CONTACT INFORMATION
Mining Records Curator
Arizona Geological Survey
3550 N. Central Ave, 2nd floor
Phoenix, AZ, 85012
602-771-1601
http://www.azgs.az.gov
inquiries@azgs.az.gov

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HAZEN RESEARCH, INC.

4601 INDIANA STREET
GOLDEN, COLORADO • 80401
TELEPHONE 303/279-4501

HRI Project 4133
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J. ABRAMO
AUG 22 1977
Mgr. Met. Opr.

ALKALINE LEACHING OF ANDERSON MINE SAMPLES

for

Minerals Exploration Company
Box 54945
Los Angeles, California 90054

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Prepared by:

Robert Balderrama
Research Engineer

Approved by:

John E. Litz
Project Manager

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INTRODUCTION AND SUMMARY

A metallurgical test program was authorized in October, 1976, by Minerals Exploration Company relative to the alkaline leach amenability of bulk and drill core samples from Anderson Mine near Wickenburg, Arizona.

Evaluation of alkaline leach tests on bulk samples from the Middle and Lower Zones showed that temperature was the most significant variable, with the uranium dissolution increasing with temperature. The data also indicate that sodium carbonate addition should be a minimum of 120 lb/ton (30 g/l Na_2CO_3 at 33% solids). Alkaline leaching of the Middle Zone gave uranium extractions of 96%; whereas, the Lower Zone extractions were about 94-95%.

A series of tests was performed on fourteen individual drill core samples considered to be representative of the Anderson Mine ore body. The results indicate uranium extractions ranging from 73 to 90%.

Leach studies on area composites from a set of 18 fresh drill cores showed uranium solubilizations of more than 90%. The optimum leach conditions were:

Size	Minus 65-mesh
Oxidant	Oxygen
Retention time	16 hours
Temperature	80°C
Cupric sulfate	2 lb/ton
Ammonia	2 lb/ton
Sodium carbonate	160-200 lb/ton
Sodium bicarbonate	40 lb/ton

The leach solutions all contain a significant amount of soluble organics which appear to inhibit the precipitation of sodium diuranate. Organic removal studies indicated that activated carbon or surfactants Aerosol C-61 and Arquad T-2C-50 are effective in removing the organic, but the amounts used are not economically practical.

Roasting the ore before alkaline leaching was also effective in eliminating the alkaline soluble organics, but roasting at temperatures above 350°C was detrimental to uranium solubilization.

DESCRIPTION OF ORE SAMPLES

BULK SAMPLES (MIDDLE ZONE AND LOWER ZONE)

There are two principal horizons known as the Middle Zone and the Lower Zone in the Anderson ore deposit. Two bulk samples were received from the ore body representing these zones. The analyses of these samples were as follows:

Chemical Analyses, %	Middle Zone	Lower Zone
U_3O_8, analyzed	0.039	0.043
U_3O_8, average calculated	0.045	0.050
V_2O_5	0.07	0.14
Mo	0.001	0.001
CO_2	0.75	3.20
Fe	3.05	3.06

CORE SAMPLES

Cores from 14 holes were received on November 18, 1976. On intervals where the core was crushed, three-fourths of the coarse reject and all the fine reject was used to prepare individual composites. Where the core was split, one-fourth was saved and the remaining core and rejects were used for individual composites. These core composites provided the samples for the second stage of leach studies. Analysis of the composites are listed below:

Hole No. AM-	Grade % U_3O_8	% CO_2
1C	0.025	13.4
7C	0.047	0.24
13C	0.027	9.2
16C	0.035	9.6
17C	0.041	1.9
18C	0.063	15.5
26C	0.115	14.3
49C	0.075	17.3
51C	0.018	12.0
113C	0.045	0.63
119C	0.125	13.3
135C	0.086	5.0
149C	0.055	0.34
Average	0.058	-
Grade weighted average	0.058	-

AREA COMPOSITES 1, 2, AND 3

Eighteen fresh drill cores were received on December 1, 1976, and January 17, 1977. Information was supplied to Hazen Research by Mr. G. C. Dohm, Jr., on the desired holes and footages to be combined to give three composites representing potential periods of mining. One-fourth of each drill core was saved and the remainder was used to make the three composites.

The samples were analyzed chemically for uranium, vanadium, molybdenum, and carbonate content and by semi-quantitative X-ray fluorescence analysis for minor elements. The analyses are shown in the following table.

Analysis	Percent		
Mining Period	Composite 1 Early	Composite 2 Middle	Composite 3 Late
U_3O_8	0.039	0.054	0.058
V_2O_5	0.06	0.09	0.11
Mo	0.002	0.007	0.006
CO_2	11.4	9.7	5.5
Copper	0.014	0.021	0.014
Zinc	0.020	0.026	0.022
Arsenic	0.001	0.011	0.012
Iron	1.4	1.7	1.7
Nickel	0.040	0.086	0.014
Rubidium	0.011	0.014	0.021
Barium	0.072	0.077	0.099
Strontium	0.060	0.120	0.110
Titanium	0.110	0.066	0.130
Zirconium	0.024	0.036	0.034
Molybdenum	0.002	0.006	0.008
Uranium	0.025	0.042	0.067
Manganese	0.051	0.025	0.044
Yttrium	0.006	0.006	0.006
Lead	-	0.016	0.010
Vanadium	-	0.071	0.008
Chromium	-	0.007	0.044

DISCUSSION OF TEST RESULTS

LEACHING OF MIDDLE ZONE AND LOWER ZONE COMPOSITES

Two bulk samples were received representing the Middle and Lower Zones of the Anderson Mine ore deposit. A series of Na_2CO_3/ $NaHCO_3$ leach tests were designed to study the variables which can affect the solubilization of values during the leaching of uranium-vanadium ores.

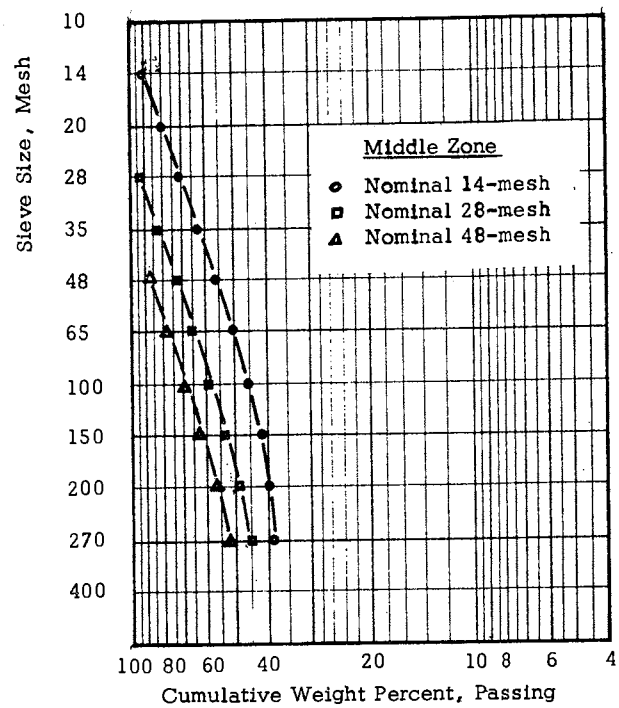
Splits were taken from each blend and dry-ground to nominal 14-, 28-, and 48-mesh sizes. Figure 1 plots the screen analyses of the three sizes for each ore.

The variables studied during the alkaline leaches included:

Temperature
Retention time
Ore size
Lixiviant concentration

The alkaline leaching procedure was to pulp the dry ore in water at 33% solids, bring the pulp up to temperature, add the reagents and digest for a predetermined time with air bubbling through the pulp at 10-20 cc/min (0.6-1.3 cfm/ton). At the conclusion of the leach, the pulp was filtered and washed with two displacements of three g/l sodium carbonate solution.

Screen Analysis of Middle and Lower Zones
Anderson Mine Composites



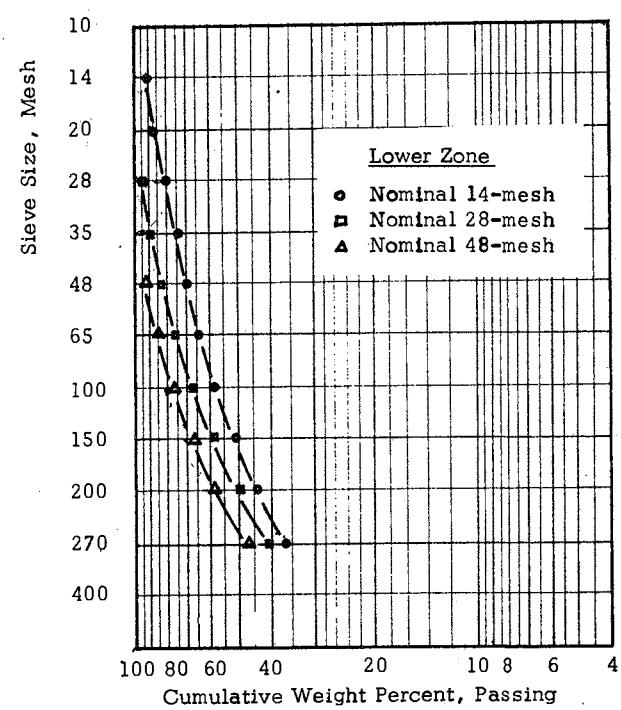


Figure 1

The results from each series of tests are tabulated in Appendix 1, Table A-1. The effects of each variable on the uranium and vanadium extractions were determined by fitting a logarithmic least square curve to the data. The quality of the fit was evaluated by calculating the Coefficient of Determination for each curve. The Coefficient of Determination, r^2, estimates the decimal percentage of the variance of the dependent variable which can be explained by changes in the independent variable. The closer r^2 is to unity, the more variance is explained. Values of r^2 approaching zero indicate the fit of the data has no statistical significance.

The effect of retention time on the leaching of uranium is plotted in Figure 2. The data indicate a slight decrease in uranium extraction with extended leaching time; however, the Coefficients of Determination do not show this to be statistically significant.

Effect of Time on Carbonate
Leaching of Anderson Mine Composites

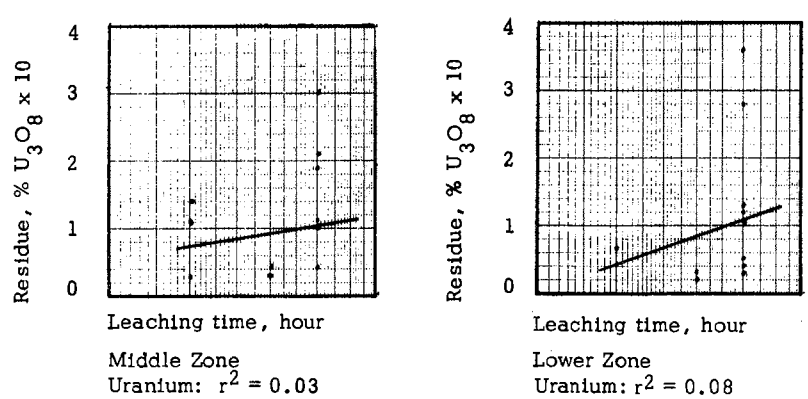


Figure 2

The effect of ore size on the leaching of uranium is plotted in Figure 3. The data indicate that the size had no effect on the uranium extraction.

Effect of Grind on Carbonate
Leaching of Anderson Mine Composites

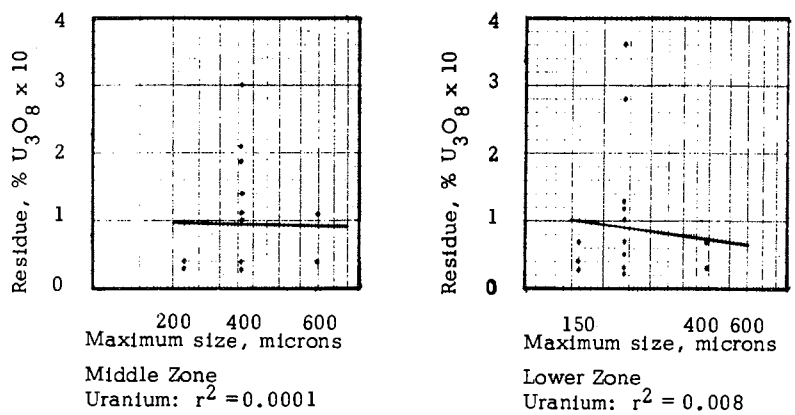
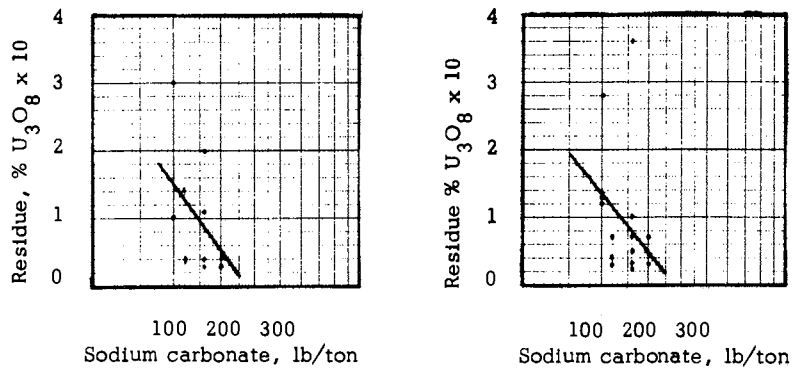


Figure 3

The effect of the sodium carbonate addition of the uranium leaching is plotted in Figure 4. Both ore zones show increasing uranium solubilization with increasing sodium carbonate addition; however, the lowest residual values also were achieved in leaches with low sodium carbonate additions, 120 lb/ton.

Effect of Sodium Carbonate
on Leaching of Anderson Mine Composites



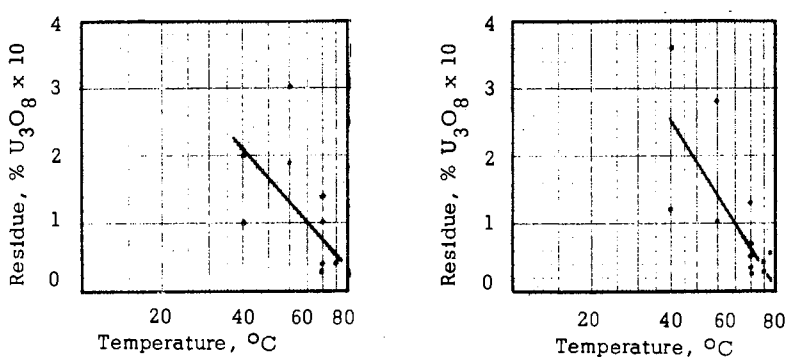
Middle Zone
Uranium: $r^2 = 0.19$

Lower Zone
Uranium: $r^2 = 0.10$

Figure 4

The effect of temperature on the leaching of the uranium is plotted in Figure 5. Both ore zones show increasing uranium extraction with increasing temperature.

Effect of Temperature
on Leaching of Anderson Mine Composites



Middle Zone
Uranium: $r^2 = 0.40$

Lower Zone
Uranium: $r^2 = 0.59$

Figure 5

Evaluation of the alkaline leaching results showed that temperature was the most significant variable with the uranium dissolution increasing with increasing temperature. The data also indicate that the sodium carbonate addition should be a minimum of 120 lb/ton (30 g/l Na_2CO_3 at 33% solids). Alkaline leaching of the Middle Zone gave uranium extractions of 96%; whereas, the Lower Zone extractions were about 94-95%.

Analysis of the leaching data indicated that the optimum conditions appeared to be 80°C for 16 hours, 33% solids, using ore ground to 80% passing 48-mesh, with a sodium carbonate addition of 120-160 lb/ton (30-40 g/l). Tests were run during the above program which approximated these conditions. Ninety-five percent of the uranium was extracted from the Middle Zone ore and ninety-four percent was extracted from the Lower Zone ore.

LEACHING INDIVIDUAL DRILL CORE SAMPLES

A series of alkaline leaching tests was run on 28-mesh individual drill core composites. Common conditions for leaching were chosen from the best results on leaching composites from the Middle Zone and Lower Zones, 33% solids, 80°C for 16 hours with fixed reagent additions of 160 lb/ton Na_2CO_3 and 40 lb/ton $NaHCO_3$.

The uranium extractions for the alkaline leaches are summarized below and the detailed data are tabulated in Appendix 1, Table A-2.

Extraction of Uranium from
Various Core Hole Composites

Hole No. AM-	Grade % U_3O_8	% CO_2	Percent of Uranium Solubilized Alkaline Leach 1/
1C	0.025	13.4	86.2
7C	0.047	0.24	79.2
13C	0.027	9.2	83.0
16C	0.035	9.6	72.6
17C	0.041	1.9	89.8
18C	0.063	15.5	85.5
26C	0.115	14.3	84.6
49C	0.075	17.3	82.2
51C	0.018	12.0	81.7
113C	0.045	0.63	79.6
119C	0.125	13.3	89.8
135C	0.086	5.0	84.7
149C	0.055	0.34	75.8
Average	0.058	-	82.6
Grade weighted average	0.058	-	83.5

1/ Reagent addition: 160 lb/ton Na_2CO_3 and 40 lb/$NaHCO_3$.

The data show reasonable amenability of these samples to alkaline leaching with uranium solubilizations of 73% to 90%. The presence of organic matter was noticeable in most of the leach solutions and uranium extractions were lower than from the Middle and Lower Zone samples.

DRILL CORE COMPOSITE

A series of tests was designed to evaluate the Atlas Minerals' process and the effect of temperature, retention time, and roasting the ore before leaching on the uranium extraction.

A composite was made using analytical pulp rejects from the following drill core samples:

Hole No. AM-	HRI No.
1C	10647
26C	10653
51C	10655
135C	10659
149C	10660

A head sample, taken from this composite, has the following analysis:

Composite No.	U_3O_8 %	V_2O_5 %	CO_2 %
976-100-0	0.058	0.083	10.0

ATLAS MINERALS ALKALINE LEACH

Two alkaline leaches were carried out using Atlas Minerals' procedure on 300 grams of composite at 33% solids heating to 80°C over a two-hour period, followed by an autoclave pressure leach at 120°C, 50 psig of air or oxygen, with 160 lb/ton Na_2CO_3 and 32 lb/ton $NaHCO_3$ for six and one-half hours retention time. As an

oxidation catalyst, 2.7 lb/ton of cupric sulfate and 0.5 lb/ton NH_4OH were added. These tests show uranium solubilizations of 89.3% and 92.7%, respectively. They are listed in Appendix 1, Table A-3, as Tests 976-100 and 976-104. The use of oxygen in Test 976-104 gave better uranium extraction.

EFFECT OF TEMPERATURE

Two agitation leach tests were run to evaluate the effect of temperature, 80°C, and the boiling point, on leaching the uranium. Conditions were 33% solids, 24 hours retention with 160 lb/ton Na_2CO_3, 40 lb/ton $NaHCO_3$, plus 8 lb/ton cupric sulfate, and 8.7 lb/ton NH_4OH as an oxidation catalyst. Air was used at 10-20 cc/min bubbling through the pulp. The results of these tests show that a temperature higher than 80°C is detrimental to uranium solubilization. These tests are tabulated in Appendix 1, Table A-3, as Tests 976-101 and 976-102.

An agitation leach test was performed, as above, with 10-20 cc/min oxygen bubbling through instead of air. This test, listed in Appendix 1, Table A-3, as Test 976-103, shows that only 63.6% of uranium was solubilized.

EFFECT OF RETENTION TIME

A series of six tests was made to evaluate the effect of retention time on leaching. Conditions were 33% solids, 80°C, 4 to 48 hours retention time, with 160 lb/ton Na_2CO_3, 40 lb/ton Na_2HCO_3. Eight lb/ton cupric sulfate and 8.7 lb/ton NH_4OH was added as an oxidation catalyst. Tests 976-106 through 976-111 in Appendix 1, Table A-3, show an increasing uranium solubilization from 89% up to 95% with increasing retention time.

ROASTING

Roasting tests were made at 350°C, 450°C, and 550°C, two hours retention time with 500 cc/min of air flow. An alkaline agitation leaches were performed to evaluate the leaching characteristics of the calcine. The results of these tests, tabulated as 976-113, 976-114, and 976-115 in Appendix 1, Table A-3, show that temperatures above 350°C are detrimental to uranium solubilization. However, roasting did eliminate the alkaline soluble organics from the ore.

LEACHING OF AREA COMPOSITES 1, 2, AND 3

Fresh drill core samples from the Anderson Mine were received on December 1, 1976, and January 17, 1977, for amenability testing. One-fourth of each drill core sample was saved and the remaining drill cores and their rejects were used to make three area composites. Each composite was crushed to pass 6-mesh. Portions were split out for head samples and the balance of the sample was ground to give a nominal 28-mesh grind and provided the feed for the leach amenabilities.

A series of alkaline agitation leaching tests were performed on each of the 28-mesh drill core composites at 33% solids for 16 hours at 80°C, with reagent additions varying from 160 to 200 lb/ton Na_2CO_3. As an oxidation catalyst 2 to 8 lb/ton of cupric sulfate and 2 to 8.7 lb/ton ammonia was added, with air or oxygen bubbling through at 10-30 cc/min. The results of these tests are tabulated in Appendix 1, Table A-4, as Tests 1009-11 through 1009-21. They show the good amenability of Composite 1, with uranium solubilizations over 90%. Composites 2 and 3 show that more oxidation is required for good uranium solubilization. Tests 1009-18 and 1009-19 had uranium solubilizations of 94.1% and 89.3%.

A series of 16 tests was carried out to evaluate ore size and addition at different levels of oxidation catalyst with air or oxygen bubbling through the pulp. The results of these tests are tabulated in Appendix 1, Table A-4, as 1009-25 through 1009-46, and they show that minus 65-mesh is the optimum ore size and oxygen is a better oxidant than air. Tests 1009-44 through 1009-46 show uranium solubilizations over 90% for the three composites.

REAGENT ADDITION OPTIMIZATION

Additional alkaline leaching tests on Anderson Mine drill core minus 65-mesh ore composite from area 3 were performed to evaluate optimum reagent additions, and the effect of different levels of oxygen as an oxidant. The results of these tests are summarized in the following table and the detailed data are tabulated in Appendix 1, Table A-5.

Test No. 1009-	Solids %	Na_2CO_3 lb/ton	$NaHCO_3$ lb/ton	$CuSO_4 \cdot 5H_2O$ lb/ton	Ammonia lb/ton	Oxygen cc/min	Residual U_3O_8 %	Extraction U_3O_8 %
48 1/	50	100	20	2	4	(10-30)	0.008	87.7
49 1/	50	150	30	2	4	(10-30)	0.005	91.4
50 1/	50	200	40	2	4	(10-30)	0.005	91.8
54	40	120	30	2	2	(10-30)	0.009	83.0
55	40	120	30	4	2	(10-30)	0.008	85.1
56	40	150	30	2	2	(10-30)	0.007	86.6
57	40	150	30	4	2	(10-30)	0.006	88.5
58	40	150	30	2	2	10	0.006	87.5
59 2/	40	150	30	2	2	20	0.006	89.8
60 3/	40	150	30	2	2	30	0.006	89.9
61	40	150	30	2	2	40	0.006	90.0

1/ 50% solids mechanically difficult to keep pulp mixing.
2/ 2 lb/ton MgO added during leach.
3/ 4 lb/ton MgO added during leach.

The data clearly show uranium solubilizations of 90% with reagent additions at 150 lb/ton Na_2CO_3, 30 lb/ton $NaHCO_3$, 2 lb/ton $CuSO_4 \cdot 5\ H_2O$, and 2 lb/ton ammonia. Oxygen addition, as an oxidant, has to be maintained at flow rates between 20 cc/min to 40 cc/min of oxygen. Analysis of the leach solutions showed Na_2CO_3 consumptions of 37 to 83 lb/ton.

ROASTING AND ALKALINE LEACHING OF COMPOSITE 3

Three alkaline leaches were performed on minus 65-mesh calcined ore, Composite 3, to evaluate the effect of roasting at temperatures of 350°C, 375°C, and 400°C. The results of these tests are summarized in Table 1, and the detailed data are tabulated in Appendix 1, Table A-6.

Table 1

Effect of Roasting on Composite 3
Anderson Mine Ore

Test No. 1009-	Roasting Temperature °C	Residual U_3O_8 %	Extraction U_3O_8 %
65	350	0.010	81.7
71	375	0.012	79.9
66	400	0.011	81.7

The low uranium extractions in these tests indicate that roasting this ore composite before leaching is detrimental to uranium solubilization.

THICKENING AND FILTRATION TESTS

Thickening tests were performed on leached pulps from area composites 1, 2, and 3. These tests do not show good unit areas. The results are summarized in the following table, and the detailed data are tabulated in Appendix 2, Table A-2.

Thickening Tests on Anderson Mine
Area Composites 1, 2, and 3

Test No. 1009-	lb/ton Arquad T-50	lb/ton MGL	Terminal Density % Solids	Unit Area ft^2/ton/day
35	6.7	0.07	53.3	7.98
36	6.7	0.07	56.4	9.34
37	6.7	0.07	53.7	8.50
38	13.4	0.14	55.0	5.10
39	13.4	0.14	62.2	5.90
40	13.4	0.14	57.8	10.5

Filtration tests on leached pulp from area composite 3 were performed. The results of these tests show poor solids filtration rates of 85 to 131 lb/sq ft/24 hr, see test data in Appendix 2, Table A-7.

ORGANIC REMOVAL

Throughout the alkaline leach studies, a continuing problem was the large amount of soluble organics observed in leach solutions. A series of tests was designed in an attempt to remove this organic from these leach solutions. Surfactants and flocculants were tested. Flotation, magnesium oxide, and activated carbon absorption also were evaluated.

SURFACTANTS AND FLOCCULANTS

A composite was made using solutions from alkaline leach Tests 976-85 through 976-104. Fifty ml samples of this composite were contacted with each reagent at concentrations of 1 g/l and 10 g/l, 0.04 lb/ton of flocculant AP-30 from Dow added, and the centrifuge was used for clarification. Samples were evaluated with Bausch and Lomb Spectronic 20 colorimeter measuring the percent transmittance. The results of these tests are tabulated in Table 2.

Table 2

Colorimetric Evaluation of Organic Removal from Alkaline Leach Solution

	1 g/l		10 g/l	
	Addition of Solution lb/ton	Transmittance %	Addition of Solution lb/ton	Transmittance %
Aerosol C-61	1.2	4.0	4.0	3.5
Polyox 1431	1.2	1.0	4.0	1.5
MRL-91	1.2	2.5	4.0	2.0
Polyhall M-630	1.2	1.2	4.0	1.0
Arquad T-2C-50	1.2	0.5	4.0	3.5

The results of these tests indicate that Aerosol C-61 and Arquad T-2C-50 appear to be effective in removing the organic matter, but the reagent additions are uneconomical and not practical. The coagulated organic material removed from one liter of leach solution was 1.28 g and contained 0.51% U_3O_8 with a heat value of 14,700 Btu/lb.

FLOTATION

A single flotation test was performed for organic removal on solution after uranium precipitation. Arquad T-2C-50, as a surfactant, at 0.4 lb/ton and 0.01 lb/ton of kerosene was used. Organic removal was poor and colorimetric evaluation of solution gave only a 10% transmittance.

MAGNESIUM OXIDE

An additional alkaline leach test was carried out to evaluate the efficiency of MgO using 20 lb/ton addition at the end of leaching. No significant improvement was observed in organic removal. The residue filtration rate was 85 to 131 lb/sq ft/24 hr, see test data in Appendix 2, Table A-7.

ACTIVATED CARBON

Four-stage countercurrent carbon treatment for organic removal from alkaline leach liquor before and after uranium precipitation was carried out. Granular activated carbon, manufactured by Atlas Chemical Industries, Darco grade 12 x 40 at 50 g/l and 100 g/l was used in all these tests. Samples were evaluated with a spectronic 20 colorimeter as a percent transmittance. The results of these tests are tabulated in Table 3.

Table 3

Four-stage Countercurrent Carbon Treatment for Organic Removal from Alkaline Uranium Leach Liquor

Cycle	Before Uranium Precipitation 100 g/l Carbon % Transmittance	Before Uranium Precipitation 50 g/l Carbon % Transmittance	After Uranium Precipitation 100 g/l Carbon % Transmittance
1st	95.0	55.0	99.0
2nd	92.5	4.5	80.0
3rd	91.0	-	-
4th	84.5	-	-

The data above indicate that high carbon dosages would be required for a good organic removal. Because of poor organic removal in two tests, only two cycles were conducted.

YELLOW CAKE PRECIPITATION

A composite was made combining filtrate and wash solutions from alkaline leach tests 1009-11 through 1009-21. A sample taken from this composite analyzed 0.121 g/l uranium. Direct caustic uranium precipitation, precipitation after organic removal with Arquad T-2C-50, and precipitation after organic removal with Arquad-T2C-50 and activated charcoal was performed using one liter composite for each test. The results are tabulated below:

Description	Temperature °C	U_3O_8 g/l	Uranium Precipitation %
Direct precipitation	85	0.0081	93.3
Direct precipitation	90	0.0140	87.6
After Arquad T-2C-50	85	0.0254	63.6
After Arquad T-2C-50 and charcoal	85	0.0094	90.0

The data clearly show that at 85°C over 90% of the uranium can be precipitated directly from alkaline leach liquor with an excess of caustic addition and that higher temperatures appear to be detrimental. Precipitation after Arquad T-2C-50 and charcoal shows that only 90% of the uranium could be precipitated.

APPENDIX 1

Table A-1-1

Alkaline Leach Data
Anderson Mine Middle Zone and Lower Zone

Hole No.	-	-	-	-	-	-	-	-	-	-	-	-	-
Test No.	976-5	976-6	976-7	976-8	976-13	976-14	976-15	976-16	976-21	976-22	976-23	976-24	976-49
HRI Sample No.	10490-1	10490-2	10490-1	10490-2	10490-1	10490-2	10490-1	10490-2	10490-1	10490-2	10490-1	10490-2	10490-1
Head Analysis													
% Uranium	0.039	0.043	0.039	0.043	0.039	0.043	0.039	0.043	0.039	0.043	0.039	0.043	0.039
% Vanadium	0.07	0.14	0.07	0.14	0.07	0.14	0.07	0.14	0.07	0.14	0.07	0.14	0.07
% Molybdenum	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001
Leach Conditions													
Leach head, g	500	500	500	500	500	500	500	500	500	500	500	500	500
Ore size, mesh	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28	-14
Temperature, ^{o}C	80	80	80	80	60	60	60	60	40	40	40	40	80
Time, hour	24	24	24	24	24	24	24	24	24	24	24	24	8
Sodium carbonate, lb/ton	100	100	160	160	100	100	160	160	100	100	160	160	160
Sodium bicarbonate, lb/ton	20	20	40	40	20	20	40	40	20	20	40	40	40
Filtrate													
Volume, ml	1150	1370	1280	1350	1520	1440	1340	1350	1240	1295	1200	1340	1100
pH	9.8	9.9	9.8	9.9	9.9	9.8	9.9	9.9	10.0	10.0	10.0	10.0	9.8
emf, mv	+60	+30	+20	-10	-20	-30	-30	-30	-30	-30	-30	-30	+150
U_3O_8, g/l	0.120	0.112	0.133	0.137	0.025	0.057	0.062	0.127	0.010	0.012	0.021	0.036	0.130
Wash													
Volume, ml	-	-	-	-	-	-	-	-	-	-	-	-	-
U_3O_8, g/l	-	-	-	-	-	-	-	-	-	-	-	-	-
Residue													
Weight, g	483.8	473.4	481.3	470.2	484.5	471.5	489.0	472.0	482.5	474.5	485.0	471.0	487.9
U_3O_8, %	0.011	0.013	0.004	0.005	0.030	0.028	0.019	0.010	0.035	0.041	0.034	0.037	0.011
Extraction													
U_3O_8, %	72.2	71.4	89.8	88.7	20.7	38.3	47.2	78.4	7.2	7.6	13.3	21.8	72.7

Table A-1-1

Hole No.	-	-	-	-	-	-	-	-	-	-	-	-	-
Test No.	976-50	976-57	976-58	976-59	976-60	976-61	976-62	976-63	976-64	976-65	976-66	976-67	976-68
HRI Sample No.	10490-2	10490-1	10490-2	10490-1	10490-2	10490-1	10490-2	10490-1	10490-2	10490-1	10490-2	10490-1	10490-2
Head Analysis													
% Uranium	0.043	0.039	0.043	0.039	0.043	0.039	0.043	0.039	0.043	0.039	0.043	0.039	0.043
% Vanadium	0.14	0.07	0.14	0.07	0.14	0.07	0.14	0.07	0.14	0.07	0.14	0.07	0.14
% Molybdenum	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001	0.001	<0.001
Leach Conditions													
Leach head, g	500	500	500	500	500	500	500	500	500	500	500	500	500
Ore size, mesh	-14	-48	-48	-28	-28	-14	-14	-28	-28	-48	-48	-14	-14
Temperature, °C	80	80	80	90	90	90	90	90	90	90	90	90	90
Time, hour	8	8	8	16	16	16	16	24	24	24	24	24	24
Sodium carbonate, lb/ton	160	200	200	200	200	120	120	160	160	120	120	200	200
Sodium bicarbonate, lb/ton	40	40	40	40	40	40	40	40	40	40	40	40	40
Filtrate													
Volume, ml	1160	1070	1060	1100	1150	1010	1010	980	1040	960	990	1080	1090
pH	9.8	9.8	9.9	9.9	9.9	9.7	9.8	9.8	9.9	9.7	9.7	9.8	9.9
emf, mv	+70	+85	+85	+75	+75	+70	+75	+70	+70	+60	+70	+60	+65
U_3O_8, g/l	0.185	0.185	0.200	0.178	0.187	0.163	0.245	0.196	0.221	0.206	0.247	0.186	0.221
Wash													
Volume, ml	-	-	-	-	-	-	-	-	-	-	-	-	-
U_3O_8, g/l	-	-	-	-	-	-	-	-	-	-	-	-	-
Residue													
Weight, g	475.4	485.7	482.5	481.6	471.9	482.0	471.7	482.0	471.0	483.0	480.0	481.5	473.0
U_3O_8, %	0.007	0.003	0.007	0.004	0.003	0.004	0.003	0.004	0.003	0.004	0.004	0.004	0.003
Extraction													
U_3O_8, %	86.6	93.1	86.3	91.0	93.8	89.5	94.6	90.9	94.2	91.1	92.7	91.3	94.4

Table A-1-2

Alkaline Leach Data
Anderson Mine Drill Core Composites

Hole No.	AM-1C	AM-7C	AM-13C	AM-16C	AM-17C	AM-18C	AM-26C	AM-49C	AM-51C	AM-79C	AM-113C	AM-119C	AM-135C	AM-149C
Test No.	976-85	976-86	976-87	976-88	976-89	976-90	976-91	976-92	976-93	976-94	976-95	976-96	976-97	976-98
HRI Sample No.	10647	10648	10649	10650	10651	10652	10653	10654	10655	10656	10657	10658	10659	10660
Head Analysis														
% Uranium	0.025	0.047	0.027	0.035	0.041	0.063	0.115	0.075	0.055	0.018	0.045	0.125	0.085	0.055
% Vanadium	0.023	0.041	0.061	0.056	0.074	0.089	0.053	0.069	0.102	0.028	0.094	0.071	0.115	0.130
% CO_2	13.4	0.24	9.2	9.6	1.9	15.5	14.3	17.3	3.3	12.0	0.63	13.3	5.0	0.34
Leach Conditions														
Leach head, g	500	200	250	190	500	500	500	500	500	210	300	260	500	500
Ore size, mesh	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28	-28
Temperature, ^{o}C	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Time, hour	16	16	16	16	16	16	16	16	16	16	16	16	16	16
Sodium carbonate, lb/ton	160	160	160	160	160	160	160	160	160	160	160	160	160	160
Sodium bicarbonate, lb/ton	40	40	40	40	40	40	40	40	40	40	40	40	40	40
Filtrate														
Volume, ml	585	270	315	200	675	550	750	720	685	200	490	455	685	690
pH	9.7	10.4	10.3	10.3	10.0	9.5	9.9	9.7	9.9	10.2	9.8	9.8	9.6	9.9
emf, mv	125	110	90	110	110	200	130	130	120	112	140	150	0	120
U_3O_8, g/l	0.103	0.212	0.138	0.135	0.177	0.242	0.507	0.320	0.216	0.063	0.150	0.421	0.352	0.205
Wash														
Volume, ml	505	505	500	590	500	550	530	520	500	590	500	500	515	490
U_3O_8, g/l	0.060	0.033	0.032	0.029	0.103	0.205	0.205	0.162	0.121	0.025	0.058	0.106	0.163	0.119
Residue														
Weight, g	483.2	194.2	244.3	185.3	487.6	480.1	494	487.3	490.4	203.8	291.0	252.8	488.5	490.1
U_3O_8, %	0.003	0.010	0.005	0.009	0.004	0.006	0.018	0.014	0.010	0.003	0.009	0.011	0.012	0.013
Extraction														
U_3O_8, %	86.2	79.2	83	72.6	89.8	85.5	84.6	82.2	81.0	81.7	79.6	89.8	84.7	75.8

Table A-1-3

Alkaline Leach Data on Anderson Mine Drill Composite

Head analysis: Uranium, 0.058%; Vanadium, 0.083%; CO_2, 10.0%

Test No.	976-100	976-104	976-101	976-102	976-103	976-106	976-107
Sample No.	976-100-0	976-100-0	976-100-0	976-100-0	976-100-0	976-100-0	976-100-0
Leach Conditions							
Leach head, g	300	300	300	300	300	300	300
Ore size, mesh	-100	-100	-100	-100	-100	-100	-100
Temperature, °C	120	120	80	Boiling	Boiling	80	80
Oxidant	Air	Oxygen	Air	Air	Oxygen	Air	Air
Pressure, psig	50	50	-	-	-	-	-
Cupric sulfate, lb/ton	2.7	2.7	8	8	8	8	8
Ammonium hydroxide, lb/ton	0.5	0.5	8.7	8.7	8.7	8.7	8.7
Sodium carbonate, lb/ton	160	160	160	160	160	160	160
Sodium bicarbonate, lb/ton	32	32	40	40	40	40	40
Time, hr	8.5	8.5	24	24	24	4	8
Filtrate							
Volume, ml	360	550	520	370	355	475	460
U_3O_8, g/l	0.288	0.242	0.269	0.193	0.150	0.252	0.252
Residue							
Weight, g	269.6	283	294.5	295.1	293.1	294.6	292
U_3O_8, %	0.007	0.005	0.005	0.021	0.022	0.007	0.006
Reagent Consumption, lb/ton							
Sodium carbonate	-	-	-	-	-	-	-
Extraction							
U_3O_8, %	89.3	92.7	92.5	68.2	63.6	88.8	90.2

Table A-1-3

Test No.	976-108	976-109	976-110	976-111	976-113	976-114	976-115
Sample No.	976-100-0	976-100-0	976-100-0	976-100-0	976-100-0	976-100-0	976-100-0
Calcining Conditions							
Feed size, mesh	-	-	-	-	-100	-100	-100
Temperature, °C	-	-	-	-	350	450	550
Atmosphere, air cc/min	-	-	-	-	500	500	500
Time at temperature, min	-	-	-	-	120	120	120
Leach Conditions							
Leach head, g	300	300	300	300	300	300	300
Ore size, mesh	-100	-100	-100	-100	-100	-100	-100
Temperature, °C	80	80	80	80	80	80	80
Oxidant	Air	Air	Air	Air	Air	Air	Air
Cupric sulfate, lb/ton	8	8	8	8	8	8	8
Ammonium hydroxide, lb/ton	8.7	8.7	8.7	8.7	8.7	8.7	8.7
Sodium carbonate, lb/ton	160	160	160	160	160	160	160
Sodium bicarbonate, lb/ton	40	40	40	40	40	40	40
Time, hr	12	16	24	48	16	16	16
Filtrate							
Volume, ml	415	460	440	275	460	475	505
U_3O_8, g/l	0.264	0.286	0.272	0.473	0.303	0.261	0.237
Residue							
Weight, g	292.7	293.3	291.9	289.3	297.3	298.6	300
U_3O_8, %	0.006	0.005	0.005	0.004	0.006	0.013	0.019
Reagent Consumption, lb/ton							
Sodium carbonate	-	-	-	-	-	-	-
Extraction							
U_3O_8, %	90	92.6	9].1	95.0	90.7	77.6	67.2

Table A-1-4

Alkaline Leach Data on Anderson Mine Drill Core Composites 1, 2, and 3

Test No.	1009-11	1009-12	1009-13	1009-15	1009-16	1009-17	1009-18	1009-19	1009-20
Composite No.	1	2	3	1	2	3	2	3	2
Leach Conditions									
Leach head, g	300	300	300	300	300	300	300	300	300
Ore size, mesh	-28	-28	-28	-28	-28	-28	-28	-28	-28
Temperature, °C	80	80	80	80	80	80	80	80	80
Oxidant	Air	Air	Air	Air	Air	Air	Oxygen	Oxygen	Air
Leach time, hour	16	16	16	16	16	16	16	16	16
Reagent Addition, lb/ton									
Cupric sulfate	8	8	8	-	-	-	8	8	8
Ammonium hydroxide	8.7	8.7	8.7	-	-	-	8.7	8.7	8.7
Sodium carbonate	160	160	160	160	160	160	200	200	200
Sodium bicarbonate	40	40	40	40	40	40	40	40	40
Filtrate									
Volume, ml	485	335	320	390	360	420	425	412	375
U_3O_8, g/l	0.133	0.223	0.282	0.168	0.248	0.229	0.230	0.281	0.250
Residue									
Weight, g	300	296	299	297	297	296.5	306.5	284	296
U_3O_8, %	0.003	0.006	0.011	0.003	0.009	0.016	0.003	0.007	0.005
Reagent Consumption, lb/ton									
Sodium carbonate	42.5	-	-	-	-	-	82.5	57.9	-
Extraction									
U_3O_8, %	90.8	87.2	80.6	91.4	83.0	73.4	94.1	89.3	90.6

Table A-1-4

Test No.	1009-21	1009-25	1009-26	1009-27	1009-28	1009-29	1009-30	1009-31	1009-32
Composite No.	3	1	2	3	1	2	3	2	2
Leach Conditions									
Leach head, g	300	300	300	300	300	300	300	300	300
Ore size, mesh	-28	-14	-14	-14	-65	-65	-65	-28	-28
Temperature, °C	80	80	80	80	80	80	80	80	80
Oxidant	Air	Air	Air	Oxygen	Air	Air	Oxygen	Air	Air
Leach time, hour	16	16	16	16	16	16	16	16	16
Reagent Addition, lb/ton									
Cupric sulfate	8	8	8	8	8	8	8	8	4
Ammonium hydroxide	8.7	8.7	8.7	8.7	8.7	8.7	8.7	8.7	4
Sodium carbonate	200	160	160	160	160	160	160	160	200
Sodium bicarbonate	40	40	40	40	40	40	40	40	40
Filtrate									
Volume, ml	417	410	380	370	390	410	420	405	415
U_3O_8, g/l	0.249	0.147	0.274	0.294	0.163	0.250	0.280	0.232	0.229
Residue									
Weight, g	292.5	298	297	295.3	298	295.4	297	297.7	297
U_3O_8, %	0.011	0.008	0.007	0.011	0.003	0.005	0.007	0.007	0.006
Reagent Consumption, lb/ton									
Sodium carbonate	-	-	-	-	36.5	45.2	53.2	-	-
Extraction									
U_3O_8, %	82.9	78.0	87.9	83.3	92.2	91.1	88.8	86.7	88.7

Table A-1-4

Test No.	1009-33	1009-34	1009-41	1009-42	1009-43	1009-44 1/	1009-45 1/	1009-46 1/	1009-67
Composite No.	3	3	1	2	3	1	2	3	3
Leach Conditions									
Leach head, g	300	300	300	300	300	300	300	300	300
Ore size, mesh	-28	-28	-65	-65	-65	-65	-65	-65	-65
Temperature, °C	80	80	80	80	80	80	80	80	80
Oxidant	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen
Leach time, hour	16	16	16	16	16	16	16	16	16
Reagent Addition, lb/ton									
Cupric sulfate	8	4	2	2	2	2	2	2	2
Ammonium hydroxide	8.7	4	2	2	2	2	2	2	2
Sodium carbonate	160	200	200	200	200	200	200	200	150
Sodium bicarbonate	40	40	40	40	40	40	40	40	30
Filtrate									
Volume, ml	440	335	480	440	540	360	365	300	310
U_3O_8, g/l	0.244	0.303	0.167	0.230	0.243	0.210	0.267	0.370	0.290
Residue									
Weight, g	296.2	295	296.5	294.5	296	296	295	295	301
U_3O_8, %	0.010	0.010	0.004	0.004	0.007	0.002	0.005	0.006	0.007
Reagent Consumption, lb/ton									
Sodium carbonate	-	-	-	-	-	-	-	-	60
Extraction									
U_3O_8, %	83.6	84.0	89.8	92.7	89.1	94.7	90.7	90.4	87.5

1/ Test 109-44 was run at 40% solids.

Table A-1-5

Alkaline Leach Data
Anderson Mine Composite 3

Test No.	1009-48	1009-49	1009-50	1009-54	1009-55	1009-56	1009-57	1009-58	1009-59	1009-60	1009-61
Composite No.	3	3	3	3	3	3	3	3	3	3	3
Leach Conditions											
Leach head, g	300	300	300	300	300	300	300	300	300	300	300
Ore size, mesh	-65	-65	-65	-65	-65	-65	-65	-65	-65	-65	-65
Temperature, °C	80	80	80	80	80	80	80	80	80	80	80
Oxidant	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen	Oxygen
Leach time, hour	16	16	16	16	16	16	16	16	16	16	16
Reagent Addition, lb/ton											
Cupric sulfate	2	2	2	2	4	2	4	2	2	2	2
Ammonium hydroxide	4	4	4	2	2	2	2	2	2	2	2
Sodium carbonate	100	150	200	120	120	150	150	150	30	30	30
Sodium bicarbonate	20	30	40	30	30	30	30	30	30	30	30
Filtrate											
Volume, ml	275	265	295	1690	1610	1760	1745	310	250	270	300
U_3O_8, g/l	0.323	0.341	0.328	0.078	0.085	0.077	0.079	0.229	0.375	0.350	0.325
Wash											
Volume, ml	820	770	765	-	-	-	-	920	900	820	870
U_3O_8, g/l	0.092	0.092	0.093	-	-	-	-	0.052	0.062	0.069	0.064
Residue											
Weight, g	293	294	295	299	300	297.5	299.5	288.2	291	292.2	287
U_3O_8, %	0.008	0.005	0.005	0.009	0.008	0.007	0.006	0.006	0.006	0.006	0.006
Reagent Consumption, lb/ton											
Sodium carbonate	-	-	-	-	-	-	-	-	-	-	-
Extraction											
U_3O_8, %	87.7	91.4	91.8	83.0	85.1	86.6	88.5	87.5	89.8	89.9	90.0

Table A-1-6

Alkaline Leach Data
Effect of Roasting on Anderson Mine Composite 3

Test No.	1009-65[1]	1009-66[2]	1009-71[3]
Composite No.	3	3	3
Leach Conditions			
Leach head, g	300	300	300
Ore size, mesh	-65	-65	-65
Temperature, °C	80	80	80
Oxidant	Air	Air	Air
Leach time, hour	16	16	16
Reagent Addition, lb/ton			
Cupric sulfate	2	2	2
Ammonium hydroxide	2	2	2
Sodium carbonate	150	150	150
Sodium bicarbonate	30	30	30
Filtrate			
Volume, ml	215	190	285
U_3O_8, g/l	0.378	0.440	0.335
Residue			
Weight, g	300.5	302.5	300
U_3O_8, %	0.010	0.011	0.012
Reagent Consumption, lb/ton			
Sodium carbonate	62	64	63
Extraction			
U_3O_8, %	81.7	81.7	79.9

APPENDIX 2

Table A-2-1

VACUUM/PRESSURE FILTRATION TEST

Project 4133
Notebook 1009
Page 146
Date 6/21/77
By Balderrama

Filtration test of Alkaline Leached Pulp
1009-145

Apparatus

Test Number	1009-146-1	1009-146-2			Units
Filter Cloth	Popr.901-F	Popr.901-F			
Precoat:					
Type					
Thickness					
Feed:					
% solids, measured					
pH					
Temperature					
% solids, calculated					
Time:					
Form	1.0	2.0			Minutes
Dewater	0.5	1.0			"
Wash	1.0	2.0			"
Dry	0.5	1.0			"
Blow					
Total	3.0	6.0			"
To cracking from start					
Vacuum/Pressure:					
Form	16	17			psi
Wash	17	18			"
Dry	14	15			"
After cracking					
Air flow:					
Form					
Dry					
Filtrate:					
Volume	62	76			
Clarity	Clear	Clear			
Wash:					
Volume	38	54			
Clarity	Clear	Clear			
Cake:					
Thickness	1/16"	3/32"			
Wet weight	21	26.5			
Dry weight	12.4	16.0			
% moisture	41	40			
Liquid Filtration Rate:					
Form	78.6	48.2		Gal/sq ft/24 hours	
Wash	48.2	34.2		"	
Total cycle	126.8	82.4		"	
Solids Filtration Rate:					
Form					
Total cycle	131.1	84.6		Dry lb/sq ft/24 hours	

Table A-2-2

KYNCH PROCEDURE - THICKENING TEST DATA

PROJECT: 4133
NOTEBOOK: 1009
PAGE: 35
DATE: 3-15-77
BY: Balderrama

OBJECTIVE: Settling of alkaline leach pulp
Anderson Mine Composite 1

FLOCCULANT: Arquad T-50 (10 g/l) AMOUNT: 6.7 lb/ton
0.07 lb/ton

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed Pulp	Terminal Pulp	Clear Liquor
1000	0	Volume, ml	1000	270	730
980	1	Gross pulp weight, g	1792		
940	2	Tare, g	676		
900	3	Net pulp weight, g	1116	358	758
865	4	Gross dry weight, g			
825	5	Tare, g			
790	6	Net dry weight, g	144	144	
755	7	Density, g/l			1038
725	8	Solids, %	14.4	53.3	
695	9				
665	10				
625	12				
595	14				
565	16				
505	20				
445	25				
405	30				
370	35				
350	40				
335	50				
325	60				
300	90				
295	120				
290	150				
280	180				
275	240				
Terminal Level 18 hrs					

Time rake installed 1 min

Thickener rake rotation: 6 min/rev

Terminal Density Calculation

Clear liquor volume: 730 ml

Clear liquor weight: 730 ml x 1038 g/l = 758 g

Terminal pulp wt: 1116 g feed pulp - 758 g clear liquor = 358 g

Terminal pulp: 53.3 Solids, %

Thickener Unit Area Requirement

Initial height, H_o: 1.14 ft

Initial pulp density, $C_o = (31.3 \times 10^{-6})$ (feed solids content, g solids/liter slurry) = ton/ft^3

$C_o = (31.3 \times 10^{-6}) \times 144 = 4.507 \times 10^{-3}$ ton/ft^3

Critical time, T_x = 0.041 days

Unit area, $UA = \frac{T_x}{C_o H_o} = \frac{0.041}{4.507 \times 10^{-3} \times 1.14}$

UA = 7.98 ft^2/ton/day

Liquor Clarity: Clear

OBSERVATIONS:

Table A-2-3

KYNCH PROCEDURE - THICKENING TEST DATA

PROJECT: 4133
NOTEBOOK: 1009
PAGE: 36
DATE: 3-15-77
BY: Balderrama

OBJECTIVE: Settling of alkaline leach pulp
Anderson Mine Composite 2

FLOCCULANT: Arquad T-50 (10 g/l) AMOUNT: 6.7 lb/ton
MGL (1 g/l) 0.07 lb/ton

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed Pulp	Terminal Pulp	Clear Liquor
1000	0	Volume, ml	1000	250	750
970	1	Gross pulp weight, g	1784		
930	2	Tare, g	671		
895	3	Net pulp weight, g	1113	333	780
860	4	Gross dry weight, g			
830	5	Tare, g			
795	6	Net dry weight, g	141	141	
765	7	Density, g/l			1040
735	8	Solids, %	14.1	56.4	
705	9				
675	10				
625	12				
580	14				
555	16				
505	20				
460	25				
420	30				
390	35				
360	40				
295	70				
285	100				
270	130				
260	160				
255	220				
Terminal Level 18 hrs					

Time rake installed 1 min

Thickener rake rotation: 6 min/rev

Terminal Density Calculation

Clear liquor volume: 750 ml

Clear liquor weight: 750 ml x 1040 g/l = 780 g

Terminal pulp wt: 1113 g feed pulp - 780 g clear liquor = 333 g

Terminal pulp: 56.4 Solids, %

Thickener Unit Area Requirement

Initial height, H_o: 1.14 ft

Initial pulp density, $C_o = (31.3 \times 10^{-6})$ (feed solids content, g solids/liter slurry) = ton/ft^3

$C_o = (31.3 \times 10^{-6}) \times 141 = 4.413 \times 10^{-3}$ ton/ft^3

Critical time, T_x = 0.047 days

Unit area, $UA = \frac{T_x}{C_o H_o} = \frac{0.047}{4.413 \times 10^{-3} \times 1.14}$

UA = 9.34 ft^2/ton/day

Liquor Clarity: Clear

OBSERVATIONS:

Table A-2-4

KYNCH PROCEDURE - THICKENING TEST DATA

PROJECT: 4133
NOTEBOOK: 1009
PAGE: 37
DATE: 3-15-77
BY: Balderrama

OBJECTIVE: Settling of alkaline leach pulp
Anderson Mine Composite 3

FLOCCULANT: Arquad T-50 (10 g/l) AMOUNT: 6.7 lb/ton
MBL (1 g/l) 0.07 lb/ton

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed Pulp	Terminal Pulp	Clear Liquor
1000	0	Volume, ml	1000	270	730
960	1	Gross pulp weight, g	1770		
930	2	Tare, g	650		
900	3	Net pulp weight, g	1120	361	759
880	4	Gross dry weight, g			
850	5	Tare, g			
825	6	Net dry weight, g	145	145	
800	7	Density, g/l			1040
770	8	Solids, %	14.5	53.7	
740	9				
720	10				
650	13				
565	18				
505	23				
450	28				
310	58				
295	88				
290	118				
280	148				
275	208				
Terminal Level 18 hrs					

Time rake installed 1 min

Thickener rake rotation: 6 min/rev

Terminal Density Calculation

Clear liquor volume: 730 ml

Clear liquor weight: 730 ml x 1040 g/l = 759 g

Terminal pulp wt: 1120 g feed pulp - 759 g clear liquor = 361 g

Terminal pulp: 53.7 Solids, %

Thickener Unit Area Requirement

Initial height, H_o: 1.14 ft

Initial pulp density, $C_o = (31.3 \times 10^{-6})$ (feed solids content, g solids/liter slurry) = ton/ft^3

$C_o = (31.3 \times 10^{-6}) \times 145 = 4.538 \times 10^{-3}$ ton/ft^3

Critical time, T_x = 0.044 days

Unit area, $UA = \frac{T_x}{C_o H_o} = \frac{0.044}{4.538 \times 10^{-3} \times 1.14}$

UA = 8.50 ft^2/ton/day

Liquor Clarity:

OBSERVATIONS:

Table A-2-5

KYNCH PROCEDURE - THICKENING TEST DATA

PROJECT: 4133
NOTEBOOK: 1009
PAGE: 38
DATE: 3-15-77
BY: Balderrama

OBJECTIVE: Settling of alkaline leach pulp
A Anderson Mine Composite 1
FLOCCULANT: Arquad T-50 (10 g/l) AMOUNT: 13.4 lb/ton
MGL (1 g/l) 0.14 lb/ton

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed Pulp	Terminal Pulp	Clear Liquor
1000	0	Volume, ml	1000	280	720
970	1	Gross pulp weight, g	1767		
890	2	Tare, g	638		
810	3	Net pulp weight, g	1129	380	749
735	4	Gross dry weight, g			
670	5	Tare, g			
610	6	Net dry weight, g	154	154	
570	7	Density, g/l			1040
525	8	Solids, %	15.4	55.0	
490	9				
470	10				
450	12				
410	15				
390	20				
370	25				
360	30				
350	35				
340	40				
335	50				
335	60				
325	70				
310	90				
310	120				
295	150				
Terminal Level 18 hrs					

Time rake installed 1 min

Thickener rake rotation: 6 min/rev

Terminal Density Calculation

Clear liquor volume: 720 ml

Clear liquor weight: 720 ml x 1040 g/l = 749 g

Terminal pulp wt: 1129 g feed pulp - 749 g clear liquor = 380 g

Terminal pulp: 55.0 Solids, %

Thickener Unit Area Requirement

Initial height, H_o: 1.14 ft

Initial pulp density, $C_o = (31.3 \times 10^{-6})$ (feed solids content, g solids/liter slurry) = ton/ft^3

$C_o = (31.3 \times 10^{-6}) \times 154 = 4.820 \times 10^{-3}$ ton/ft^3

Critical time, T_x = 0.028 days

Unit area, $UA = \frac{T_x}{C_o H_o} = \frac{0.028}{4.820 \times 10^{-3} \times 1.14}$

UA = 5.1 ft^2/ton/day

Liquor Clarity: Clear

OBSERVATIONS:

Table A-2-6

KYNCH PROCEDURE - THICKENING TEST DATA

PROJECT: 4133
NOTEBOOK: 1009
PAGE: 39
DATE: 3-15-77
BY: Balderrama

OBJECTIVE: Settling of alkaline leach pulp
Anderson Mine Composite 2

FLOCCULANT: Arquad T-50 (10 g/l) AMOUNT: 13.4 lb/ton
MGL (1 g/l) 0.14 lb/ton

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed Pulp	Terminal Pulp	Clear Liquor
1000	0	Volume, ml	1000	250	750
950	1	Gross pulp weight, g	1785		
890	2	Tare, g	660		
825	3	Net pulp weight, g	1125	348	777
775	4	Gross dry weight, g			
720	5	Tare, g			
675	6	Net dry weight, g	155.5	155.5	
635	7	Density, g/l			1036
605	8	Solids, %	16.0	62.2	
580	9				
550	10				
510	12				
475	14				
445	16				
405	19				
360	24				
335	29				
310	39				
300	49				
290	59				
280	79				
270	109				
265	139				
265	169				
Terminal Level 18 hrs					

Time rake installed 1 min

Thickener rake rotation: 6 min/rev

Terminal Density Calculation

Clear liquor volume: 750 ml

Clear liquor weight: 750 ml x 1036 g/l = 777 g

Terminal pulp wt: 1125 g feed pulp - 777 g clear liquor = 348 g

Terminal pulp: 62.2 Solids, %

Thickener Unit Area Requirement

Initial height, H_o: 1.14 ft

Initial pulp density, $C_o = (31.3 \times 10^{-6})$ (feed solids content, g solids/liter slurry) = ton/ft^3

$C_o = (31.3 \times 10^{-6}) \times 155.5 = 4.867 \times 10^{-3}$ ton/ft^3

Critical time, T_x = 0.033 days

Unit area, $UA = \frac{T_x}{C_o H_o} = \frac{0.033}{4.867 \times 10^{-3} \times 1.14}$

UA = 5.9 ft^2/ton/day

Liquor Clarity: Clear

OBSERVATIONS:

Table A-2-7

KYNCH PROCEDURE - THICKENING TEST DATA

PROJECT: 4133
NOTEBOOK: 1009
PAGE: 40
DATE: 3-15-77
BY: Balderrama

OBJECTIVE: Settling of alkaline leach pulp
Anderson Mine Composite 3

FLOCCULANT: Arquad T-50 (10 g/l) AMOUNT: 13.4 lb/ton
MGL (1 g/l) 0.14 lb/ton

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed Pulp	Terminal Pulp	Clear Liquor
1000	0	Volume, ml	1000	260	740
1000	1	Gross pulp weight, g	1753		
975	2	Tare, g			
950	3	Net pulp weight, g	1118	350	768
930	4	Gross dry weight, g			
910	5	Tare, g			
890	6	Net dry weight, g	150	150	
875	7	Density, g/l			1038
855	8	Solids, %	15.0	57.8	
835	9				
815	10				
725	15				
645	20				
535	30				
460	40				
405	50				
315	70				
300	100				
270	130				
270	160				
Terminal Level 18 hrs					

Time rake installed 1 min

Thickener rake rotation: 6 min/rev

Terminal Density Calculation

Clear liquor volume: 740 ml

Clear liquor weight: 740 ml x 1038 g/l = 768 g

Terminal pulp wt: 1118 g feed pulp - 768 g clear liquor = 350 g

Terminal pulp: 57.8 Solids, %

Thickener Unit Area Requirement

Initial height, H_o: 1.14 ft

Initial pulp density, $C_o = (31.3 \times 10^{-6})$ (feed solids content, g solids/liter slurry) = ton/ft^3

$C_o = (31.3 \times 10^{-6}) \times 150 = 4.675 \times 10^{-3}$ ton/ft^3

Critical time, T_x = 0.056 days

Unit area, $UA = \frac{T_x}{C_o H_o} = \frac{0.056}{4.695 \times 10^{-3} \times 1.14}$

UA = 10.5 ft^2/ton/day

Liquor Clarity: Clear

OBSERVATIONS:

APPENDIX 3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-53

Sample No. Middle Zone 0.039 % U_3O_8 0.75 % CO_2
0.07 % V_2O_5 3.05 % Fe
0.001 % Mo %

Conditions: 80 °C psi , 16 hr
33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.8 pH 90 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.039				
Grams	500	0.195				
Filtrate						
g/l		0.187				
Grams	1060	0.198				
Wash						
g/l						
Grams						
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.003				
Grams	484.5	0.015				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		93.2				
Calculated head, %		0.043				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-54

Sample No. Lower Zone 0.043 % U_3O_8 3.20 % CO_2

0.14 % V_2O_5 3.06 % Fe

<0.001 % Mo %

Conditions: 80 °C psi , 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.75 pH 90 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.043				
Grams	500	0.215				
Filtrate						
g/l		0.200				
Grams	1130	0.226				
Wash						
g/l						
Grams						
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.002				
Grams	485.5	0.010				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		95.9				
Calculated head, %		0.047				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-55

Sample No. Middle Zone 0.039 % U_3O_8 0.75 % CO_2
0.07 % V_2O_5 3.05 % Fe
0.001 % Mo %

Conditions: 80 °C psi , 16 hr
33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.8 pH 90 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.039				
Grams	500	0.195				
Filtrate						
g/l		0.187				
Grams	1060	0.198				
Wash						
g/l						
Grams						
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.003				
Grams	497	0.015				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		93.0				
Calculated head, %		0.043				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-56

Sample No. Lower Zone — 0.043 % U_3O_8 — 3.20 % CO_2

0.014 % V_2O_5 — 3.06 % Fe

<0.001 % Mo — %

Conditions: 80 °C ____ psi ____, 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.8 pH 90 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.043				
Grams	500	0.215				
Filtrate						
g/l		0.192				
Grams	1130	0.217				
Wash						
g/l						
Grams						
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.003				
Grams	480.6	0.014				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		93.8				
Calculated head, %		0.046				

Calculated soda ash consumption, ____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-62

Sample No. Lower Zone 0.043 % U_3O_8 3.20 % CO_2

0.14 % V_2O_5 3.06 % Fe

< 0.001 % Mo %

Conditions: 90 °C psi , 16 hr

33 % solids 30 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.8 pH 75 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.043				
Grams	500	0.215				
Filtrate						
g/l		0.245				
Grams	1010	0.247				
Wash						
g/l						
Grams						
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.003				
Grams	471.7	0.014				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		94.6				
Calculated head, %		0.052				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-85

Sample No. Hole AM-1C 0.025 % U_3O_8 _____ %

_____ 0.023 % V_2O_5 _____ %

_____ 13.4 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.7 pH 125 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.025				
Grams	500	0.125				
Filtrate						
g/l		0.103				
Grams	585	0.060				
Wash						
g/l		0.060				
Grams	505	0.030				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.003				
Grams	483.2	0.014				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		86.2				
Calculated head, %		0.021				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-86

Sample No. Hole AM-7C 0.047 % U_3O_8 _____ %

_____ 0.041 % V_2O_5 _____ %

_____ 0.24 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 10.4 pH 110 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.047				
Grams	200	0.094				
Filtrate						
g/l		0.212				
Grams	270	0.057				
Wash						
g/l		0.033				
Grams	505	0.017				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.010				
Grams	194.2	0.019				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		79.2				
Calculated head, %		0.047				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-87

Sample No. Hole AM-13C 0.027 % U_3O_8 _____ %

_____ 0.061 % V_2O_5 _____ %

_____ 9.2 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 10.3 pH 110 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.027				
Grams	250	0.068				
Filtrate						
g/l		0.138				
Grams	315	0.043				
Wash						
g/l		0.032				
Grams	500	0.016				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.005				
Grams	244.3	0.012				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		83.0				
Calculated head, %		0.029				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-88

Sample No. Hole AM-16C 0.035 % U_3O_8 _____ %
_____ 0.056 % V_2O_5 _____ %
_____ 9.6 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr
33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 10.3 pH 110 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.035				
Grams	190	0.067				
Filtrate						
g/l		0.135				
Grams	200	0.027				
Wash						
g/l		0.029				
Grams	590	0.017				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.009				
Grams	185.3	0.017				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		72.6				
Calculated head, %		0.032				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-89

Sample No. Hole AM-17C 0.041 % U_3O_8 _____ %

_____ 0.074 % V_2O_5 _____ %

_____ 1.9 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 10.0 pH 110 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.041				
Grams	500	0.205				
Filtrate						
g/l		0.177				
Grams	675	0.119				
Wash						
g/l		0.103				
Grams	500	0.052				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.004				
Grams	487.6	0.020				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		89.8				
Calculated head, %		0.038				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-90

Sample No. Hole AM-18C 0.063 % U_3O_8 _____ %
_____ 0.089 % V_2O_5 _____ %
_____ 15.5 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr
33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.5 pH 200 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.063				
Grams	500	0.315				
Filtrate						
g/l		0.242				
Grams	550	0.133				
Wash						
g/l		0.205				
Grams	550	0.113				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.006				
Grams	480.1	0.029				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		85.5				
Calculated head, %		0.055				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-91

Sample No. Hole AM-26C 0.115 % U_3O_8 _____ %

_____ 0.053 % V_2O_5 _____ %

_____ 14.3 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.9 pH 130 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.115				
Grams	500	0.575				
Filtrate						
g/l		0.507				
Grams	750	0.380				
Wash						
g/l		0.205				
Grams	530	0.109				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.018				
Grams	494	0.089				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		84.6				
Calculated head, %		0.116				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-92

Sample No. Hole AM-49C 0.075 % U_3O_8 _____ %
_____ 0.069 % V_2O_5 _____ %
_____ 17.3 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr
33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.7 pH 130 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.075				
Grams	500	0.375				
Filtrate						
g/l		0.320				
Grams	720	0.230				
Wash						
g/l		0.162				
Grams	520	0.084				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.014				
Grams	487.3	0.068				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		82.2				
Calculated head, %		0.077				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-93

Sample No. Hole AM-51C 0.055 % U_3O_8 _____ %

_____ 0.102 % V_2O_5 _____ %

_____ 3.3 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.9 pH 120 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.055				
Grams	500	0.275				
Filtrate						
g/l		0.216				
Grams	685	0.148				
Wash						
g/l		0.121				
Grams	500	0.061				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.010				
Grams	490.4	0.049				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		81.0				
Calculated head, %		0.052				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-94

Sample No. Hole AM-79C 0.018 % U_3O_8 _____ %
_____ 0.028 % V_2O_5 _____ %
_____ 12.0 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr
33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 10.2 pH 112 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.018				
Grams	210	0.038				
Filtrate						
g/l		0.063				
Grams	200	0.013				
Wash						
g/l		0.025				
Grams	590	0.015				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.003				
Grams	203.8	0.006				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		81.7				
Calculated head, %		0.016				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-95

Sample No. Hole AM-113C 0.045 % U_3O_8 _____ %

_____ 0.094 % V_2O_5 _____ %

_____ 0.063 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.8 pH 140 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.045				
Grams	300	0.135				
Filtrate						
g/l		0.150				
Grams	490	0.074				
Wash						
g/l		0.058				
Grams	500	0.029				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.009				
Grams	291.0	0.026				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		79.6				
Calculated head, %		0.043				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-96

Sample No. Hole AM-119C 0.125% U_3O_8 _____%
_____ 0.071% V_2O_5 _____%
_____ 13.3 % CO_2 _____%

Conditions: 80 °C _____ psi _____, 16 hr
33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.8 pH 150 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.125				
Grams	260	0.325				
Filtrate						
g/l		0.421				
Grams	455	0.192				
Wash						
g/l		0.106				
Grams	500	0.053				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.011				
Grams	252.8	0.028				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		89.8				
Calculated head, %		0.105				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-97

Sample No. Hole AM-135C 0.086 % U_3O_8 _____ %

_____ 0.115 % V_2O_5 _____ %

_____ 5.0 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.6 pH 0.0 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.086				
Grams	500	0.430				
Filtrate						
g/l		0.352				
Grams	685	0.241				
Wash						
g/l		0.163				
Grams	515	0.084				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.012				
Grams	488.5	0.059				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		84.7				
Calculated head, %		0.077				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 976-98

Sample No. Hole AM-149C 0.055 % U_3O_8 _____ %

_____ 0.130 % V_2O_5 _____ %

_____ 0.34 % CO_2 _____ %

Conditions: 80 °C _____ psi _____, 16 hr

33 % solids 40 g/l Na_2CO_3 10 g/l $NaHCO_3$

Filtrate: 9.9 pH 120 mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.055				
Grams	500	0.275				
Filtrate						
g/l		0.205				
Grams	690	0.141				
Wash						
g/l		0.119				
Grams	490	0.058				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.013				
Grams	490.1	0.064				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		75.8				
Calculated head, %		0.053				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 1009-11

Sample No. Composite 1 — 0.039 % U_3O_8 — 11.4 % CO_2
0.06 % V_2O_5 — %
0.002 % Mo — %

Conditions: 80 °C — psi , 16 hr
33 % solids — 40 g/l Na_2CO_3 — 10 g/l $NaHCO_3$

Filtrate: pH mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.039				
Grams	300	0.117				
Filtrate						
g/l		0.133				
Grams	485	0.065				
Wash						
g/l		0.029				
Grams	840	0.024				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.003				
Grams	300	0.009				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		90.8				
Calculated head, %		0.033				

Calculated soda ash consumption, lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 1009-12

Sample No. Composite 2 — 0.054 % U_3O_8 — 9.7 % CO_2
0.09 % V_2O_5 — %
0.007 % Mo — %

Conditions: 80 °C — psi — , 16 hr
33 % solids — 40 g/l Na_2CO_3 — 10 g/l $NaHCO_3$

Filtrate: pH — mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.054				
Grams	300	0.162				
Filtrate						
g/l		0.223				
Grams	335	0.075				
Wash						
g/l		0.057				
Grams	820	0.047				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.006				
Grams	296	0.018				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		87.2				
Calculated head, %		0.047				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 1009-13

Sample No. Composite 3 — 0.058 % U_3O_8 — 5.5 % CO_2
0.11 % V_2O_5 — %
0.006 % Mo — %

Conditions: 80 °C — psi — , 16 hr
33 % solids — 40 g/l Na_2CO_3 — 10 g/l $NaHCO_3$

Filtrate: pH — mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.058				
Grams	300	0.174				
Filtrate						
g/l		0.282				
Grams	320	0.090				
Wash						
g/l		0.063				
Grams	740	0.047				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.011				
Grams	299	0.033				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		80.6				
Calculated head, %		0.057				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 1009-28

Sample No. Composite 1 — 0.039 % U_3O_8 — 11.4 % CO_2
0.06 % V_2O_5 — %
0.002 % Mo — %

Conditions: 80 °C — psi — , 16 hr
33 % solids — 40 g/l Na_2CO_3 — 10 g/l $NaHCO_3$

Filtrate: pH — mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.039				
Grams	300	0.117				
Filtrate						
g/l		0.173				
Grams	390	0.067				
Wash						
g/l		0.057				
Grams	680	0.039				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.003				
Grams	298	0.009				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		92.2				
Calculated head, %		0.038				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 1009-29

Sample No. Composite 2 — 0.054 % U_3O_8 — 9.7 % CO_2

0.09 % V_2O_5 — %

0.007 % Mo — %

Conditions: 80 °C — psi , 16 hr

33 % solids — 40 g/l Na_2CO_3 — 10 g/l $NaHCO_3$

Filtrate: pH mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.054				
Grams	300	0.162				
Filtrate						
g/l		0.250				
Grams	410	0.103				
Wash						
g/l		0.068				
Grams	740	0.050				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.005				
Grams	295.4	0.015				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		91.1				
Calculated head, %		0.056				

Calculated soda ash consumption, _____ lb/ton Na_2CO_3

URANIUM ALKALINE LEACH AMENABILITY
No. 1009-30

Sample No. Composite 3 — 0.058 % U_3O_8 — 5.5 % CO_2

0.11 % V_2O_5 — %

0.006 % Mo — %

Conditions: 80 °C — psi , 16 hr

33 % solids — 40 g/l Na_2CO_3 — 10 g/l $NaHCO_3$

Filtrate: pH mv

Metallurgical Balance

	Weight/ Volume	Uranium U_3O_8	Na_2CO_3	$NaHCO_3$		
Leach head						
%		0.058				
Grams	300	0.174				
Filtrate						
g/l		0.280				
Grams	430	0.120				
Wash						
g/l		0.057				
Grams	800	0.046				
Residue						
___hour, %						
___hour, %						
___hour, %						
16 hour, %		0.007				
Grams	297	0.021				
Percent solubilized						
___hour						
___hour						
___hour						
16 hour		88.8				
Calculated head, %		0.062				

Calculated soda ash consumption, lb/ton Na_2CO_3