consumption, 74 lb/ton						

Uranium Acid Leach Amenability

No. 1141-22

Sample No. 1141-19-9 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 40°C, 6 hr, 60% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H ₂ SO ₄	NaClO ₃
		Read/Adjusted			Cum lb/ton	Cum lb/ton
0		1.10			40	
1		2.25	1.17	330	57	0.7
2		1.35	1.08	405	70	1.0
3		1.09		430		1.3
4		1.08		440		1.5
6		1.29		455		

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	600	0.548	21.0				
Filtrate							
g/l		0.160	1.6				
Gram	3190	0.510	5.1				
Wash							
g/l		0.071					
Gram	1200	0.085	0.9				
Residue							
.6-hour							
+150-mesh, %	412.0	0.0013					
-150-mesh, %	157.2	0.0043					
Total		0.0021					
Gram	569.2	0.012					
Percent solubilized							
hour							
hour							
hour							
6 hour		98.0					
Calculated head, %		0.101					
Acid consumption, 50 lb/ton							

Uranium Acid Leach Amenability

No. 1141-24

Sample No. 1141-19-9 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 40°C, 10 hr, 60% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H ₂ SO ₄	NaClO ₃	Cum lb/ton
		Read/Adjusted			Cum lb/ton	Cum lb/ton	
0		1.02			48		
1		1.77	0.85	340	82	0.7	
2		1.00	0.83	430	98	1.0	
3		0.89	0.81	425	105		
4		0.83	0.75	480	107		
6		1.03	0.79	470	147		
8		0.33		465			
10		0.69		460			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.108					
Gram	600	0.648	4.0				
Filtrate							
g/l		0.184	6.7				
Gram	3150	0.580	21.1				
Wash							
g/l		0.054					
Gram	1260	0.068	2.5				
Residue							
12-hour							
+150-mesh, %	181.0	0.0010					
-150-mesh, %	91.1	0.0013					
Total		0.0011					
Gram	551.5	0.006					
Percent solubilized							
hour							
hour							
hour							
6 hour		99.1					
Calculated head, %		0.109					
Acid consumption, 68 lb/ton							

Uranium Acid Leach Amenability

No. 1141-26

Sample No. 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 40°C, 10 hr, 60% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H_2SO_4 Cum lb/ton	$NaClO_3$ Cum lb/ton	Cum lb/ton
		Read	Adjusted				
1		1.10		310	57	0.7	
2		2.15	1.17	415	70	1.0	
3		1.33	1.07	450			
4		1.10		460			
6		0.90		455	93		
8		1.18	1.05	450			
10		0.60		445			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	600	0.648	28.0				
Filtrate							
g/l		0.175	3.0				
Gram	3230	0.565	9.7				
Wash							
g/l		0.052					
Gram	1280	0.067	1.1				
Residue							
6-hour							
+150-mesh, %	202.3	0.0009					
-150-mesh, %	93.0	0.0019					
Total		0.0013					
Gram	561.0	0.007					
Percent solubilized							
hour							
hour							
hour							
6 hour		98.8					
Calculated head, %		0.107					
Acid consumption,	57 lb/ton						

Uranium Acid Leach Amenability

No. 1141-28

Sample No. 1141-19-9 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 40°C, 10 hr, 60% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H_2SO_4 Cum lb/ton	$NaClO_3$ Cum lb/ton	Cum lb/ton
		Read	Adjusted				
0			1.25		57		
1			1.46	315		0.7	
2			1.52	380		1.3	
3		1.33	1.62	420	63	1.7	
4			1.37	440		2.0	
6			1.45	470			
8			1.50	475			
10			1.64	470			

Metallurgical Balance

	Weight/ Volume	Metallurgical Balance					
		Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	600	0.648	19.0				
Filtrate							
g/l		1.03	3.7				
Gram	375	0.386	1.4				
Wash							
g/l		0.180					
Gram	1370	0.247	0.9				
Residue							
10-hour							
+150-mesh, %	409.1	0.0006					
-150-mesh, %	164.0	0.0035					
Total		0.0014					
Gram	573.1	0.008					
Percent solubilized							
hour							
hour							
hour							
10 hour		98.8					
Calculated head, %		0.107					
Acid consumption, % lb/ton							

Uranium Acid Leach Amenability
No. 1141-30

Sample No. 0.108% U₃O₈
Moore Ranch Comp. 0.59% CO₂
894-5, 1818-9

Conditions: 40°C, 14 hr, 60% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
		Read	Adjusted				
0		1.04			60		
1		1.32	0.78	320	87	0.7	
2		0.85		420		1.0	
3		0.96	0.84	435	97	1.3	
4		0.83		450			
6		0.90	0.82	455	103		
8		0.78		450			
10		0.96	0.80	435	110		
12		0.92	0.78	460	117		
14		0.80		460			

Metallurgical Balance

	Weight/ Volume	Uranium U ₃ O ₈	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.108					
Gram	600	0.648	35.0				
Filtrate							
g/l		0.99	23				
Gram	320	0.317	7.4				
Wash							
g/l		0.19					
Gram	1390	0.264	6.1				
Residue							
14-hour							
+150-mesh, %	393.4	0.0003					
-150-mesh, %	176.4	0.0044					
Total		0.0016					
Gram	569.8	0.009					
Percent solubilized							
hour							
hour							
hour							
14 hour		98.5					
Calculated head, %		0.098					
Acid consumption, 72 lb/ton							

Uranium Acid Leach Amenability

No. 1141-32

Sample No. 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 40°C, 14 hr, 60% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H ₂ SO ₄	NaClO ₃
		Read/Adjusted			Cum lb/ton	Cum lb/ton
0		0.94			57	
1		1.01		290		0.7
2		1.45	1.08	390	70	1.3
3		1.04		440		1.5
4		1.15		450		
6		1.2	1.08	470	77	
8		1.01		465		
10		1.10		460		
12		1.20	1.10	460	83	
14		0.99		455		

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	600	0.648	25.0				
Filtrate							
g/l		1.04	8.3				
Gram	290	0.302	2.4				
Wash							
g/l		0.195					
Gram	1380	0.269	2.1				
Residue							
14-hour							
+150-mesh, %	409.0	0.0005					
-150-mesh, %	172.6	0.0067					
Total		0.0023					
Gram	581.6	0.013					
Percent solubilized							
hour							
hour							
hour							
14 hour		97.7					
Calculated head, %		0.097					
Acid consumption, 68 lb/ton							

Uranium Acid Leach Amenability

No. 1141-33

Sample No. 1141-19-9 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 50°C, 6 hr, 47% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H_2SO_4 Cum lb/ton	$NaClO_3$	
		Read	Adjusted			Cum lb/ton	Cum lb/ton
0	50		1.00		60.0		
1	50	1.47	0.85	350	95.0	1.0	
2	50	0.97	0.80	465	110.0		
3							
4	50	1.86	0.81	450	115.0		
6	50	0.78		440			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	400	0.432	23.0				
Filtrate							
g/l		0.098	2.8				
Gram	3690	0.362	10.3				
Wash							
g/l		0.021					
Gram	1250	0.026	0.7				
Residue							
0-hour							
+150-mesh, %	334.4	0.0016					
-150-mesh, %	43.6	0.0028					
Total		0.0017					
Gram	378	0.006					
Percent solubilized							
hour							
hour							
hour							
6 hour		98.4					
Calculated head, %		0.099					
Acid consumption, 60 lb/ton							

Uranium Acid Leach Amenability

No. 1141-34

Sample No. 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 40°C, 14 hr, 60% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H_2SO_4 Cum lb/ton	$NaClO_3$ Cum lb/ton	Cum lb/ton
		Read	Adjusted				
0		1.27			37		
1		3.05	1.46	140	47	1.7	
2		1.92	1.43	400	53	2.0	
3		1.41		435		2.3	
4		1.68	1.37	450	60		
6		1.35		480			
8		1.26		480			
10		1.33		480			
12		1.56	1.40	480	67		
14		1.32		475			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	600	0.648	20.0				
Filtrate							
g/l		0.982	4.8				
Gram	340	0.334	1.6				
Wash							
g/l		0.170					
Gram	1370	0.233	1.1				
Residue							
14-hour							
+150-mesh, %	383.0	0.0019					
-150-mesh, %	189.0	0.0041					
Total		0.0026					
Gram	572	0.015					
Percent solubilized							
hour							
hour							
hour							
14 hour		97.4					
Calculated head, %		0.097					
Acid consumption, 57 lb/ton							

Uranium Acid Leach Amenability

No. 1141-36

Sample No. 1141-19-9 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 50°C, 6 hr, 47% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H_2SO_4 Cum lb/ton	$NaClO_3$ Cum lb/ton	Cum lb/ton
		Read	Adjusted				
0	50	1.09			50.0		
1	50	1.72	1.13	330	70.0	1.0	
2	50	1.23	1.08	455	80.0		
3							
4	50	1.13	1.07	450	85.0		
6	50	1.02		440			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	400	0.432	17.0				
Filtrate							
g/l		0.099	1.1				
Gram	3730	0.369	4.1				
Wash							
g/l		0.019					
Gram	1220	0.023	0.3				
Residue							
6-hour							
+150-mesh, %	336.8	0.0020					
-150-mesh, %	38.3	0.0025					
Total		0.0021					
Gram	374.8	0.008					
Percent solubilized							
hour							
hour							
hour							
6 hour		98.0					
Calculated head, %		0.100					
Acid consumption, 63 lb/ton							

Uranium Acid Leach Amenability

No. 1141-38

Sample No. 1141-19-9 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 50°C, 10 hr, 47% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H_2SO_4 Cum lb/ton	$NaClO_3$ Cum lb/ton	Cum lb/ton
		Read	Adjusted				
0	50	0.90			80		
1	50	1.07	0.83	355	105	1.0	
2	50	0.83		465			
3							
4	50	0.86	0.81	450	110		
6	50	0.77		450			
8	50	0.98		435	135	1.5	
10	50	0.75		470			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	400	0.432	27.0				
Filtrate							
g/l		0.222	6.6				
Gram	1670	0.371	11.0				
Wash							
g/l		0.050					
Gram	850	0.043	1.3				
Residue							
10-hour							
+150-mesh, %	310.0	0.0024					
-150-mesh, %	76.1	0.0018					
Total		0.0023					
Gram	386.1	0.009					
Percent solubilized							
hour							
hour							
hour							
10 hour		97.9					
Calculated head, %		0.106					
Acid consumption, 74 lb/ton							

Uranium Acid Leach Amenability

No. 1141-41

Sample No. 1141-19-9 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 50°C, 10 hr, 47% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H_2SO_4 Cum lb/ton	$NaClO_3$ Cum lb/ton	Cum lb/ton
		Read	Adjusted				
0	50	1.08			50.0		
1	50	1.70	1.11	340	70.0	1.0	
2	50	1.21	1.13	460	75.0		
3							
4	50	1.20	1.13	450	80.0		
6	50	1.06		450			
8	50	1.30	1.07	440	95.0	1.5	
10	50	0.99		475			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	400	0.432	19.0				
Filtrate							
g/l		0.207	4.1				
Gram	1710	0.354	7.0				
Wash							
g/l		0.047					
Gram	800	0.038	0.8				
Residue							
10-hour							
+150-mesh, %	312.5	0.0014					
-150-mesh, %	74.2	0.0017					
Total		0.0015					
Gram	360.7	0.006					
Percent solubilized							
hour							
hour							
hour							
10 hour		98.6					
Calculated head, %		0.099					
Acid consumption, 56 lb/ton							

Uranium Acid Leach Amenability

No. 1141-42

Sample No. 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-9

Conditions: 30°C, 6 hr, 47% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H ₂ SO ₄	NaClO ₃	Cum lb/ton
		Read/Adjusted			Cum lb/ton	Cum lb/ton	
0					75.0		
1	33	0.75		315		2.0	
2	32	1.13	1.08	435	80.0		
3							
4	31	1.09		470			
6	29	1.05		470			

Metallurgical Balance

	Weight/ Volume	Uranium					
		U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	400	0.432	16.0				
Filtrate							
g/l		0.219	2.4				
Gram	1700	0.372	4.1				
Wash							
g/l		0.041					
Gram	800	0.033	0.4				
Residue							
6-hour							
+150-mesh, %	308.0	0.0					
-150-mesh, %	71.3	0.00					
Total		0.00					
Gram	389.3	0.010					
Percent solubilized							
hour							
hour							
hour							
6 hour		97.6					
Calculated head, %		0.104					
Acid consumption, 58 lb/ton							

Uranium Acid Leach Amenability
No. 1141-44

Sample No. 0.108% U_3O_8
Moore Ranch Comp. 0.59% CO_2
894-5, 1818-9

Conditions: 30°C, 10 hr, 47% solids

Data

Elapsed Time, hr	Temperature °C	pH		emf/mv	H_2SO_4 Cum lb/ton	$NaClO_3$ Cum lb/ton	Cum lb/ton
		Real	Adjusted				
0					75		
1	33	0.74	315			2.0	
2	32	1.05	435				
3							
4	31	1.07	465				
6	29	1.04	460				
8							
10	28	1.00	470				

Metallurgical Balance

	Weight/ Volume	Metallurgical Balance					
		Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.108					
Gram	400	0.432	15.0				
Filtrate							
g/l		0.180	2.7				
Gram	1700	0.306	4.6				
Wash							
g/l		0.033					
Gram	800	0.026	0.4				
Residue							
10-hour							
+150-mesh, %	306.0	0.0009					
-150-mesh, %	70.6	0.0032					
Total		0.0020					
Gram	376.6	0.008					
Percent solubilized							
hour							
hour							
hour							
10 hour		97.8					
Calculated head, %		0.085					
Acid consumption, 50 lb/ton							

Uranium Acid Leach Amenability

No. 1141-46

Sample No. 0.108% U_3O_8
 Moore Ranch Comp. 0.59% CO_2
 894-5, 1818-8

Conditions: 30°C, 6 hr, 4% solids

Data

Elapsed Time, hr	Temperature °C	pH Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0				100		
1	33	0.57	320		2.0	
2	32	0.84	445			
3						
4	31	0.96	470	120		
6	29	0.75	470			

	Weight/ Volume	Metallurgical Balance				
		Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe Fe ²⁺
Leach head						
%		0.108				
Gram	400	0.432	24.0			
Filtrate						
g/l		0.192	7.6			
Gram	1710	0.328	13.0			
Wash						
g/l		0.031				
Gram	800	0.025	1.0			
Residue						
6-hour						
+150-mesh, %	312.4	0.0008				
-150-mesh, %	66.5	0.0019				
Total		0.0013				
Gram	379.9	0.005				
Percent solubilized						
hour						
hour						
hour						
6 hour		98.6				
Calculated head, %		0.90				
Acid consumption, 50 lb/ton						

Uranium Acid Leach Amenability

No. 1141-48

Sample No. 1141-19-12 0.097% U_3O_8
 Moore Ranch Comp. 0.56% CO_2
 894-5, 1818-9, 1813-4

Conditions: 40°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	pH Read/Adjusted	emi/mv	H ₂ SO ₄	NaClO ₃	
				Cum lb/ton	Cum lb/ton	Cum lb/ton
0				60	1.0	
1	40	1.38	435			
2	40	1.58	445			
3						
4	40	1.56	430			
6	40	1.68	430			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.097					
Gram	400	0.388	12.0				
Filtrate							
g/l		0.21	0.5				
Gram	1740	0.365	0.9				
Wash							
g/l		0.050					
Gram	820	0.041	0.1				
Residue							
6 -hour							
+150-mesh, %	309.5	0.0043					
-150-mesh, %	71.9	0.0052					
Total		0.0045					
Gram	381.4	0.017					
Percent solubilized							
hour							
hour							
hour							
6 hour		96.0					
Calculated head, %		0.106					
Acid consumption, 55 lb/ton							

Uranium Acid Leach Amenability

No. 1141-50

Sample No. 1141-19-12 0.097% U_3O_8
 Moore Ranch Comp. 0.56% CO_2
 894-5, 1818-9, 1813-4

Conditions: 40°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	pH Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0				60	2.0	
1	40	1.37	470			
2	40	1.54	490			
3						
4	40	1.53	480			
6	40	1.61	480			

Metallurgical Balance

	Weight/Volume	Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	400	0.388	12.0				
Filtrate							
g/l		0.212	0.8				
Gram	1750	0.391	1.4				
Wash							
g/l		0.046					
Gram	820	0.038	0.1				
Residue							
6 -hour							
+150-mesh, %	307.6	0.0015					
-150-mesh, %	74.7	0.0028					
Total		0.0018					
Gram	382.3	0.007					
Percent solubilized							
hour							
hour							
hour							
6 hour		98.4					
Calculated head, %		0.104					
Acid consumption, 52 lb/ton							

Uranium Acid Leach Amenability

No. 1141-52

Sample No. 1141-19-12 0.097% U_3O_8
 Moore Ranch Comp. 0.56% CO_2
 894-5, 1818-9, 1813-4

Conditions: 40°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	pH Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0				75	1.0	
1	40	1.09	455			
2	40	1.22	450			
3						
4	40	1.24	445			
6	40	1.29	440			

Metallurgical Balance

	Weight/Volume	Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	400	0.388	15.0				
Filterate							
g/l		0.199	1.5				
Gram	1740	0.346	2.6				
Wash							
g/l		0.043					
Gram	830	0.036	0.3				
Residue							
6-hour							
+150-mesh, %	308.3	0.0013					
-150-mesh, %	73.9	0.0027					
Total		0.0017					
Gram	382.2	0.006					
Percent solubilized							
hour							
hour							
hour							
6 hour		98.3					
Calculated head, %		0.097					
Acid consumption, 61 lb/ton							

Uranium Acid Leach Amenability

No. 1141-54

Sample No. 1141-19-12 0.097% U₃O₈
 Moore Ranch Comp. 0.56% CO₂
 894-5, 1818-9, 1813-4

Conditions: 40°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	pH Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0				75	2.0	
1	40	1.06	500			
2	40	1.20	510			
3						
4	40	1.20	500			
6	40	1.26	500			

Metallurgical Balance

	Weight/ Volume	Uranium U ₃ O ₈	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	400	0.388	15.0				
Filtrate							
g/l		0.208	1.3				
Gram	1745	0.363	2.3				
Wash							
g/l		0.035					
Gram	825	0.029	0.2				
Residue							
6 -hour							
+150-mesh, %	309.6	0.0020					
-150-mesh, %	74.3	0.0028					
Total		0.0022					
Gram	383.6	0.008					
Percent solubilized							
hour							
hour							
hour							
6 hour		97.9					
Calculated head, %		0.100					
Acid consumption, 63 lb/ton							

Uranium Acid Leach Amenability

No. 1141-56

Sample No. 1141-19-12 0.097% U_3O_8
 Moore Ranch Comp. 0.56% CO_2
 894-5, 1818-9, 1813-4

Conditions: 30°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	pH Read/Adjusted	emf/mv	H ₂ SO ₄	NaClO ₃	
				Cum lb/ton	Cum lb/ton	Cum lb/ton
0	30			60	1.0	
1	31	0.92	395			
2	30	1.01	405			
3						
4	29	1.09	415			
6	30	1.14	420			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.097					
Gram	500	0.485	15.0				
Filtrate							
g/l		0.217	1.8				
Gram	1660	0.360	3.0				
Wash							
g/l		0.078					
Gram	820	0.064	0.5				
Residue							
6 -hour							
+150-mesh, %	395.6	0.0077					
-150-mesh, %	79.1	0.017					
Total		0.0092					
Gram	474.7	0.044					
Percent solubilized							
hour							
hour							
hour							
6 hour		90.7					
Calculated head, %		0.094					
Acid consumption, 46 lb/ton							

Uranium Acid Leach Amenableity
No. 1141-58

Sample No. 1141-19-12 0.097% U_3O_8
Moore Ranch Comp. 0.56% CO_2
894-5, 1818-9, 1313-4

Conditions: 30°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	pH Read/Adjusted	emf/mv	H_2SO_4 Cum lb/ton	$NaClO_3$ Cum lb/ton	Cum lb/ton
0	30			60	2.0	
1	31	0.90	425			
2	30	0.97	440			
3						
4	29	1.05	450			
6	30	1.10	470			

Metallurgical Balance

	Weight/Volume	Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.097					
Gram	600	0.582	18.0				
Filtrate							
g/l		0.292	1.6				
Gram	1600	0.467	2.6				
Wash							
g/l		0.079					
Gram	820	0.065	0.4				
Residue							
6-hour							
+150-mesh, %	472.3	0.0025					
-150-mesh, %	101.0	0.0031					
Total		0.0026					
Gram	573.3	0.015					
Percent solubilized							
hour							
hour							
hour							
6 hour		97.2					
Calculated head, %		0.091					
Acid consumption, 50 lb/ton							

Uranium Acid Leach Amenability
No. 1141-60

Sample No. 1141-19-12 0.097% U_3O_8
Moore Ranch Comp. 0.56% CO_2
894-5, 1818-9, 1813-4

Conditions: 30°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	pH Read/Adjusted	emf/mv	H ₂ SO ₄	NaClO ₃	
				Cum lb/ton	Cum lb/ton	Cum lb/ton
0	30			75	1.0	
1	31	0.80	410			
2	30	0.75	420			
3						
4	29	0.78	425			
6	30	0.79	430			

Metallurgical Balance

	Weight/ Volume	Metallurgical Balance					
		Uranium U_3O_8	H_2SO_4	Mo	P_2O_5	Fe	Fe^{2+}
Leach head							
%		0.097					
Gram	500	0.485	18.8				
Filtrate							
g/l		0.249	2.2				
Gram	1655	0.412	3.6				
Wash							
g/l		0.078					
Gram	840	0.066	0.6				
Residue							
6 -hour							
+150-mesh, %	413.0	0.0035					
-150-mesh, %	74.8	0.0069					
Total		0.0040					
Gram	487.8	0.020					
Percent solubilized							
hour							
hour							
hour							
6 hour		96.1					
Calculated head, %		0.099					
Acid consumption, 58 lb/ton							

Uranium Acid Leach Amenability

No. 1141-62

Sample No. 1141-19-12 0.097% U_3O_8
 Moore Ranch Comp. 0.56% CO_2
 894-5, 1818-9, 1813-4

Conditions: 30°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	pH Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0	30			75	2.0	
1	31	0.74	440			
2	30	0.70	460			
3						
4	29	0.75	475			
6	30	0.77	485			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	22.5				
Filtrate							
g/l		0.314	2.8				
Gram	1600	0.502	4.5				
Wash							
g/l		0.100					
Gram	840	0.084	0.7				
Residue							
6 -hour							
+150-mesh, %	481.3	0.0018					
-150-mesh, %	90.2	0.0028					
Total		0.0020					
Gram	571.5	0.011					
Percent solubilized							
hour							
hour							
hour							
6 hour		98.1					
Calculated head, %		0.100					
Acid consumption, 56 lb/ton							

Uranium Acid Leach Amenability
No. 1141-68

Sample No. 1141-19-12A, 0.097 % U_3O_8
Composite 894-5, 1813-4, 1818-9
Conditions: 30°C, 10 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0	30			60	0.5	
1	30					
2	30					
3	30					
4	30					
6	30					
8	30					
10	30					

Metallurgical Balance

	Weight/Volume	Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	18.0				
Raffinate							
g/l		0.238	5.3				
Gram	2900	0.690	15.4				
Filtrate							
g/l		0.326	4.6				
Gram	3550	1.157	16.3				
Wash							
g/l		0.054					
Gram	1645	0.089	1.3				
Residue							
Total		0.0054					
Grams	5803	0.031					
Percent solubilized							
— hour		95.3					
Calculated head, %		0.098					
Acid consumption, 53 lb/ton							

Uranium Acid Leach Amenability
No. 1141-71

Sample No. 1141-19-12A, 0.097% U₃O₈

Composite 894-5, 1813-4, 1818-9

Conditions: 30°C, 10 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄	NaClO ₃	
				Cum lb/ton	Cum lb/ton	Cum lb/ton
0	30			70	0.5	
1	30					
2	30					
3	30					
4	30					
6	30					
8	30					
10	30					

Metallurgical Balance

	Weight/ Volume	Uranium U ₃ O ₈	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	21.0				
Raffinate							
g/l		0.238	5.3				
Gram	1000	0.238	5.3				
Filtrate							
g/l		0.400	4.9				
Gram	1580	0.632	7.7				
Wash							
g/l		0.125					
Gram	830	0.104	1.3				
Residue							
Total		0.0073					
Gram	575.5	0.042					
Percent solubilized							
_____ hour		92.2					
Calculated head, %		0.090					
Acid consumption, 58 lb/ton							

Uranium Acid Leach Amenability
No. 1141-73

Sample No. 1141-19-12A, 0.097% U_3O_8
Composite 894-5, 1813-4, 1818-9
Conditions: 30°C, 10 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0	30			60	1	
1	30					
2	30					
3	30					
4	30					
6	30					
10	30					

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	18.0				
Raffinate							
g/l		0.238	5.3				
Gram	1000	0.238	5.3				
Filtrate							
g/l		0.400	3.1				
Gram	1580	0.632	4.9				
Wash							
g/l		0.107					
Gram	835	0.089	0.7				
Residue							
Total		0.0036					
Grams	571.2	0.021					
Percent solubilized							
_____ hour		95.9					
Calculated head, %		0.084					
Acid consumption, 59 lb/ton							

Uranium Acid Leach Amenability
No. 1141-75

Sample No. 1141-19-12A, 0.097% U_3O_8

Composite 894-5, 1813-4, 1818-9

Conditions: 30°C, 10 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄	NaClO ₃
				Cum lb/ton	Cum lb/ton
0	30			60	1.5
1	30				
2	30				
3	30				
4	30				
6	30				
8	30				
10	30				

Metallurgical Balance

	Weight/ Volume	Uranium	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
		U ₃ O ₈					
Leach head							
%		0.097					
Gram	600	0.582	18.0				
Raffinate							
g/l		0.238	5.3				
Gram	1000	0.238	5.3				
Filtrate							
g/l		0.451	3.2				
Gram	1580	0.713	5.1				
Wash							
g/l		0.122					
Gram	800	0.098	0.7				
Residue							
Total		0.0015					
Gram	582.0	0.009					
Percent solubilized							
— hour		98.5					
Calculated head, %		0.097					
Acid consumption, 58 lb/ton							

Uranium Acid Leach Amenability
No. 1141-77

Sample No. 1141-19-12A, 0.097% U₃O₈

Composite 894-5, 1813-4, 1818-9

Conditions: 30°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0	30			60	1.75	
1	30					
2	30					
3	30					
4	30					
6	30					

Metallurgical Balance

	Weight/Volume	Uranium U ₃ O ₈	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	18.0				
Filtrate							
g/l		0.763	4.0				
Gram	440	0.335	1.8				
Wash							
g/l		0.183					
Gram	1050	0.192	1.0				
Residue							
12-hour							
+150-mesh, %							
-150-mesh, %							
Total		0.0065					
Gram	590.0	0.039					
Percent solubilized							
6 hour		93.2					
hour							
hour							
hour							
Calculated head, %		0.094					
Acid consumption, 51 lb/ton							

Uranium Acid Leach Amenability
No. 1141-78

Sample No. 1141-19-12A, 0.097% U₃O₈
Composite 894-5, 1813-4, 1816-9
Conditions: 30°C, 6 hr, 50% solids

Data

Flapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0	30			60	1.5	
1	30					
2	30					
3	30					
4	30					
6	30					

Metallurgical Balance

	Weight Volume	Uranium U ₃ O ₈	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	18.0				
Filtrate							
g/l		0.669	4.8				
Gram	420	0.281	2.0				
Wash							
g/l		0.203					
Gram	1020	0.207	1.5				
Residue							
12-hour							
+150-mesh, %							
-150-mesh, %							
Total		0.0130					
Gram	584.9	0.076					
Percent solubilized							
6 hour		86.5					
hour							
hour							
hour							
Calculated head, %		0.094					
Acid consumption, 48 lb/ton							

Uranium Acid Leach Amenability
No. 1141-79

Sample No. 1141-19-12A, 0.097% U₃O₈

Composite 894-5, 1813-4, 1818-9

Conditions: 30°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cu lb/ton
0	30			65	1.5	
1	30					
2	30					
3	30					
4	30					
6	30					

Metallurgical Balance

	Weight/ Volume	Uranium U ₃ O ₈	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582					
Filtrate							
g/l		0.558	5.9				
Gram	435	0.243	2.6				
Wash							
g/l		0.130					
Gram	1030	0.133	1.4				
Residue							
12-hour							
+150-mesh, %							
-150-mesh, %							
Total		0.0125					
Gram	583.7	0.073					
Percent solubilized							
6 hour		83.7					
hour							
hour							
hour							
Calculated head, %		0.075					
Acid consumption, 52 lb/ton							

Uranium Acid Leach Amenability
No. 1141-80

Sample No. 1141-19-12A, 0.097% U_3O_8

Composite 884-5, 1813-4, 1818-9

Conditions: 30°C, 6 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0	30			60	2	
1	30					
2	30					
3	30					
4	30					
6	30					

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	18.0				
Filtrate							
g/l		0.820	3.8				
Gram	455	0.373	1.7				
Wash							
g/l		0.169					
Gram	1040	0.176	0.8				
Residue							
12-hour							
+150-mesh, %							
-150-mesh, %							
Total		0.0121					
Gram	582.1	0.070					
Percent solubilized							
6 hour		88.6					
hour							
hour							
hour							
Calculated head, %		0.103					
Acid consumption, 52 lb/ton							

Uranium Acid Leach Amenability
No. 1141-81b

Sample No. 1141-19-12A, 0.097% U₃O₈

Composite 894-5, 1813-4, 1818-9

Conditions: 30°C, 2 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0	30			60	2	
1	30					
2	30					

Metallurgical Balance

	Weight/ Volume	Uranium U ₃ O ₈	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	18.0				
Filtrate							
g/l		0.648	4.4				
Gram	505	0.327	2.2				
Wash							
g/l		0.307					
Gram	555	0.170	1.2				
Residue							
12-hour							
+150-mesh, %							
- 30-mesh, %							
Total		0.0084					
Gram	204.9	0.050					
Percent solubilized							
2 hour		90.9					
hour							
hour							
hour							
Calculated head, %		0.091					
Acid consumption, 49 lb/ton							

Uranium Acid Leach Amenability
No. 1141-82a

Sample No. 1141-19-12a, 0.097% U₃O₈

Composite 894-5, 1813-4, 1818-9

Conditions: 30°C, 4 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄	NaClO ₃	Cum lb/ton
				Cum lb/ton	Cum lb/ton	
0	30			60	2	
1	30					
2	30					
3	30					
4	30					

Metallurgical Balance

	Weight/ Volume	Uranium					
		U ₃ O ₈	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	18.0				
Filtrate							
g/l		0.736	3.5				
Gram	445	0.328	1.6				
Wash							
g/l		0.208					
Gram	510	0.139	0.7				
Residue							
4 -hour		0.0076					
+150-mesh, %							
-150-mesh, %							
Total							
Gram	593	0.045					
Percent solubilized							
4 hour		91.2					
hour							
hour							
hour							
Calculated head, %		0.085					
Acid consumption, 53 lb/ton							

Uranium Acid Leach Amenability
No. 1141-82b

Sample No. 1141-19-12a, 0.097% U_3O_8

Compos: 894-5, 1813-4, 1818-9

Conditions: 30°C, 4 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0	30			60	2	
1	30					
2	30					
3	30					
4	30					

Metallurgical Balance

	Weight/Volume	Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	18.0				
Filtrate							
g/l		0.756	4.5				
Gram	445	0.336	2.0				
Wash							
g/l		0.307					
Gram	530	0.163	1.0				
Residue							
4-hour		0.0064					
+150-mesh, %							
-150-mesh, %							
Total							
Gram	586	0.038					
Percent solubilized							
hour		92.9					
hour							
hour							
hour							
Calculated head, %		0.090					
Acid consumption, 50 lb/ton							

Uranium Acid Leach Amenability
No. 1141-100

Sample No. 1141-19-12, 0.097% U_3O_8
Composite 894-5, 1813-4, 1818-9
Conditions: 30°C, 2 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted		emf/mv	H ₂ SO ₄	NaClO ₃	Cum lb/ton
					Cum lb/ton	Cum lb/ton	
0	30	8.2	0.82		75	2	
1	30	0.95		460			
2	30	1.01		490			

	Weight/ Volume	Metallurgical Balance				
		Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe Fe ²⁺
Leach head						
%		0.097				
Gram	600	0.582	22.5			
Filtrate						
g/l		0.843	10.5			
Gram	480	0.405	5.0			
Wash						
g/l		0.149				
Gram	1150	0.171	2.1			
Residue						
2-hour		0.0056				
+150-mesh, %						
-150-mesh, %						
Total						
Gram	585.5	0.033				
Percent solubilized						
hour						
hour						
hour						
2 hour		94.6				
Calculated head, %		0.101				
Acid consumption, 51 lb/ton						

Uranium Acid Leach Amenability
No. 1141-101

Sample No. 1141-19-12, 0.097% U_3O_8
Composite 894-5, 1813-4, 1816-9
Conditions: 30°C, 2 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄	NaClO ₃	Cum lb/ton
				Cum lb/ton	Cum lb/ton	
0	30	8.2	0.82	75	2	
1	30	0.94	460			
2	30	1.00	490			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head		0.097					
%							
Gram	600	0.582	22.5				
Filtrate		0.829	11.0				
g/l							
Gram	480	0.398	5.3				
Wash		0.139					
g/l							
Gram	1100	0.153	2.0				
Residue		0.0033					
2-hour							
+150-mesh, %							
-150-mesh, %							
Total							
Gram	589.3	0.019					
Percent solubilized		96.6					
2 hour							
hour							
hour							
hour							
Calculated head, %		0.095					
Acid consumption, 51 lb/ton							

Uranium Acid Leach Amenability
No. 1141-102

Sample No. 1141-19-12, 0.097% U_3O_8
Composite 894-5, 1813-4, 1818-9
Conditions: 30°C, 4 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted	emf/mv	H ₂ SO ₄ Cum lb/ton	NaClO ₃ Cum lb/ton	Cum lb/ton
0	30	8.2	0.82	75	2	
1	30	0.95	460			
2	30	1.00	480			
3	30	1.03	490			
4	30	1.05	495			

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	22.5				
Filtrate							
g/l		0.843	8.6				
Gram	440	0.371	3.8				
Wash							
g/l		0.176					
Gram	1000	0.176	1.6				
Residue							
4 hour		0.0050					
+150-mesh, %							
-150-mesh, %							
Total							
Gram	587.5	0.029					
Percent solubilized							
hour							
hour							
hour							
4 hour		94.9					
Calculated head, %		0.096					
Acid consumption, 56 lb/ton							

Uranium Acid Leach Amenability
No. 1141-103

Sample No. 1141-19-12, 0.097% U_3O_8
Composite 894-5, 1813-4, 1818-9
Conditions: 30°C, 4 hr, 50% solids

Data

Elapsed Time, hr	Temperature °C	Read/Adjusted		emf/mv	H ₂ SO ₄	NaClO ₃
					Cum lb/ton	Cum lb/ton
0	30	8.2	0.82		75	2
1	30	0.94		460		
2	30	1.01		480		
3	30	1.03		490		
4	30	1.05		495		

	Weight/ Volume	Metallurgical Balance					
		Uranium U_3O_8	H ₂ SO ₄	Mo	P ₂ O ₅	Fe	Fe ²⁺
Leach head							
%		0.097					
Gram	600	0.582	22.5				
Filtrate							
g/l		0.839	10.5				
Gram	440	0.369	4.6				
Wash							
g/l		0.198					
Gram	1100	0.218	2.7				
Residue							
4 hour		0.0050					
+150-mesh, %							
-150-mesh, %							
Total							
Gram	585.7	0.029					
Percent solubilized							
hour							
hour							
hour							
4 hour		95.2					
Calculated head, %		0.103					
Acid consumption, 51 lb/ton							

APPENDIX B
FILTRATION DATA

B-1

Top Feed Filtration Test

Test No., 1141-	83-1	2	3	4	84-1	2	3	4	85-1	2	3	4	86-1	2	3	4
Filter cloth																
Flocculant, lb/T lb/ton	Pb-1641 0.07	0.15	0.25	0.25	Jag-333 0.07	0.15	0.25	0.25	Jag-MDD 0.07	0.15	0.25	0.25	Fb-1080 0.07	0.15	0.25	0.25
Pulp volume	48	47	45	46	48	46	46	44	48	48	47	46	46	48	47	47
% solids	48	47	45	46	48	46	46	44	48	48	47	46	46	48	47	47
Wash volume	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50	50
Times																
Dewater	90	40	10	37	95	60	45	33	140	43	21	90	105	52	22	81
Wash	140	38	7	20	127	65	46	31	210	40	12	55	225	88	23	56
Dry	60	60	60	60	60	60	60	60	60	60	15	15	10	10	10	10
Total	290	138	77	117	282	185	151	124	410	143	48	155	340	150	55	147
Primary filtrate																
Volume	76	70	78	128	71	77	78	86	73	70	78	133	74	68	66	128
Clarity	Turbid	Turbid	Cloudy	Turbid	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy	Cloudy
Wash filtrate																
Volume	56	59	59	73	61	60	60	54	59	57	50	64	52	52	55	66
Clarity																
Cake																
Thickness, in.	1/4	1/4	5/16	9/16	1/4	1/4	1/4	1/4	5/16	1/4	1/4	9/16	1/4	1/4	3/16	1/2
Wet weight	121.8	120.2	118.5	260.0	132.3	125.3	123.5	120.5	137.6	120.8	116.2	257.3	118.2	118.2	110.9	244.2
Dry weight	98.3	93.2	92.1	195.4	102.3	98.0	97.2	91.7	105.0	94.0	90.9	186.2	89.7	90.5	84.5	183.7
% moisture	19	22	22	25	23	22	21	24	24	22	22	28	24	23	23	25
Filtration rate																
Wash liquid	3.34	12.32	66.86	23.40	3.69	7.20	10.17	15.10	2.23	11.70	39.00	8.51	2.08	5.32	20.35	8.36
Dewater, solid	85.19	181.78	718.38	411.92	83.99	127.40	168.48	216.75	58.50	170.51	337.63	161.37	66.63	135.75	299.59	176.90
Total, solid	26.44	52.68	93.30	130.27	28.21	41.32	50.21	57.68	19.98	51.27	147.71	93.70	20.58	47.06	119.84	97.47