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URANIUM RECOVERY FROM ANDERSON MINE ORE

Laboratory Studies

for

Minerals Exploration Company
P. O. Box 50324
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INTRODUCTION AND SUMMARY

On August 24, 1977, the amenability of Minerals Exploration's Anderson Mine[1/] uranium ore samples to acid leaching and solvent extraction was reported. This work showed that 87-93% uranium extraction can be achieved, but because of the ore's high carbonate and organic content, the acid and oxidant consumptions were high and settling rates were poor. No major difficulty was encountered in recovering uranium from the leach solutions using tertiary amine SX-ammonium sulfate stripping and yellow cake precipitation.

Additional laboratory scale test work on more recent drill core samples was authorized by Minerals Exploration on December 2, 1977, to develop design criteria data on critical process areas for a conventional one-stage leach-SX flowsheet. The main objective of the test program, which was directed by A. H. Ross & Associates, was to obtain more detailed information on thickening and solvent extraction.

Six composites, representing the Anderson Mine ore body and assaying from 0.044 to 0.098% U_3O_8 and from 1.6 to 9.1% CO_2, were leached under appropriate conditions to determine their uranium extraction, acid/oxidant consumption, and thickening characteristics. The results were similar to those reported previously, with uranium extractions ranging from 85 to 95%, H_2SO_4 consumptions[2/] from 137 to 538 lb/ton, and $NaClO_3$ consumption greater than 12 lb/ton.

The effect of grind, oxidant addition, acidity, and weathering was determined next using a master composite of all six ores and a composite of two ores which were difficult to thicken. Based on these

1/ Located near Wickenburg, Arizona.
2/ Total H_2SO_4 added in 8 hours.

results, the following near optimum leach conditions were established which gave 90% uranium extraction for the six-ore composite:

Heads	0.064% U_3O_8
Grind	0.6% plus 28-mesh
% Solids	±40
Acidity	20 g/l H_2SO_4
H_2SO_4 added	416 lb/ton
consumed	359 lb/ton
$NaClO_3$ added	6.3 lb/ton
Temperature	75°C
Time	6 hours
Residue	0.0063% U_3O_8
Thickening/filtration	Tested in detail by Enviro-Clear, and Envirotech personnel.
Off-gases	Some of the ores evolved obnoxious off-gases which had to be vented.

High uranium recovery was achieved from liquors prepared under the above conditions in a continuous SX run using Alamine 336 extraction-ammonium sulfate stripping. Because trace amounts of zirconium are present in the leach liquors, some scum (equivalent to 0.6 gal/1000 gal organic) formed in the strip circuit but did not present any major problem. In a commercial plant, some physical method of removing this scum will have to be provided. Extraction/stripping isotherms and rates, phase separation rates, and organic short-term stability data were determined.

Yellow cake prepared from the ammonium sulfate strip solution met all typical Allied Chemical and Kerr-McGee specifications.

DESCRIPTION OF ORE SAMPLES AND COMPOSITES

During the week of November 21, 1977, core samples from 35 drill holes were received from Minerals Exploration's Tucson office as listed on page A-1[1/]. From these samples, which were already crushed to minus 1/2-inch, six ore composites were made from appropriate holes and footages as instructed by Minerals Exploration personnel, page A-5[1/]. Analytical data for the composites A through F are given in Table 1.

To test the effect of leach variables, the ore composites were made into master composites No. 1 and 2, and composite B+C as follows:

Ore Composite	Weight % Master Composite No. 1	Master Composite No. 2	Composite B+C
A	16.67	16	
B	16.67	14	39
C	16.67	22	61
D	16.67	19	
E	16.67	21	
F	16.67	8	

These ores were not examined mineralogically.

1/ Appendix section.

GRINDING

The minus 6-mesh samples were wet ground to appropriate grinds for leaching in a steel ball mill for the first series with the individual ore composites and master composite No. 1 and in a steel rod mill for the latter tests. Screen analysis data are given in the appendix section as follows:

Ore	Mill Used	Page1/
Composite A→F	Ball	A-9
Master Composite No. 1	Ball	A-12
Composite No. 2	Rod	A-16
Composite B+C	Rod	A-15

Each ore composite was ground under similar ball mill conditions to determine their comparative hardness, page A-13 1/. Composites A, B, C, and E are similar in hardness and are the hardest of the six composites. Composite D is less hard, and composite F is the softest.

A Bond Work Index on composite B+C was determined to be 11.8 kwhr/ton when ground to 100% passing 28-mesh.

1/ Appendix section.

LEACHING

Each ore composite and master composite No. 1 were leached under conditions previously determined to be applicable for high uranium extraction from Anderson Mine ores to determine if their leaching characteristics were similar to earlier samples tested. Following these tests, the effect of oxidant, grind, acidity, and weathering was determined using master composites 1 and 2 and composite B+C.

All tests were batch leaches consisting of wet grinding 1.0 kg minus 6-mesh ore to the appropriate grind using either a 7-5/8" diam steel ball mill or rod mill and separating the ground ore by filtration or settling. The solids were transferred to a 2-liter reaction vessel, slurried to ±41% solids, a ±250-gram slurry sample was removed for heads assay, the required amount of H_2SO_4 was added as 19 N H_2SO_4, the slurry was heated to test temperature, 1/2 of the required $NaClO_3$ was added, and, after two hours, the second half of the $NaClO_3$ was added. Interval and final slurry samples were taken and filtered for prime filtrate (PF) and residue[1/] assay. The remaining slurry was allowed to stand overnight at room temperature and used for thickening tests the next day.

LEACH OF ORE COMPOSITES

Each ore composite and master composite No. 1 was leached at minus 28-mesh grind, 35-43% solids[2/], pH 1, about minus 400 mv[3/] emf, 80°C for 12 hours. Pertinent test results, given in Table 2, show composites A, B, C, D, and E are moderately difficult to leach (85 to 91%

1/ The residues were well washed with pH 1.5 H_2SO_4, then H_2O.
2/ Too viscous at higher % solids for proper stirring.
3/ Attempted to maintain emf at minus 400 mv although $NaClO_3$ consumption was high.

U_3O_8 extraction) having high H_2SO_4 and $NaClO_3$ consumption because of their high carbonate and asphaltic material content, and their thickening characteristics are poor. Composite F, which contains less carbonate and organics, responded better to leaching (95% U_3O_8 extraction) and thickened fairly well.

These results are similar to those previously reported for fresh drill core samples received December 1, 1976 and January 17, 1977.

EFFECT OF GRIND

The effect of grinding master composite No. 1 to 2 and 8% plus 28-mesh is given in Table 2, tests 7 and 9. Uranium distribution in the screen fractions of these test residues, given in Table 3, show significantly higher U_3O_8 assay in the coarser fractions.

Using master composite No. 2, the effect of grind was tested at two acid levels, Table 4. With the lower acid addition (355 lb H_2SO_4/ton) there is an apparent increase in uranium extraction with finer grinding. However, with the higher acid addition (417 lb H_2SO_4/ton) finer grinding did not significantly improve extraction.

Better uranium extraction was obtained with finer grinding with the higher grade composite B+C at both low and high acidity, Table 4.

EFFECT OF OXIDANT

Table 5 shows the effect of increasing $NaClO_3$ addition from 2.1 to 28 lb/ton on leaching master composites No. 1 and 2, and composite B+C. Uranium extraction increased by 1% (from 87.5 to 88.5% for master composite No. 1) by increasing $NaClO_3$ addition from 2.1 to 6.3 lb/ton. Adding an excessive 28 lb $NaClO_3$/ton only increased the extraction by an additional 1-1.5%.

EFFECT OF ACIDITY

The effect of acidity is given in Table 6. These data show a significant increase in uranium extraction from 83 to 88% by leaching master composite No. 1 at 5 and 10 g/l free H_2SO_4. With master composite No. 2 and composite B+C, increasing the free acid from 10 to 20 g/l H_2SO_4, increased uranium extraction from 87-88 to 90-92%, and increased H_2SO_4 consumption by 28-33 lb/ton.

EFFECT OF WEATHERING

It is anticipated that the Anderson Mine ore will be mined and stockpiled before processing. The effect of stockpiling was determined in an Accelerated Weathering test which consisted of sprinkling minus 6-mesh master composite No. 2 to 20% moisture three times per week, and maintaining the ore in an oven at 50-55°C for four weeks. The weathered ore and a control sample, which were held at room temperature in a nitrogen atmosphere, were leached under various conditions for comparison, Table 7. No significant leaching difference was apparent between the weathered and control sample.

PULP DENSITY

Because of the high carbonate content of the ores, the leach slurries became very thick during acidification and, to ensure proper stirring during the first 2-3 hours of leaching, the slurries were diluted to 36-43% solids. Leach tests at greater than 43% solids were not run.

Power requirements for mixing the leach slurry at 50% solids were determined by Mr. D. W. Daigler of D. W. Daigler Company, the Denver representative for Mixing Equipment Company, on February 7,

1978. A 28-kg, minus 20-mesh composite of 39% A + 61% E was leached at 50% solids, 400 lb H_2SO_4 and 6 lb $NaClO_3$/ton ore, 75°C, in a 14" diam 316 ss tank using a variable speed Lightnin® mixer with various size ship-type impellers. Results of this test were reported directly to A. H. Ross & Associates.

During this test with composite A+E, malodorous fumes were evolved. The odor was not identified but it was quite obnoxious and would require venting the leach vessels in a commercial plant.

OPTIMUM CONDITIONS

Based on the above data, near optimum conditions for leaching Anderson Mine ore in a conventional one-stage system are:

Grind	1-2% plus 28-mesh
Pulp density	43% solids
Acidity	20 g/l free H_2SO_4
Oxidant	6 lb $NaClO_3$/ton
Temperature	75°C
Time	6 hour

Under these conditions, the following results were obtained:

Test Ore	14 Master Composite No. 2	20 Composite B+C
Heads, % U_3O_8	0.064	0.091
Residue, % U_3O_8	0.0063	0.0080
U_3O_8 extracted, %	90	91
H_2SO_4 added, lb/ton	416	434
H_2SO_4 consumed, lb/ton	359	383

THICKENING

Comparative thickening tests run on each ore composite showed that composites B and C had the slowest settling rates, Table 8. Composite B+C was therefore chosen for detailed testing by Enviro-Clear and Envirotech personnel during a three-week period starting January 23, 1978. Leach conditions used in preparing the slurries for the thickening test work are detailed in the appendix section. Test results obtained by Enviro-Clear and Envirotech were reported directly to A. H. Ross & Associates and are not included in this report.

During the leach test work standard settling tests, using the Kynch procedure, were run to determine if any of the leach variables significantly affected settling rates, Table 8. Fine grinding and excessive $NaClO_3$ addition appear to adversely affect thickening.

SOLVENT EXTRACTION

The response of leach liquor prepared by leaching mixtures of the ore composites to uranium recovery by Alamine 336-$(NH_4)_2SO_4$ stripping was determined in a continuous SX run during which 12 organic cycles were accumulated. Extraction/stripping isotherm and rates, scum formation, phase separation rates, and organic stability data were developed. Sufficient strip solution was produced for yellow cake precipitation and analysis.

LEACH LIQUOR

Approximately 500 liters of leach liquor were prepared in five separate batches using composite B+C ore for the first two batches and mixtures of each ore composite for the last three. Leach conditions were minus 28-mesh grind, 41% solids, 20 g/l free H_2SO_4, 6 lb $NaClO_3$/ton, at 75°C for 6 hours. In the last three batches, SX raffinate was used to wash the leach residue in order to build up liquor impurities.

Analytical data for batch 4 liquor which was used near the end of the SX run are given in Table 9. Except for Zr, none of the liquor impurities presented any SX difficulties. Trace amounts of Zr were extracted and formed some scum (stable emulsion) during $(NH_4)_2SO_4$ stripping at pH 3-4.5. Molybdenum presented no problem since it was not present in significant amounts in these liquors. Vanadium was present in the reduced cationic form and was not extracted.

EQUIPMENT

The SX unit was of the mixer-settler type constructed of Pyrex glass and consisting of 2-1/4" diam, 150 ml capacity mixers throughout and 2-1/4" diam, 1000 ml capacity settlers for the extraction and loaded organic wash sections. For stripping, the settlers were decreased to 1-1/2" diam, 60 ml capacity in order to minimize organic inventory. Solutions were metered by peristaltic pumps, and polyethylene pumping-type impellers mixed and pumped the O/A phases countercurrently. In the stripping circuit, the pH was measured in the aqueous stream which was pumped from the point where the emulsion entered the settler, through a jackleg which contained the pH electrode, and back to the settler.

The circuit consisted of four extraction, one organic wash, and three stripping stages. A photograph of the SX unit is given in Figure 1.

REAGENTS

The following reagents were used:

Organic	2.5 vol % Alamine (0.048 N amine) + 2.5 vol % isodecanol diluted in Napoleum 470B kerosene. Starting inventory = 4.0 liters, decreased to 3.5 liters after 11 hours.
Organic wash solution	pH 1.8 H_2SO_4
Strip solution	150 g/l $(NH_4)_2SO_4$, pH was adjusted by injecting into the mixers 3.7 N NH_4OH in stage 1, and 0.37 N NH_4OH in stages 2 and 3.

SX RUN

Twelve organic cycles were accumulated in 77 hours of operation during which 477 liters of leach liquor were processed, producing 3.33 liters of strip solution averaging 20 g/l U_3O_8. Test conditions and results at the end of the run are given in Table 10. Other analytical, entrainment, NH_3 consumption, and U_3O_8 material balance data are given in the appendix section.

EXTRACTION

With organic loadings of 1.9-2.0 g/l U_3O_8, raffinates assaying 0.0005 g/l U_3O_8 (or 99.7% U_3O_8 extraction from 0.16 g/l U_3O_8 feed liquor) were obtained during the last 45 hours of the run. Extraction isotherms for the 12-cycle and fresh organic are given in Figure 2.

Five cc of a grey-colored scum containing 0.03 g solids (equivalent to 0.01 gal scum/1000 gal liquor) accumulated in the loaded stage. Spectrographic analyses of the scum solids showed (in %) 10^+ Si, 5 U, 1 Na, 10 Al, 3 Fe, and 1 Ti, suggesting the solids were unfiltered leach residue. A photograph of the scum is given in Figure 3.

The extraction rate is rapid, requiring <0.3 minute to reach equilibrium, page A-100.

The raffinate discharging from the unit was sparkling clear throughout the run.

ORGANIC WASH

The loaded organic was washed in one stage with 0.1 vol pH 1.8 H_2SO_4/vol organic (the O/A ratio in the mixer was maintained at 2/1 by aqueous recycle) to remove any aqueous entrainment (±0.07 vol % aqueous) and avoid contaminating the strip solution with leach liquor impurities. No chemical or physical difficulties were encountered in the organic wash step.

STRIPPING

Using 150 g/l $(NH_4)_2SO_4$ and controlling the pH at 3.9-4.5 with NH_4OH, 92-95% uranium stripping was achieved in three stages producing 21-25 g/l U_3O_8 strip solutions. Shake-out stripping isotherm data using 12-cycle organic and strip solutions from the SX unit at the end of the run are given in Figure 4.

A brownish-white scum was formed during stripping which increased at a constant rate until 15, 5, and 3 cc (equivalent to 0.4, 0.1, and 0.07 gal scum/1000 gal organic processed) were accumulated in stage 1, 2, 3 settlers by the end of the run. A photograph of the scum in stage 1 settler is given in Figure 5. Spectrographic analysis of the scum solids (±0.3 g) showed major U, 1% Si, 1% Zr, and minor amounts of other impurities. Zirconium is probably the contaminant which caused the scum to form.

Ammonia consumption for stripping was 0.41 lb NH_3/lb U_3O_8.

Stripping equilibrium is reached in <1 minute, page A-100.

ORGANIC STABILITY

Amine normalities of fresh and 12-cycle organics were 0.0484 and 0.0474 N, respectively, indicating no significant short-term amine degradation. No inorganic foulants were detected spectrographically in the barren stripped 12-cycle organic.

ORGANIC REGENERATION

Very slow phase separation was encountered when barren stripped 12-cycle organic was contacted with 50 or 100 g/l Na_2CO_3. Although the slight brown coloration which the organic had taken on during the

SX run was removed, a stable emulsion was formed which did not completely collapse even on standing overnight. Shake-out tests using $NaHCO_3 \pm Na_2CO_3$ solutions showed that stable emulsions are not formed if the aqueous solution pH is maintained below 9. With 50 g/l $NaHCO_3$ (pH 8.3), phase separation is moderately rapid with only a slight amount of brownish colored scum formed, and the brown coloration is discharged from the organic. After the $NaHCO_3$ scrub, the organic responded normally to uranium extraction.

PHASE SEPARATION RATES

Extraction, organic wash, and stripping phase separation rates were determined by static and dynamic methods[1/] using the 12-cycle organic and aqueous solutions from the SX unit at the end of the run. These data are summarized in Table 11, and Figures 6 and 7.

1/ Described in the appendix section.

YELLOW CAKE PRECIPITATION

A composite of the strip solution produced during the last 60 hours of the SX run was neutralized to pH 7.5 with NH_4OH to precipitate the uranium as yellow cake. Simulating a continuous operation, the 22 g/l U_3O_8 strip solution and 7.2 N NH_4OH were added simultaneously over one hour at 40°C, the precipitate was allowed to settle, and the clear supernate decanted off. The thickened slurry was filtered, the precipitate washed with 10 g/l $(NH_4)_2SO_4$ pH 7.5, then pH 8 NH_4OH, and dried at 90-100°C for 12 hours. Test details are given in the appendix section.

Pertinent precipitation data are:

% U_3O_8 precipitated	99.9+
NH_3 consumption	0.18 lb NH_3/lb U_3O_8
Yellow cake, grade	87.2% U_3O_8
purity	Meets typical refinery specifications, Table 12.
S/L separation	The precipitate settled and filtered well.

SX RAFFINATE NEUTRALIZATION

A raffinate sample produced during the latter part of the SX run was neutralized with reagent grade $Ca(OH)_2$ at ambient temperature to determine lime consumption and liquor assay at pH's 8.0 and 9.2. Test results, detailed in the appendix section, summarize as follows:

$Ca(OH)_2$ CONSUMPTION

	$Ca(OH)_2$ Consumption	
pH	lb/gal Raffinate	lb/lb U_3O_8 1/
5.2	0.095	107
6.7	0.105	117
7.0	0.106	120
8.0	0.110	124
9.2	0.138	155

1/ The liquor before SX contained 0.17 g/l U_3O_8.

LIQUOR ASSAYS

Analytical data for the raffinate and pH 8 and 9.2 solutions are given in Table 13.

Table 1

Analysis of Composite Samples

Composite	A	B	C	D	E	F
Wt, lb	75	81	136	68	80	46
Specific gravity	2.36	2.41	2.28	2.38	2.41	2.47
Assays, in %						
U_3O_8, radiometric, β/γ 2/	0.065	0.11	0.10	0.066	0.040	0.049
β equiv	0.054	0.082	0.079	0.055	0.035	0.041
γ equiv	0.046	0.065	0.061	0.047	0.028	0.037
fluorimetric	0.064	0.092	0.084	0.066	0.042	0.049
volumetric	0.061	0.100	0.091	0.067	0.045	0.049
V_2O_5	0.089	0.062	0.15	0.10	0.066	0.14
Mo	0.005	0.009	0.015	0.006	0.008	0.002
CO_2	8.0	9.1	3.4	2.7	6.2	1.6
PO_4	0.16	0.13	0.17	0.14	0.15	0.17
Cl	<0.01	<0.01	<0.01	<0.01	<0.01	±0.01
S_{Total}	0.48	0.70	1.08	1.03	0.96	<0.02
Spectrographic 1/, in %						
U	0.065	0.10	0.090	0.077	0.059	0.053
V	0.02	0.008	0.03	0.02		0.02
Mo	0.005	0.01	0.02	0.008	0.02	0.003
Cu	0.01	0.007	0.01	0.005	0.01	0.01
Pb	0.004	0.009	0.003	0.01	0.004	0.01
As	0.008	0.007	0.01	0.008	0.01	0.004
Fe	2.3	1.7	1.9	2.7	2.1	1.8
Ni	0.004	0.004	0.002	0.005	0.003	0.002
Rb	0.02	0.02	0.02	0.02	0.02	0.03
Ba	0.04	0.06	0.05	0.08	0.07	0.07
Sr	0.08	0.1	0.09	0.08	0.1	0.05
Ti	0.03	0.05	0.08	0.07	0.05	0.1
Zr	0.03	0.04	0.03	0.03	0.04	0.03
Mn	0.04	0.03	0.04	0.04	0.04	0.02
Zn	0.02	0.02	0.02	0.02	0.02	0.02
Y	0.005	0.004	0.006	0.008	0.008	0.007
Se			0.005			

1/ Semi-quantitative XRF scan, by Fluo-X-Spec Lab, Denver, Colorado.
2/ Calculated radiometric U_3O_8 assay from β and γ equivalents.

Table 2

Summary of H_2SO_4 Leach Tests on Individual Composites and Master Composite No. 1 (1 of 2 pages)

Test No.		2			4			5			1			6			3	
Book No. 1070-		5			10			12			4			14			6	
Composite		A			B			C			D			E			F	
Grind, % plus 28-mesh		2			2			2			3			4			2	
% minus 200-mesh		53			53			50			62			52			68	
% solids		39			35			43			40			41			43	
Acidity, pH		1.0-1.1			1.0-1.2			1.0-1.1			0.9-1.1			1.0-1.1			1.0-1.1	
Temperature, °C		80			80			80			80			80			80	
Assay, heads, % U_3O_8		0.064			0.092			0.084			0.066			0.042			0.049	
Calculated heads, % U_3O_8		0.058			0.089			0.083			0.069			0.040			0.051	
Leach time, hr	4	8	12	4	8	12	4	8	12	4	8	12	4	8	12	4	8	12
Residue, % U_3O_8	0.0066	0.0070	0.0061	0.0079	0.0077	0.0074	0.0078	0.0095	0.0086	0.0084	0.0082	0.0081	0.0061	0.0061	0.0061	0.0020	0.0024	0.0024
% U_3O_8 extracted[2]	88.6	87.9	89.4	91.1	91.3	91.7	90.6	88.6	89.6	87.8	88.1	88.3	84.8	84.8	84.8	96.1	95.3	95.3
H_2SO_4 added, lb/ton	440	453	467	516	538	548	250	266	278	204	223	223	374	397	397	121	137	144
$NaClO_3$ added, lb/ton	20	21	27	25	30	30	32	32	32	30	30	44	26	31	31	12	12	12
emf (-mv)	420	400	440	430	420	370	430	340	330	390	360	390	410	390	350	720	720	710
Thickening test																		
Initial pulp, % solids		20.8			20.4			20.2			20.8			19.8			20.3	
Flocculant[1], lb/ton		0.14			0.15			0.15			0.14			0.15			0.15	
UA, ft^2/ton solid/day		8.9			15			11			9.1			7.8			6.0	
Thickened pulp, % solids		43			40			42			47			41			46	

1/ Separan MG 200.
2/ Based on calculated heads.

Table 2 (2 of 2 pages)

Test No.		9			8			7			10			11			12	
Book No. 1070-		28			26			24			36			38			40	
Composite		Master Composite No. 1			Master Composite No. 1			Master Composite No. 1			Master Composite No. 1			Master Composite No. 1			Master Composite No. 1	
Grind, % plus 28-mesh		1.3			1.3			8			2			2			2	
% minus 200-mesh		53			53			45			53			53			53	
% solids		37			39			39			39			38			38	
Acidity, pH		1.0-1.1			1.5-1.6			1.0-1.1			1.0-1.1			1.0-1.1			1.0-1.1	
Temperature, °C		80			80			80			75			75			75	
Assay, heads, % U_3O_8		0.063			0.064			0.064			0.064			0.065			0.066	
Calculated heads, % U_3O_8		0.071			0.059			0.069			0.065			0.065			0.063	
Leach time, hr	4	8	12	4	8	12	4	8	12	4	6	10	4	6	10	4	6	10
Residue, % U_3O_8	0.0084	0.0079	0.0080	0.010	0.011	0.012	0.0086	0.0081	0.0086	0.0085	0.0081	0.0084	0.0075	0.0075	0.0085	0.0076	0.0081	0.0076
% U_3O_8 extracted[2/]	88.2	88.9	88.7	83.1	81.4	79.7	87.5	88.3	87.5	86.9	87.5	87.1	88.5	88.5	86.9	87.9	87.1	87.9
H_2SO_4 added, lb/ton	332	352	371	275	278	281	324	337	356	343	348	369	340	340	361	336	336	357
$NaClO_3$ added, lb/ton	18	22	23	20	25	28	18	21	23	2.1	2.1	2.1	6.3	6.3	6.3	13	13	13
emf (-mv)	370	370	390	420	370	360	385	400	390	350	330	330	365	340	340	370	345	345
Thickening test																		
Initial pulp, % solids		20.4			20.4			19.9			N/D			N/D			N/D	
Flocculant[1/], lb/ton		0.15			0.15			0.15										
UA, ft^2/ton solid/day		11			8.0			7.6										
Thickened pulp, % solids		41			47			43										

1/ Separan MG 200.
2/ Based on calculated heads.

Table 3

Screen Analysis and U_3O_8 Distribution in Residue Samples from Tests 7 and 9

Leach Test	Size Mesh	Wt %	Assay % U_3O_8	U_3O_8 Distribution %
No. 7	+14	1.2	0.028	4.3
	14x20	1.6	0.019	3.7
(Book No.	20x28	3.6	0.015	6.7
1070-24)	28x35	3.4	0.013	5.5
	30x48	6.9	0.013	11.1
	48x65	6.8	0.011	9.2
	65x100	7.3	0.0088	7.9
	100x150	7.6	0.0075	7.0
	150x200	6.5	0.0063	5.1
	200x270	4.7	0.0045	2.6
	270x325	1.4	0.0041	0.7
	-325	49.0	0.0060	36.2
	Calculated	100.0	0.0081	100.0
	Assay		0.0086	
No. 9	+20	0.5	0.033	2.3
	20x28	0.9	0.016	2.0
(Book No.	28x35	1.5	0.013	2.7
1070-28)	35x48	4.3	0.013	7.7
	48x65	6.4	0.011	9.7
	65x100	8.2	0.0090	10.2
	100x150	7.6	0.0078	8.2
	150x200	7.2	0.0077	7.7
	200x270	6.4	0.0063	5.6
	270x325	3.3	0.0053	2.4
	-325	53.7	0.0056	41.5
	Calculated	100.0	0.0072	100.0
	Assay		0.0080	

Table 4

Effect of Grind

	Master Composite No. 1	Master Composite No. 2	Composite B+C
Grind	In ball mill	In rod mill	In rod mill
% solids	38	38	42
$NaClO_3$ added, lb/ton	22	6.3	6.3
Temperature, °C	80	75	75

Test No.	7	9	16	13	19	18	14	20	25	22	26	23
Ore	Master Composite 1		Master Composite 2						Composite B+C			
Grind, min	7	11	3.5	5	6.5	3.5	5	6.5	3.5	5	3.5	5
% plus 28-mesh	8	1	5	0.6	0.2% +35M	5	0.6	0.2% +35M	7	0.5	7	0.5
% minus 200-mesh	45	53	45	44	53	45	44	53	41	47	41	47
H_2SO_4 added, lb/ton	337	352	355	355	355	417	416	417	366	372	429	434
Heads, % U_3O_8	0.067	0.067	0.069	0.066	0.065	0.068	0.064	0.066	0.086	0.088	0.091	0.091
Residue, % U_3O_8												
4-hr	0.0086	0.0084	0.0087	0.0080	0.0069	0.0063	0.0066	0.0057	0.012	0.011	0.0097	0.0073
6-hr	0.0081 2/	0.0079 2/	0.0087	0.0080	0.0067	0.0062	0.0063	0.0058	0.012	0.011	0.0087	0.0080
U_3O_8, extracted, %												
4-hr	87.2	87.5	87.4	87.9	89.4	90.7	89.7	91.4	86.0	87.5	89.3	92.0
6-hr	87.9 2/	88.2 2/	87.4	87.9	89.7	90.9	90.2	91.2	86.0	87.5	90.4	91.2
H_2SO_4 consumed, lb/ton												
4-hr			325	323	317	348	355	344	336	347	365	375
6-hr			329	329	322	354	359	351	343	350	375	383
Thickening 1/												
UA, ft^2/TPD			3.3	4.2	4.5	4.1	4.1	4.9	2.7	3.5	2.8	4.0
Final pulp, % solids			38	43	38	40	38	36	40	36	38	36

1/ Initial pulp density = 14-15% solids, flocculant added = 0.2 lb Separan MG 200/ton.
2/ In 8 hr.

Table 5

Effect of $NaClO_3$ Addition

	Master Composite No. 1	Master Composite No. 2	Composite B+C
Grind	Ball mill/11 min	Rod mill/5 mil	Rod mill/5 min
% plus 28-mesh	1.3	0.6	0.5
% minus 200-mesh	53	44	47
% solids	38-39	38-39	41-42
Acidity, pH	1.0	0.8	0.8
H_2SO_4 added, lb/ton	336-348	417	434-421
Temperature, °C	75	75	75

Test No.	10	11	12	14	15	23	24
Ore	Master Composite No. 1			Master Composite No. 2		Composite B+C	
$NaClO_3$ added, lb/ton	2.1	6.3	13	6.3	28	6.3	27
Heads, % U_3O_8	0.065	0.065	0.063	0.064	0.065	0.091	0.094
Residue, % U_3O_8							
4-hr	0.0085	0.0075	0.0076	0.0066	0.0057	0.0073	0.0071
6-hr	0.0081	0.0075	0.0081	0.0063	0.0055	0.0080	0.0070
U_3O_8 extracted, %							
4-hr	86.9	88.5	87.9	89.7	91.2	92.0	92.4
6-hr	87.5	88.5	87.1	90.2	91.5	91.2	92.6
Thickening							
UA, ft^2/TPD				4.1	6.4	4.0	3.3
Final pulp, % solids				38	38	36	36

Table 6

Effect of Acidity

	Master Composite No. 1	Master Composite No. 2	Composite B+C
Grind	Ball mill/11 min	Rod mill/5 min	Rod mill/5 min
% plus 28-mesh	1.3	0.6	0.5
% minus 200-mesh	53	44	47
% solids	38	40	42
$NaClO_3$ addition, lb/ton	23-28	6.3	6.3
Temperature, °C	80	75	75

Test No.	8	7	13	14	22	23
Ore	Master Composite No. 1		Master Composite No. 2		Composite B+C	
Acidity[3/], g/l H_2SO_4	5	10	10	20	10	20
H_2SO_4 added, lb/ton	278[1/]	352[1/]	355	416	372	434
Heads, % U_3O_8	0.061	0.067	0.066	0.064	0.088	0.091
Residue, % U_3O_8						
4-hr	0.010	0.0084	0.0080	0.0066	0.011	0.0073
6-hr	0.011[1/]	0.0079[1/]	0.0080	0.0063	0.011	0.0080
U_3O_8 extracted, %						
4-hr	84	87	87.9	89.7	87.5	92.0
6-hr	82[1/]	88[1/]	87.9	90.1	87.5	91.2
H_2SO_4 consumed, lb/ton						
4-hr			323	355	347	375
6-hr			329	359	350	383
Thickening[2/]						
UA, ft^2/TPD			4.2	4.1	3.5	4.0
Final pulp, % solids			43	38	36	36

1/ In 8 hr.
2/ Initial pulp - 14-15% solids, flocculant added = 0.2 lb Separan MG 200/ton.
3/ At 6 hr.

Table 7

Effect of Weathering

Ore	Master composite No. 2
Weathering conditions	
Grind	Minus 6-mesh
Moistening	Moistened to 20% H_2O, 3 times per week
Temperature	50-55°C, in air atmosphere
Time	4 weeks
"Control" ore	Stored in nitrogen atmosphere at 22-25°C
Common leach conditions	
Grind	Rod mill, 5 min
% solids	39-42
Leach time	6 hr

Test	28	29	30	31
Ore	Weathered	Weathered	Control	Control
H_2SO_4 added, lb/ton	374	446	448	373
H_2SO_4 consumed, lb/ton	331	362	354	325
$NaClO_3$ added, lb/ton	2.0	6.2	2.0	6.2
Temperature, °C	60	60	60	60
Heads, assay % U_3O_8	0.069	0.067	0.064	0.064
calculated % U_3O_8	0.068	0.066	0.068	0.069
Residue, % U_3O_8	0.0082	0.0070	0.0067	0.0077
% U_3O_8 extracted	88.0	89.4	89.8	88.4

Test	32	33	34	35
Ore	Weathered	Weathered	Control	Control
H_2SO_4 added, lb/ton	441	375	374	445
H_2SO_4 consumed, lb/ton	364	339	338	375
$NaClO_3$ added, lb/ton	2.0	6.2	2.0	6.2
Temperature, °C	75	75	75	75
Heads, assay % U_3O_8	0.066	0.066	0.064	0.066
calculated % U_3O_8	0.067	0.063	0.065	0.062
Residue, % U_3O_8	0.0070	0.0070	0.0066	0.0058
% U_3O_8 extracted	89.5	89.1	89.8	90.9

Table 8

Thickening Test Data

Comparative tests on individual composites

Test	2	4	5	1	6	3
Composite	A	B	C	D	E	F
Grind, % plus 28-mesh	2	2	2	3	4	2
Acidity, g/l H_2SO_4	10	10	10	10	10	10
$NaClO_3$ added, lb/ton	27	30	32	44	31	12
Initial pulp, % solids	21	20	20	21	20	20
Flocculant 1/, lb/ton	0.14	0.15	0.15	0.14	0.15	0.15
UA, ft^2/TPD	8.9	15	11	9.1	7.8	6.0
Thickened pulp, % solids	43	40	42	47	41	46

Effect of leach variables

Test	17	18	14	15	20	21	26	23
Composite	Master Composite No. 2						Composite B+C	
Grind, % plus 28-mesh	4.5	4.5	0.6	0.6	0.2% 35M	0.2% 35M	7	0.5
Acidity, g/l H_2SO_4	18	20	19	19	21	20	20	19
$NaClO_3$ added, lb/ton	6.3	28	6.3	28	6.3	27	6.3	6.3
Initial pulp, % solids	15	15	14	14	15	15	15	15
Flocculant 1/, lb/ton	0.20	0.20	0.21	0.21	0.20	0.20	0.20	0.20
UA, ft^2/TPD	3.3	4.1	4.1	6.4	4.9	5.2	2.8	4.0
Thickened pulp, % solids	37	40	38	38	36	37	38	36

1/ Separan MG 200/ton

Table 9

Analysis of Leach Liquor (Batch 4) Used at End of Continuous SX Run

1. Chemical

	g/l
U_3O_8	0.17
V_2O_5	0.13
Mo	<0.001
Al	1.18
Si	0.077
Mg	1.80
Fe	1.78
Ca	0.31
Cl	0.31
PO_4	0.32
SO_4	34.5
H_2SO_4	14
Total diss. salts	43.7

Spectrographic (qual/semi-quantitative)

	Emission	XRF
U		0.2
Si	0.04	
Al	1	
Fe	2	1
Ca	0.3	
Mg	2	
Na	3	
Ti	0.03	
Mn	0.1	0.04
Cr	0.003	
V	0.03	
Sr	0.0005	0.02
Cu		0.002
Zn		0.03
Pb		0.002
Ni		0.003
Ba		0.004
Zr		0.004
Mo		0.003
Y		0.001

Table 10

Test Conditions and Results at End of SX Run

Organic	2.5 vol % Alamine 336 + 2.5 vol % isodecanol in Napoleum 470B kerosene Amine normality = 0.048 N
Organic wash solution	pH 1.8 H_2SO_4
Strip solution	150 g/l $(NH_4)_2SO_4$, pH adjusted with 3.7 N NH_4OH in stage 1, and 0.37 N NH_4OH in stages 2 and 3.

	Extraction	Organic Wash	Stripping
No. of stages	4	1	3
O/A ratio in mixer	0.6[1/]	2	1-3
Flow rate, ml/min			
Organic	9.33	9.33	9.33
Aqueous	101	1.03	0.46
Recycle	±60 (O)	4 (A)	±4 (A)
NH_4OH, stage 1			0.089
2			0.12
3			0.088
Contact time, min/stage	0.9	10	10
Temperature, °C	23	23	23
Strip pH, stage 1			3.7
2			3.9
3			4.2

Circuit profile

	g/l U_3O_8[2/]		g/l Mo[3/]	
Stage	Aqueous	Organic	Aqueous	Organic
Feed liquor	0.173		<0.001	
organic		0.20		0.015
Extraction E4	0.0006	0.20		
E3	0.0007	0.14		
E2	0.0033	0.53		
E1	0.038	2.04		
Organic wash	0.012	2.09		0.038
Strip S1	20.5	0.61	0.18	
S2	9.41	0.22		
S3	2.31			0.015

1/ Maintained organic continuous.
2/ 2/8/78 assays.
3/ 2/7/78 assays.

Table 11

Phase Separation Rates

Organic and aqueous solutions	From SX circuit at end of run
Temperature	22-24°C
Phase continuous	Organic

Stage	O/A Ratio	Contact Time min	Phase Separation Rate, gpm O+A/ft^2			
			Static Method		Dynamic Method	
			5" Band	Complete	5" Band	2" Band
Extraction, barren	1.2/1	1	2.4	2.0	2.1	1.5
loaded	1.2/1	1	3.1	2.4	2.3	1.7
Organic wash (pH 1.8 H_2SO_4)	2/1	1	3.4	2.8		
Stripping, pregnant	2/1	5	4.5	3.3		±2.8
barren		5				±2.8
Organic scrub ($NaHCO_3$)	2/1	5		2.2		

Table 12

Yellow Cake Product Analysis

	Yellow Cake %	Typical Specifications[2] Kerr-McGee %	Allied Chemical %
Uranium , U_3O_8	87.2[1]	70.6 min	76.5 min
		Maximum[3]	Maximum[4]
Molybdenum, Mo	0.049	0.15	0.10
Vanadium , V	<0.01	0.10	0.06
Calcium , Ca	<0.01	1.00	0.05
Sodium , Na	<0.01		0.50
Potassium , K	<0.01		0.10
Zirconium , Zr	<0.1	2.00	
Thorium , Th	<0.1	2.00	
Iron , Fe	<0.01		0.15
Titanium , Ti	<0.01		
Magnesium , Mg	<0.01		
Phosphorus , P	<0.01	0.35	0.033
Arsenic , As	<0.01	1.00	0.05
Boron , B	<0.005	0.15	0.005
Halides , Cl, Br, I	<0.03	0.25	0.05
Fluoride , F	<0.02	0.15	0.01[5]
Sulfur , SO_4	0.82	10.5	3.0
Carbonates , CO_3	<0.1	2.00	0.20
HNO_3 insoluble U_3O_8	<0.05	0.10	

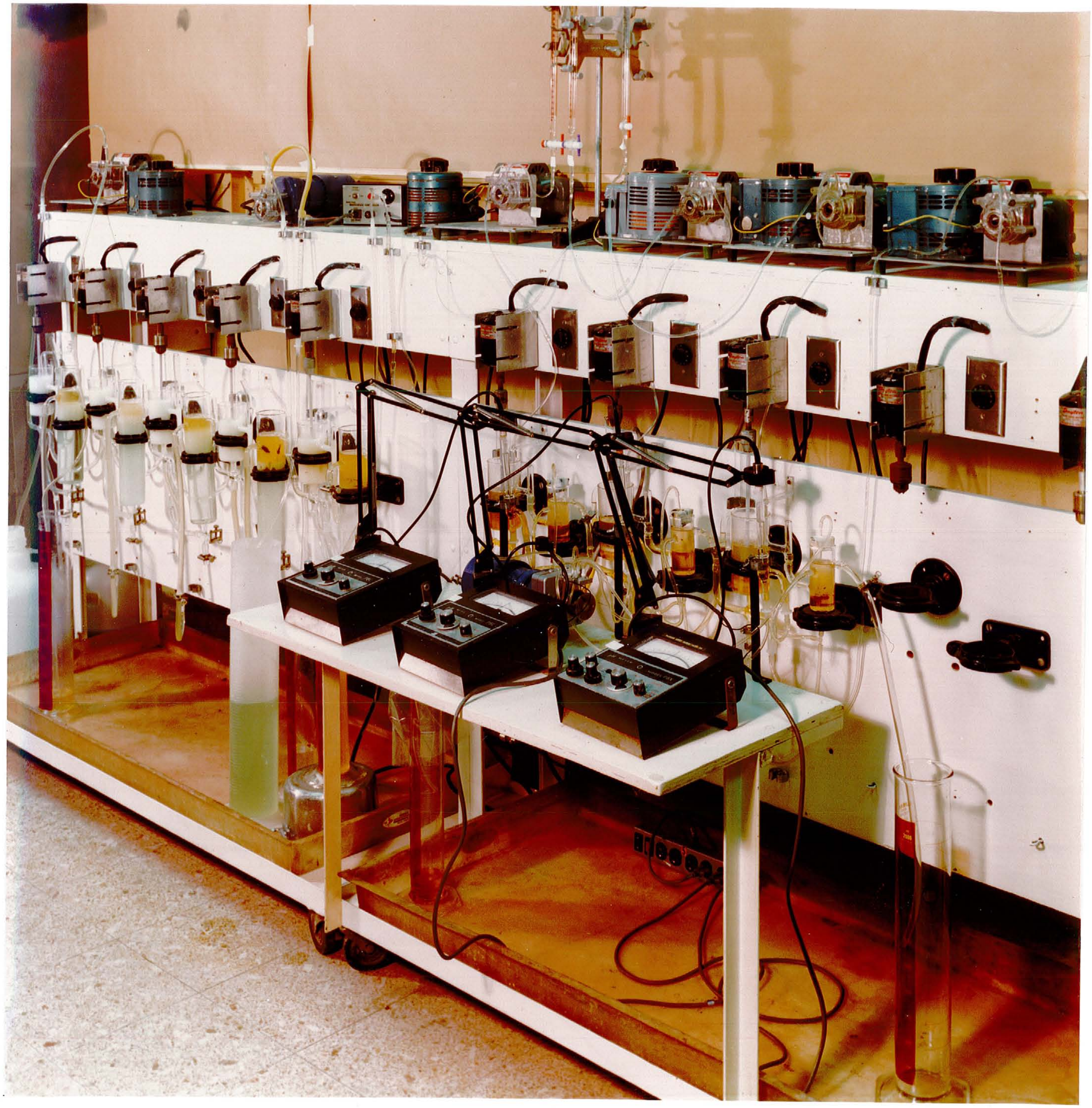
1/ Dried at 90-100°C overnight.
2/ For 1976, limit without surcharge.
3/ Based on uranium content.
4/ Based on "standard concentrates."
5/ 0.10% maximum.

Table 13

Analysis of Raffinate and Neutralized Solutions

	Assay, g/l		
	Raffinate	pH 8.0 Solution	pH 9.2 Solution
1. Chemical			
U_3O_8	0.0005		
H_2SO_4	14		
Cations	0.76 eq/L	0.22 eq/L	0.074 eq/L
Fe	1.93	<0.002	<0.002
Al	1.31	<0.005	<0.005
Mg	2.10	1.83	0.051
V_2O_5	0.14	<0.002	<0.002
Ca	0.32	0.42	0.45
Si	0.082	<0.01	<0.01
SO_4	36.1	10.3	2.91
Cl	0.33	0.33	0.30
PO_4	0.33	0.001	0.002
TDS1/	45.8	15.1	4.9
2. Spectrographic2/			
Al	1	ND3/	ND
Fe	2	0.004	0.005
Ca	0.3	0.2	0.2
Mg	1	2	0.05
Na	3	2	>0.5
Si	0.05	<0.0001	<0.0001
K		0.2	0.2
Ti	0.02	ND	ND
Mn	0.1	0.03	<0.001
Cr	0.005	ND	ND
Mo	0.002	<0.001	<0.001
V	0.04	ND	ND
B	<0.001	<0.0005	<0.0005
Sr	0.01	<0.001	<0.001
Cu	0.002	<0.001	<0.001
Zn	0.01	<0.001	<0.001
Pb	0.003	ND	ND
As	0.003	<0.001	<0.001
Ni	0.004	<0.001	<0.001
Rb	0.0005	0.002	0.002
Ba	0.007	0.003	ND
Zr	0.003	<0.001	<0.001
Y	0.004	<0.001	0.006
Th	<0.001	ND	ND
Se	0.003	ND	ND

1/ TDS - total dissolved solids.
2/ Qual/semi-quantitative.
3/ ND = not detected, <0.001



Photograph of SX Equipment

Figure 1

EXTRACTION ISOTHERMS, COMPARISON OF CYCLED TO FRESH ORGANIC

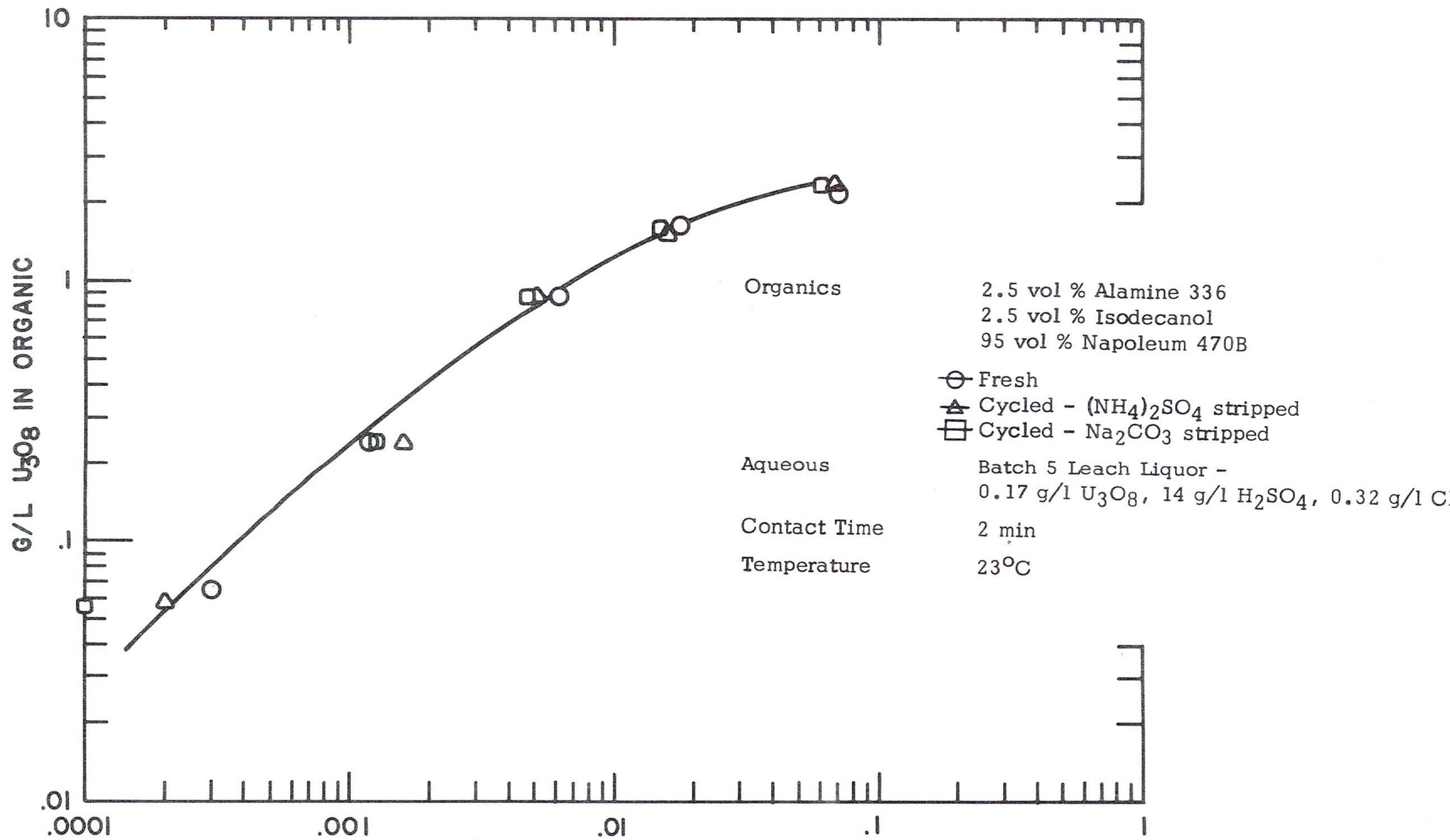


FIGURE 2

hri

Photograph of scum which accumulated in loaded extraction stage settler during SX run.

Figure 3

STRIPPING ISOTHERM

Organic	From SX Circuit at End of Run
Strip Solutions	From SX Circuit at End of Run
pH	Adjusted with NH_4OH or H_2SO_4
Contact Time	5 min at pH
Temperature	23°C

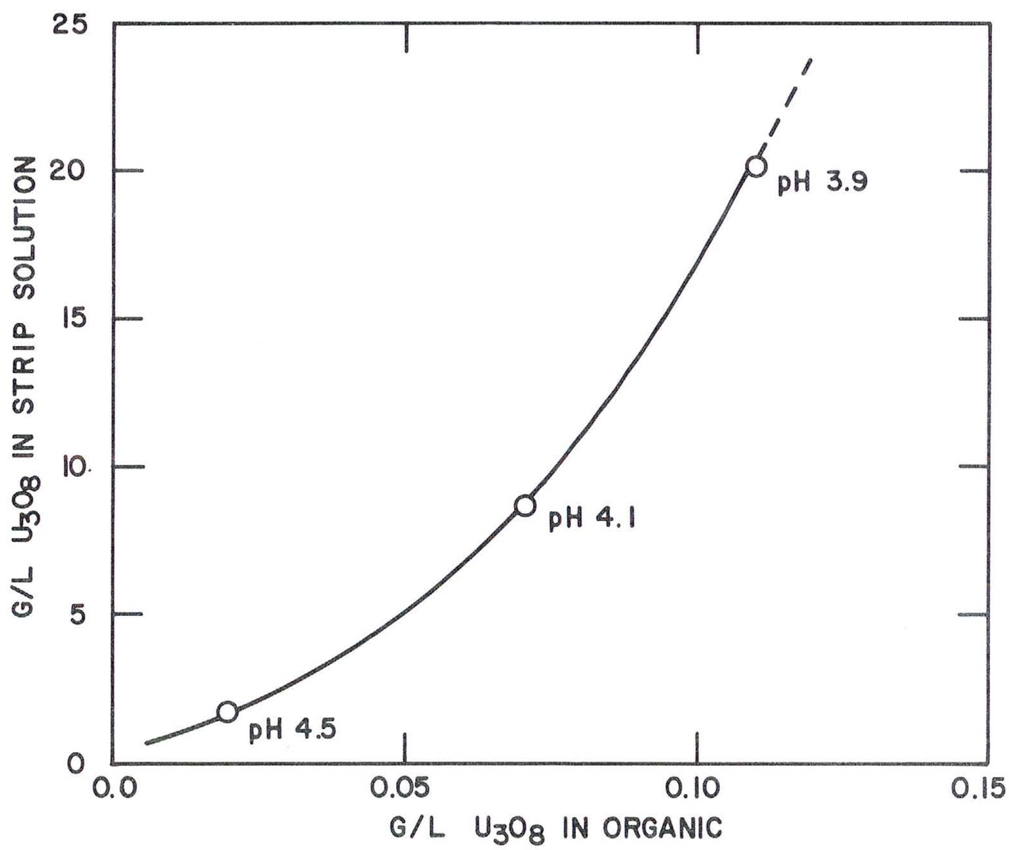


FIGURE 4

hri

Photograph of scum which accumulated in pregnant strip stage settler during SX run.

Figure 5

PHASE SEPARATION RATE - BARREN AND LOADED
EXTRACTION STAGES BY DYNAMIC METHOD

Book No.	1070-134/139
Organic	12 Cycle Organic from SX Run
	Barren Organic - 0.1 g/l U_3O_8
	Loaded Organic - 1.9 g/l U_3O_8
Aqueous	Barren Stage - Raffinate from SX Run 2/7
	Loaded Stage - Batch 4 Leach Liquor
O/A Ratio	1.2/1
Impeller Speed	1500 rpm
Phase Continuous	Organic
Temperature	24°C

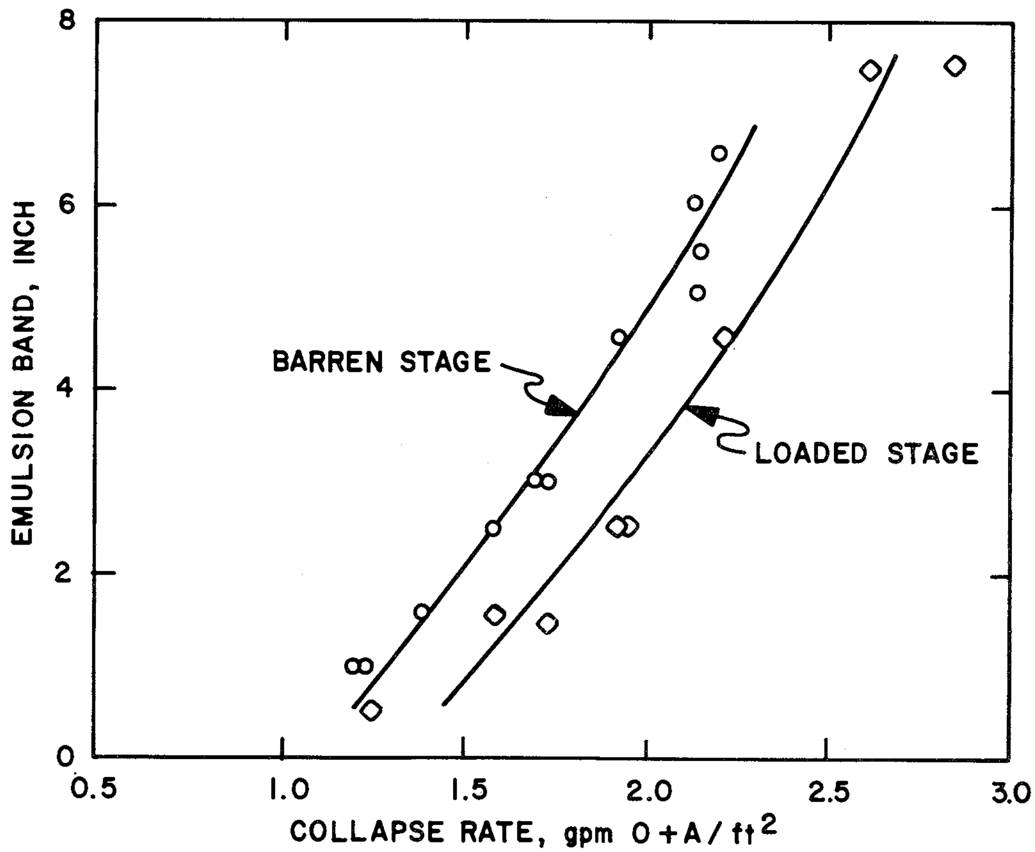


FIGURE 6

hri

PHASE SEPARATION RATE - PREGNANT AND BARREN STRIPPING STAGES BY DYNAMIC METHOD

Organic	12 Cycle Organic from SX Run
Strip Solutions	Pregnant Stage - From SX Run at 15 g/l U_3O_8 Diluted to 10 g/l U_3O_8 with 150 g/l $(NH_4)_2SO_4$, Contacted with Organic and pH Adjusted to pH 4.0
	Barren Stage - Pregnant Stage Strip Solution Adjusted to 3 g/l U_3O_8 with 150 g/l $(NH_4)_2SO_4$ and pH to 4.5
O/A Ratio	2/1
Impeller Speed	1500 rpm
Phase Continuous	Organic
Temperature	25°C

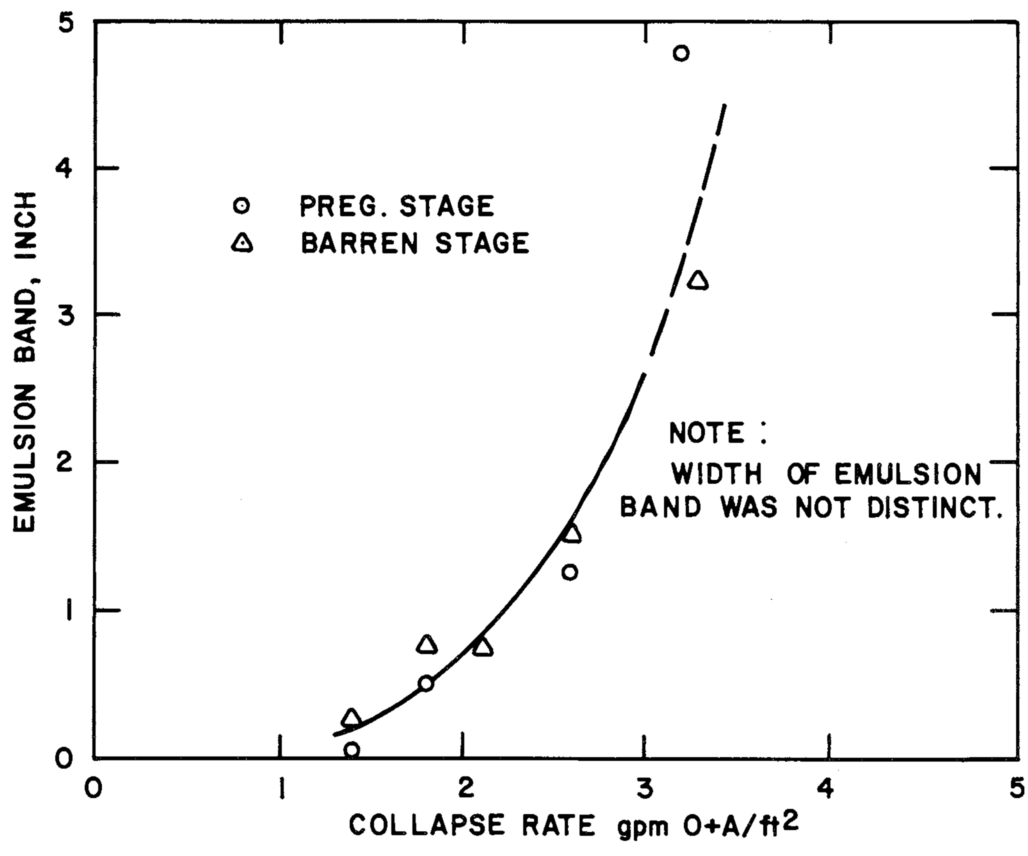


FIGURE 7

APPENDIX

APPENDIX

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TABLE OF CONTENTS (Cont'd)

Core Samples Received from Minerals Exploration

Samples received from	Minerals Exploration, Tucson office, (R. Lucht, Geological Engineer)
Date received	Week of November 21, 1977.
Shipment	1-foot sections of the cores[1/] were individually packaged in sealed plastic bags, and shipped in four 55-gal drums plus two 5-gal pails.
HRI designation no.	12652 series

Hole No. AM-	Footage	No. of Samples
2C	68-86	18
10C	240-245	5
	301-310	9
22C	440-450	10
	458-463	5
28C	396-404	8
40C	68-71	3
63C	191-199	8
	219-222	3
	226-227	1
67C	51-56	5
	120-126	6
	130-139	9
68C	72-76	4
	105-122	17
	150-162	12
71C	47-53	6
	75-92	17
88C	83-91	8
106C	240-259	19
107C	249-264	15
	269-279	9
	282-290	8
	337-339	2
	340-344	4
	345-347	2

1/ Crushed to minus 1/2-inch.

Hole No. AM-	Footage	No. of Samples
107C	348-351	3
129C	281-285	4
	328-349	11
	351-356	5
	371.5"-372.2"	1
	373.5"-376.3"	3
136C	299-304	5
	335-337	2
	352-361	9
	369-378	9
152C	130-136	6
152C1	127-130	3
156C	433-438	5
	496-499	3
	501-504	3
	522-525	3
	539-545	6
	582-585	3
	612-615	3
	624-627	3
171C	537-540	3
	542-545	3
	556-559	3
	574-578	4
258C	80-95	15
281C	156.6"-160	1
	160-174	14
	193-195	2
	196-202	6
286C	60-70	10
	90-111	11
	112-114	2
308C	72-75	3
323C	142.6"-143.6"	1
	144.2"-144.10"	1
	144.6"-147.6"	3
	148.6"-149.6"	1
	149.6"-150.2"	1
	150.8"-152.8"	2
	152.2"-153.8"	2

Hole No. AM-	Footage	No. of Samples
325C	113-116	3
	136-143	7
	146-149	3
336C	213-217	4
	253.6"-256.6"	3
	256.6"-257	1
338C	346-355	9
338C1	330-333	3
	337-340	3
	345-351	6
	352-355	3
338C2	334-346	12
345C	369-375	6
	415-424	9
	443-459	16
	465-470	5
351C	389-400	11
371C	407-410	3
	411-416	5
	428-450	22
373C	368-374	6
	378-380	2
384C	365-368	3
	398-401	3
	436-439	3
	443-445	2
384C1	362-364	2
388C	344-349	5
	372-375	3
	380-383	3
	387-397	10
	404-412	8
	427-430	3
	431-437	6
396C	72-80	8
	126-131	5
	142-146	4
419C	455-465	10
	490-504	14
	515-528	13

Hole No. AM-	Footage	No. of Samples
419C	545-552	7
	563-567	4
443C	275-281	6
	315-324	9
	328-331	3
	333-335	2
	338-346	8
	357-362	5
	371-377	6
486C	443-448	5
	494-497	3
	500-504	4
	510-511	1
	511-511.9"	1
	511.9"-512.3"	1
	512.3"-513	1

Preparation of Individual Composites A through F

According to Mr. R. Lucht of Minerals Exploration Company, Tucson, instructions, the following core samples were used to make up the six composites. Each core was riffled in half, one-half was used for compositing and the second half stored. The composite was dried at 50°C, cone-crushed to minus 6-mesh, blended, and split into 1 and 10-kg portions for testing.

Composite	Hole	Footage	Assay[1/] % U_3O_8
A	AM2C	69 -74	0.017
	2C	76 -86	0.111
	40C	68 -71	0.024
	88C	83 -87	0.036
	258C	80 -90	0.065
	258C	92 -95	0.026
	281C	158'6"-163	0.028
	281C	166 -171	0.033
	281C	195 -198	0.036
	286C	60 -64	0.040
	286C	90 -95	0.035
	286C	98 -101	0.037
	308C	72 -75	0.024
	323C	142'6"-147'6"	0.155
	323C	148'6"-152'8"	0.104
	Calculated assay		0.0595
	Composite assay		0.064

1/ Reported by R. Lucht

Composite	Hole	Footage	Assay % U_3O_8
B	AM106C	240 -245	0.057
	106C	252 -259	0.051
	107C	254 -258	0.029
	107C	260 -264	0.028
	107C	270 -278	0.034
	107C	287 -290	0.040
	107C	345 -347	0.022
	129C	281 -285	0.025
	129C	328 -334	0.077
	129C	345 -348	0.055
	129C	351 -356	0.131
	129C	373'6"-376'3"	0.051
	325C	113 -116	0.054
	325C	136 -142	0.581
	336	253'6"-257	0.032
	336	213 -217	0.048
	Calculated assay		0.0964
	Composite assay		0.092
C	AM136C	299 -303	0.031
	136C	336 (Note 1)	
	136C	352 -360	0.102
	136C	369 -378	0.142
	152C-1	127 -130	0.021
	338C-1	330 -333	0.025
	338C-1	337 -340	0.028
	338C-1	345 -351	0.149
	338C-1	352 -355	0.057
	338C-2	335 -346 (Note 2)	
	371C	429 -450	0.136
	371C	407 -416	0.044
	373C	368 -374	0.053
	373C	378 -381	0.018
	384C-1	362 -364	0.236
	384C	365 -368	0.024
	384C	398 -401	0.192
	384C	436 -439	0.019
	384C	443 -445'9"	0.041
	388C	345 -348	0.016

Note 1: Footage 337-344 were missing.
Note 2: Footage 346-353 were missing.

Composite	Hole	Footage	Assay % U_3O_8
C contd.	AM388C	388-397	0.050
	388C	406-412	0.195
	388C	427-430	0.032
	388C	431-436	0.042
	396C	75-79	0.327
	396C	142-146	0.033
	Calculated assay		0.0880
	Composite assay		0.084
D	AM22C	443-447	0.043
	22C	460-463	0.041
	419C	491-499	0.048
	419C	515-521	0.055
	419C	546-550	0.091
	345C	373-375	0.250
	345C	417-422	0.096
	345C	447-450	0.182
	345C	452-457	0.051
	345C	468-470	0.064
	443C	275-277	0.025
	443C	319-324	0.095
	443C	328-331	0.026
	443C	333-336	0.023
	443C	340-346	0.061
	443C	357-362	0.056
	443C	371-377	0.033
	Calculated assay		0.0667
	Composite assay		0.066
E	AM28C	396-402	0.034
	156C	433-438	0.034
	156C	496-499	0.072
	156C	501-504	0.031
	156C	522-525	0.023
	156C	539-545	0.066
	156C	582-585	0.038
	156C	612-615	0.012
	156C	624-627	0.035
	171C	537-540	0.031
	171C	542-545	0.034

Composite	Hole	Footage	Assay % U_3O_8
E contd.	AM171C	556-559	0.027
	171C	574-578	0.043
	351C	389-393	0.034
	351C	394-399	0.028
	486C	500-504	0.023
	486C	444-448	0.057
	486C	494-497	0.037
	486C	510-514	0.118
	Calculated assay		0.0421
	Composite assay		0.042
F	AM10C	301-308	0.037
	10C	240-243	0.201
	63C	191-198	0.053
	63C	219-222	0.054
	68C	105-110	0.031
	68C	112-118	0.034
	68C	150-153	0.064
	68C	154-157	0.114
	71C	47-52	0.026
	71C	77-82	0.052
	71C	85-90	0.031
	Calculated assay		0.0544
	Composite assay		0.049

Grinding Data, Ball Mill

Screen Analysis of Minus 6-mesh Ore and Ground Leach Feed

Conditions

Ball mill: 7-5/8" I.D. x 7-1/8", 85/90 rpm

Ball charge:

Ball Size, Inch Diam	No. of Balls	Weight, kg
1-1/2 to 1-3/4	7	1.54
1 to 1-1/4	33	2.25
3/4	17	0.52
1/2	25	0.27

Ore charge: 1.0 kg minus 6-mesh

H_2O: 1.0 liter

Composite Sample Grind time, min		A Minus 6-mesh 0			A Leach feed 12.5	
			Cum Wt %			Cum Wt %	
Size Mesh	Wt, %	Retained	Passing	Wt, %	Retained	Passing
+8	10.6	10.6	89.4			
8x10	21.6	32.2	67.8			
10x14	17.3	49.5	50.5			
14x20	11.9	61.4	38.6			
20x28	8.5	69.9	30.1	1.9	1.9	98.1
28x35	6.1	76.0	24.0	0.3	2.2	97.8
35x48	5.0	81.0	19.0	5.2	7.4	92.6
48x65	3.6	84.6	15.4	9.6	17.0	83.0
65x100	3.4	88.0	12.0	11.3	28.3	71.7
100x150	2.7	90.7	9.3	11.0	39.3	60.7
150x200	2.4	93.1	6.9	7.8	47.1	52.9
200x270	6.9	100.0	0	0.5	47.6	52.4
270x325				6.5	54.1	45.9
-325				45.9	100.0	0

Composite Sample Grind time, min	Size Mesh	Wt, %	B Minus 6-mesh ore 0 Cum Wt % Retained	 Passing	Wt, %	B Leach feed 12 Cum Wt % Retained	 Passing
	+8	7.5	7.5	92.5			
	8x10	18.7	26.2	73.8			
	10x14	15.5	41.7	58.3			
	14x20	11.5	53.2	46.8			
	20x28	9.0	62.2	37.8	2.3	2.3	97.7
	28x35	6.7	68.9	31.1	0.9	3.2	96.8
	35x48	5.8	74.7	25.3	5.4	8.6	91.4
	48x65	4.3	79.0	21.0	9.2	17.8	82.2
	65x100	4.2	83.2	16.8	11.7	29.5	70.5
	100x150	3.5	86.7	13.3	11.0	40.5	59.5
	150x200	3.3	90.0	10.0	6.9	47.4	52.6
	200x270	10.0	100.0	0.0	8.9	56.3	43.7
	270x325				4.6	60.9	39.1
	-325				39.1	100.0	0.0

Composite Sample Grind time, min	Size Mesh	Wt, %	C Minus 6-mesh ore 0 Cum Wt % Retained	 Passing	Wt, %	C Leach feed 12 Cum Wt % Retained	 Passing
	+8	6.7	6.7	93.3			
	8x10	17.6	24.3	75.7			
	10x14	15.0	39.3	60.7			
	14x20	11.3	50.6	49.4			
	20x28	8.7	59.3	40.7	2.4	2.4	97.6
	28x35	6.7	66.0	34.0	1.0	3.4	96.6
	35x48	5.7	71.7	28.3	5.3	8.7	91.3
	48x65	4.2	75.9	24.1	9.4	18.1	81.9
	65x100	4.1	80.0	20.0	12.0	30.1	69.9
	100x150	4.6	84.6	15.4	11.6	41.7	58.3
	150x200	5.5	90.1	9.9	8.0	49.7	50.3
	200x270	9.9	100.0	0.0	6.6	56.3	43.7
	270x325				5.1	61.4	38.6
	-325				38.6	100.0	0.0

Composite Sample Grind time, min		D Minus 6-mesh ore 0		D Leach feed 10		
Size Mesh	Wt, %	Cum Wt % Retained	Passing	Wt, %	Cum Wt % Retained	Passing
+8	7.1	7.1	92.9			
8x10	19.8	26.9	73.1			
10x14	16.7	43.6	56.4			
14x20	12.0	55.6	44.4			
20x28	9.0	64.6	35.4	2.5	2.5	97.5
28x35	6.6	71.2	28.8	0.8	3.3	96.7
35x48	5.6	76.8	23.2	4.2	7.5	92.5
48x65	4.1	80.9	19.1	6.7	14.2	85.8
65x100	3.9	84.8	15.2	9.3	23.5	76.5
100x150	3.0	87.8	12.2	8.7	32.2	67.8
150x200	2.7	90.5	9.5	6.1	38.3	61.7
200x270	9.5	100.0	0.0	16.2	54.5	45.5
270x325				1.2	55.7	44.3
-325				44.3	100.0	0.0

Composite Sample Grind time, min		E Minus 6-mesh ore 0		E Leach feed 12		
Size Mesh	Wt, %	Cum Wt % Retained	Passing	Wt, %	Cum Wt % Retained	Passing
+8	7.6	7.6	92.4			
8x10	18.8	26.4	73.6			
10x14	15.6	42.0	78.0			
14x20	11.4	53.4	46.6			
20x28	8.8	62.2	37.8	3.7	3.7	96.3
28x35	6.6	68.8	31.2	5.0	4.2	95.8
35x48	6.0	74.8	25.2	5.1	9.3	90.7
48x65	4.7	79.5	20.5	9.3	18.6	81.4
65x100	4.6	84.1	15.9	12.0	30.6	69.4
100x150	3.8	87.9	12.1	10.5	41.1	58.9
150x200	3.7	91.6	8.4	7.3	48.4	51.6
200x270	8.4	100.0	0.0	6.8	55.2	44.8
270x325				5.3	60.5	39.5
-325				39.5	100.0	0.0

Composite Sample Grind time, min	Size Mesh	Wt %	F Minus 6-mesh ore 0 Cum Wt % Retained	Passing	Wt, %	F Leach feed 7 Cum Wt % Retained	Passing
	+8	8.7	8.7	91.3			
	8x10	21.4	30.1	69.9			
	10x14	16.4	46.5	53.5			
	14x20	11.2	57.7	42.3			
	20x28	7.9	65.6	34.4	2.3	2.3	97.7
	28x35	5.7	71.3	28.7	1.4	3.7	96.3
	35x48	4.8	76.1	23.9	3.0	6.7	93.3
	48x65	3.6	79.7	20.3	4.5	11.2	88.8
	65x100	3.7	83.4	16.6	6.5	17.7	82.3
	100x150	3.4	86.8	13.2	7.6	25.3	74.7
	150x200	3.4	90.2	9.8	7.2	32.5	67.5
	200x270	9.8	100.0	0.0	19.0	51.5	48.5
	270x325				1.5	53.0	47.0
	-325				47.0	100.0	0.0

Composite Sample Grind time, min	Size Mesh	Wt, %	Master Composite #1 Leach feed 7 Cum Wt % Retained	Passing	Wt, %	Master Composite #1 Leach feed 11 Cum Wt % Retained	Passing
	+8						
	8x10	0					
	10x14	1.9	1.9	98.1			
	14x20	2.0	3.9	96.1	0.6	0.6	99.4
	20x28	3.6	7.5	92.5	9.7	1.3	98.7
	28x35	5.9	13.4	86.8	2.0	3.3	96.7
	35x48	7.9	21.3	78.7	5.1	8.4	91.6
	48x65	8.2	29.5	70.5	8.1	16.5	83.5
	65x100	8.8	38.3	61.7	10.8	27.3	72.7
	100x150	9.0	47.3	52.7	11.5	38.8	61.2
	150x200	7.3	54.6	45.4	8.6	47.4	52.6
	200x270	7.5	62.1	37.9	8.9	56.3	43.7
	270x325	3.1	65.2	34.8	3.8	60.1	39.9
	-325	34.8	100.0	0.0	39.9	100.0	0.0

Ore Hardness - Comparative Grinds

Grinding conditions:

Ore feed	Minus 6-mesh, all composites of similar size distribution, 1000 g		
Ball mill	7-5/8" I.D. x 7-1/8", 85/90 rpm		
Ball charge	Size Inch Diam	No.	Wt, kg
	1-1/2 to 1-3/4	7	1.54
	1 to 1-1/4	33	2.25
	3/4	17	0.52
	1/2	25	0.27
% solids	50		
Time	10 minutes		

Screen analysis

Size Mesh	Weight Distribution, % Minus 6-mesh Feed	Composite A	Composite B	Composite C	Composite D	Composite E	Composite F
+8	6.7-7.5						
8x10	17.6-19.8						
10x14	15.0x16.7						
14x20	11.3-12.0						
20x28	8.7-9.0	5.0	4.8	4.5	2.5	6.6	0.5
28x35	6.6-6.7	2.1	2.0	1.7	0.8	1.5	0.6
35x48	5.6-6.0	7.5	7.4	6.8	4.2	6.7	1.6
48x65	4.1-4.7	9.5	9.3	9.2	6.7	9.1	3.4
65x100	3.9-4.6	10.6	10.4	11.0	9.3	10.0	6.4
100x150	3.0-4.6	9.4	9.4	10.0	8.7	9.4	8.7
150x200	2.7-5.5	6.6	6.0	6.3	6.1	5.9	8.5
-200	8.4-10.0	49.3	50.7	50.5	61.7	50.8	70.3

Rod Mill Grind, Composite C

Grind conditions:

Rod mill	7-5/8" diam x 8-1/2", 85/90 rpm
Rod charge	8.04 kg
Ore charge	1.0 kg minus 6-mesh
H_2O	1.0 liter

Screen analysis

Grind Time, min	Weight Distribution, %					
Mesh	2	3	4	5	7	10
+14	5.1	1.4	0.3	0.0		
14x20	7.2	3.2	0.8	0.1		
20x28	10.2	8.2	4.1	1.5	0.0	
28x35	10.3	10.6	9.9	3.9	0.1	0.0
35x48	9.6	10.0	11.9	12.3	1.9	0.2
48x65	8.1	6.5	8.0	11.2	8.3	2.2
65x100	3.1	6.9	8.3	11.0	14.9	10.5
100x150	6.0	5.8	7.7	11.8	14.1	14.6
150x200	5.8	5.5	6.9	8.6	11.0	14.0
200x270	4.8	5.2	5.9	2.7	7.3	9.3
270x325	1.2	2.4	2.0	0.4	1.2	2.4
-325	28.6	34.3	34.2	36.5	41.2	46.8
	100.0	100.0	100.0	100.0	100.0	100.0

Rod Mill Grind of Composite B+C1/

Grind conditions:

Rod mill: 7-5/8" diam x 9-1/2", steel, 85/90 rpm

Rods:

Size, inch	No. Rods	Wt, kg
1/4	6	0.47
3/8	7	0.96
1/2	16	4.04
5/8	6	2.57
		8.04

Ore: 1.0 kg minus 6-mesh
H_2O: 1.0 liter
Time: 3-1/2 and 5 minutes

Screen analysis

Size	3-1/2 min Grind			5 min Grind		
		Cum Wt %			Cum Wt %	
Mesh (Tyler)	Wt, %	Retained	Passing	Wt, %	Retained	Passing
+14	0.4	0.4	99.6			
14x20	1.2	1.6	98.4			
20x28	5.7	7.3	92.7	0.5	0.5	99.5
28x35	11.1	18.4	81.6	3.6	4.1	95.9
35x48	11.5	29.9	70.1	13.5	17.6	82.4
48x65	7.7	37.6	62.4	12.9	30.5	69.5
65x100	7.7	45.3	54.7	5.9	36.4	63.6
100x150	7.0	52.3	47.7	9.4	45.8	54.2
150x200	6.4	58.7	41.3	7.5	53.3	46.7
200x270	5.1	63.8	36.2	6.1	59.4	40.6
270x325	2.2	66.0	34.0	1.4	60.8	39.2
-325	34.0			39.2		

1/ 39 wt % Composite B
61 wt % Composite C

Rod Mill Grind, Master Composite No. 2[1/]

Grind conditions:

Rod mill	7-5/8" diam x 9-1/2", 85/90 rpm		
Rod charge	Diam, inch	No.	Wt, kg
	1/4	6	0.47
	3/8	7	0.96
	1/2	16	4.04
	5/8	6	2.57
			8.04
Ore charge	1.0 kg, minus 6-mesh		
H_2O	1.0 liters		
Time	3-1/2, 5, 6-1/2 min		

Size	3-1/2 min Grind			5 min Grind			6-1/2 min Grind		
	Wt,	Cum Wt %		Wt,	Cum Wt %		Wt,	Cum Wt %	
Mesh	%	Retained	Passing	%	Retained	Passing	%	Retained	Passing
+20	0.8	0.8	99.2	0.0	0.0	100.0			
20x28	3.7	4.5	95.5	0.6	0.6	99.4	0.0		
28x35	9.7	14.2	85.2	1.4	2.0	98.0	0.2	0.2	99.8
35x48	11.4	25.6	74.4	9.0	11.0	89.0	2.7	2.9	97.1
48x65	8.6	34.2	65.8	12.8	23.8	76.2	8.8	11.7	88.3
65x100	6.9	44.1	58.9	11.8	35.6	64.4	14.0	25.7	74.3
100x150	7.1	48.2	51.8	12.3	47.9	52.1	11.9	37.6	62.4
150x200	6.5	54.7	45.3	8.5	56.4	43.6	9.4	47.0	53.0
200x270	5.4	60.1	39.9	3.6	60.0	40.0	8.4	55.4	44.6
270x325	2.3	62.4	37.6	0.7	60.7	39.3	1.6	57.0	43.0
-325	37.6			39.3			43.0		

1/

Composite	Wt, %
A	16
B	14
C	22
D	19
E	21
F	8

Date 1/27/78

Laboratory Grinding Study for Determination of
"Bond Work Index" on a Sample of HRI 12652 Composite B+C[1/]

for ____________

HRI Project No. 4407

The "Bond Work Index" was determined to be 11.8 on the sample of raw material submitted as " HRI 12652 Composite B+C " when ground to 100% passing 28- mesh. The sample was stage crushed to minus 6-mesh and this material was used as the feed to the grindability test.

Calculation of Bond Work Index

$$Wi = \frac{44.5}{(P_i)^{0.23} \times (G_{bp})^{0.82} \times \left(\frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}}\right)}$$

Wi = Bond Work Index, kwhr/ton to 80% minus 100 microns.

P_i = Sieve opening in microns (28 mesh = 589 microns).

G_{bp} = Ball mill grindability, net grams per revolution (5.12 grams).

P = Product size, 80% passing 460 microns.

F = Feed size, 80% passing 1770 microns, (approximately 10 mesh).

$$Wi = \frac{44.5}{(589)^{0.23} \times (5.12)^{0.82} \times \left(\frac{10}{\sqrt{460}} - \frac{10}{\sqrt{1770}}\right)}$$

Wi = 11.7660

1/ 39 wt % Composite B + 61 wt % Composite C

Mill Ball Charge:

The tests were made in smooth shell, 12" x 12", steel mill rotating at 70 rpm, with a 20,126 gram ball load of the following size distribution:

Nominal Size	No. Balls	Weight, grams
1.50"	40	8521
1.25"	63	8316
1.00"	9	641
0.75-0.50"	98	2648

Total Weight 20,126 grams

Mill Ore Charge & Procedure:

Ore fed to the grinding test was crushed to minus 6-mesh. A 700 cc packed volume of feed solids was ground in each cycle, which weighed 832.0 grams. The ore was dry ground for the number of revolutions indicated in each cycle.

The ground ore was dry screened on 28 mesh to separate the ground product from the circulating load (+ 28 mesh). The oversize was returned to the mill together with sufficient ___ mesh ore to bring the weight of the ore charge back to the original weight. The number of revolutions of the mill was adjusted to obtain 250% circulating load.

The net grams of product were calculated by subtraction of the weight of minus 28 mesh in the new feed from the weight of -28 mesh produced in each cycle.

Grinding Data

Cycle No.	Revolutions of Mill	Grams of Product -28M	Grams in Feed -28M	Net Grams -28M	GBP Net Grams/ Revolution
1	50	512.6	300.4	212.2	4.24
2	50	413.6	185.0	228.6	4.57
3	50	382.1	149.3	232.8	4.65
4	33	305.1	137.9	167.2	5.06
5	30	265.5	110.1	155.4	5.18
6	30	248.4	95.8	152.6	5.09
7	30	246.8	89.7	157.1	5.24
8	32	255.5	89.1	166.4	5.20
9	29	241.3	92.2	149.1	5.14
10	29	234.8	87.1	147.7	5.09
11	30	238.5	84.8	153.7	5.12
12					
13					
14					
15					
16					

The last three cycles generated an average of 249 % circulating load. The mill reached equilibrium at an average of 5.12 net grams of -28 mesh per revolution.

Screen Analysis of Ore Feed,
Circulating Load and Ground Product

Tyler Mesh	Feed Sample % On	Feed Sample % Passing	Circulating Load % On	Circulating Load % Passing	Ground Product % On	Ground Product % Passing
6	0	100.0	0	100.0		
8	5.8	94.2	3.3	96.7		
10	17.3	76.9	13.7	83.0		
14	17.4	59.5	21.4	61.6		
20	13.5	46.0	28.6	33.1		
28	9.9	36.1	33.1	0	0	100.0
35	6.7	29.4			28.2	71.8
48	5.5	23.9			17.2	54.6
65	4.0	19.9			10.8	43.8
100	3.7	16.2			9.2	34.6
150	3.4	12.8			7.2	27.4
200	3.0	9.8			6.4	21.0
Pan	9.8	0			21.0	0
Total	100.0		100.0		100.0	

Reference: Bond, F. C., "Crushing and Grinding Calculations," Allis-Chalmers Manufacturing Co., Milwaukee, Wisconsin, January 2, 1961, Bulletin 07R9235B.

BOND WORK INDEX DATA SHEET

GR No.: BWI 197

HRI No.: 12652

Project: 4407

Standard: ± 28M

Date: 26 Jan 78

Engineer: Gene

Remarks:

		Ball Charge	Wt, Grams
Ore feed wt	832.0	40x1.50"	8,521
% minus feed	36.1	63x1.25"	8,316
Target WTS +28M	594.3	9x1.00"	641
-28M	237.7	66x0.75"	1,858
		91x0.50"	790
		Total	20,126

CYC.	REV.	TOTAL +28	TOTAL -28	FEED -28	NET	G.P.R.	% C.L.		PRODUCE: 151.9
1	50	319.4	512.6	300.4	212.2	4.24	62		
2	50	418.4	413.6	185.0	228.6	4.57	101		
3	50	449.9	382.1	149.3	232.8	4.65	117		
4	33	526.9	305.1	137.9	167.2	5.06	172		
5	30	566.5	265.5	110.1	155.4	5.18	213		
6	30	583.6	248.4	95.8	152.6	5.09	235		
7	30	585.2	246.8	89.7	157.1	5.24	237		
8	32	576.8	255.5	89.1	166.4	5.20	226		
9	29	590.7	241.3	92.2	149.1	5.14	245		
10	29	597.2	234.8	87.1	147.7	5.09	254		
11	30	593.5	238.5	84.8	153.7	5.12	249		
							Avg C.L.		249
							Avg. b/RCU		5.12

WET / DRY SCREEN ANALYSIS

PROJECT: 4407

NOTEBOOK:

PAGE:

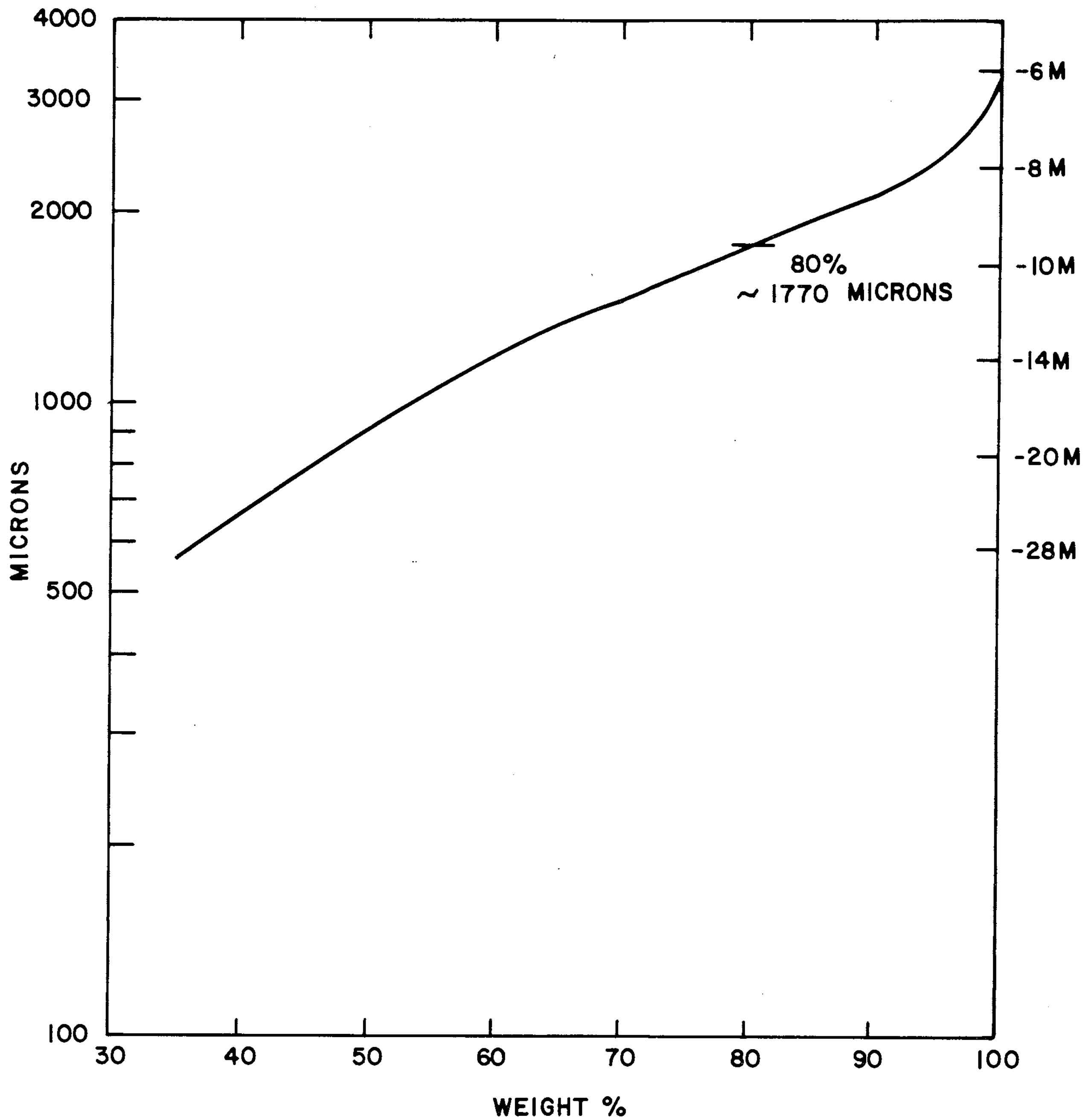
DATE: 26 Jan 78

BY: Gene

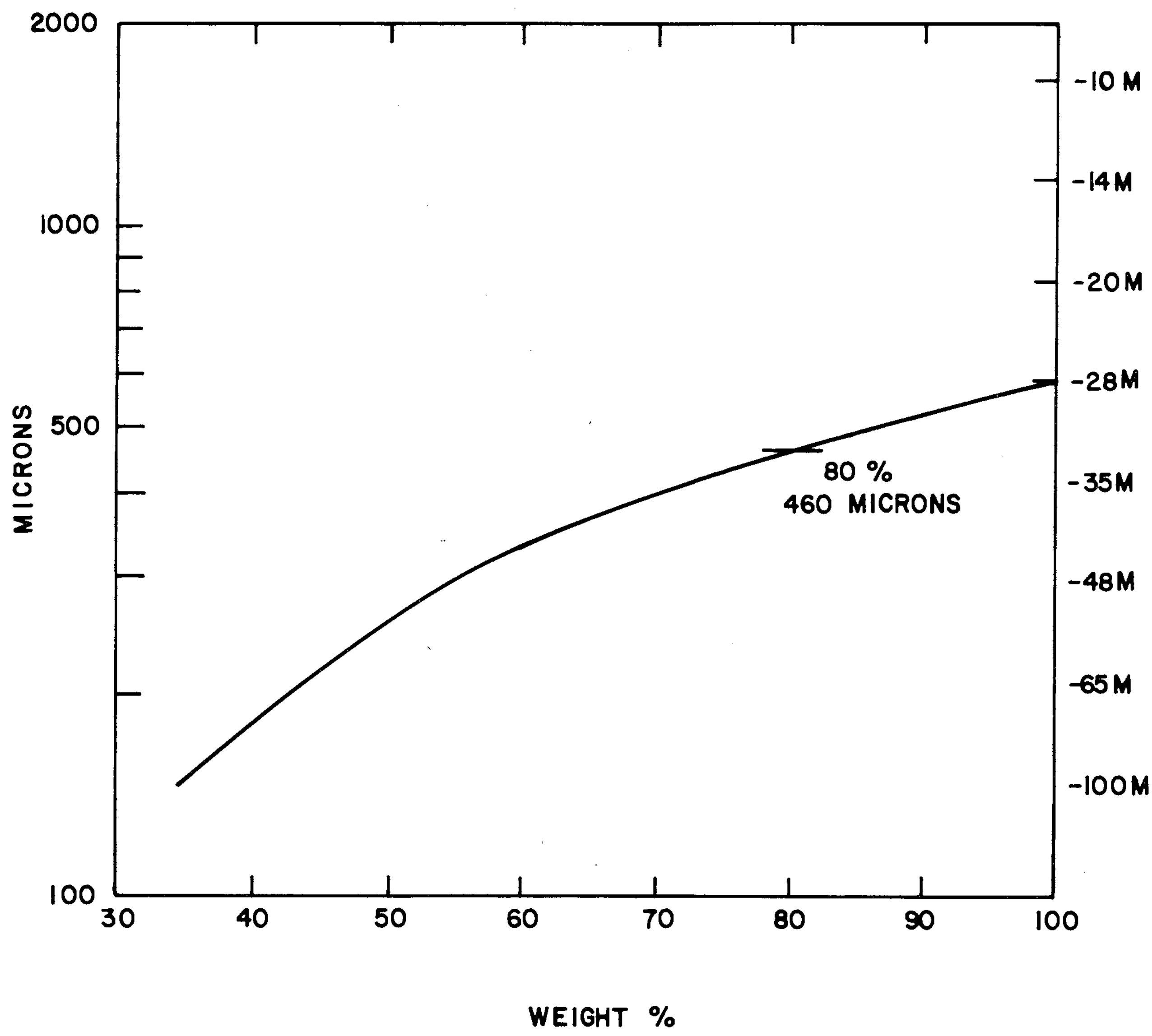
OBJECTIVE: BWI 197 HRI 12652 Composite B and C

Size, (Inches, Mesh, μ)		Minus 6-mesh Feed				Plus 28-mesh C Load				Minus 28-mesh Product			
		Weight	Weight	Cum Weight, %		Weight	Weight	Cum Weight, %		Weight	Weight	Cum Weight, %	
Passing	Retained	g	%	Retained	Passing	g	%	Retained	Passing	g	%	Retained	Passing
1.05"	0.742"												
0.742"	0.525"												
0.525"	0.371"												
0.371"	3												
3	4												
4	6												
6	8	29.0	5.8	5.8	94.2	19.4	3.3	3.3	96.7				
8	10	85.9	17.3	23.1	76.9	81.6	13.7	17.0	83.0				
10	14	86.5	17.4	40.5	59.5	127.3	21.4	38.4	61.6				
14	20	67.1	13.5	54.0	46.0	170.1	28.6	66.9	33.1				
20	28	49.1	9.9	63.9	36.1	196.7	33.1	100.0	0.0				
28	35	33.3	6.7	70.6	29.4					65.2	28.2	28.2	71.8
35	48	27.4	5.5	76.1	23.9					39.8	17.2	45.4	54.6
48	65	19.8	4.0	80.1	19.9					24.9	10.8	56.2	43.8
65	100	18.5	3.7	83.8	16.2					21.3	9.2	65.4	34.6
100	150	17.0	3.4	87.2	12.8					16.7	7.2	72.6	27.4
150	200	15.3	3.0	90.2	9.8					14.7	6.4	79.0	21.0
200	-200	49.0	9.8	100.0	0.0					48.4	21.0	100.0	0
270	400												
400	30 μ												
30 μ	20 μ												
20 μ	10 μ												
10 μ	Pan												
	TOTAL	497.9	100.0			595.1	100.0			231.0	100.0		

SIZE DISTRIBUTION OF -6 MESH FEED



SIZE DISTRIBUTION OF - 28 MESH PRODUCT



H_2SO_4 Leach of Composite A

Test No. 2 Book No. 1070-5 Date 12/16/77 By RJ/JB

Grind, time, min	12.5 (ball mill)		
% +28 mesh	1.9	Acidity	pH 1.0-1.1
% -200mesh	53	$NaClO_3$ added, g	10.7 total
Heads, total slurry, wt, g	2000	lb/ton	26.9 total
Spl. slurry wt, g	282	Temperature	74-82°C
solids, g	135	Time, total hr	12
% solids	47.9	Sampled at	4, 8, 12 hr
Solids in leach, g	822		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	162	394	5.2	12.7	78					
1-3/4	178	433	7.2	17.5	82	1.0	400			1.
4	181	440	8.2	20.0	78	1.0	420	132.0	38.5	
8	186	453	8.7	21.3	78	1.1	400	135.6	38.6	
12	191	467	10.7	26.9	79	1.0	440	135.0	38.7	

Assay data

Time			Amount		Assay, % or g/l						Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	Fe	Cl	U_3O_8
0	Heads	1070-5-1		822	0.064						
4	PF	-2	77		0.34						0.026
	Residue	-3		50.8	0.0066						0.0034
8	PF	-4	79		0.33						0.026
	Residue	-5		52.4	0.0070						0.0037
12	PF	-6	79		0.36	0.001	0.18	0.37	1.74	2.98	0.028
	Residue	-7		52.2	0.0061						0.0032
	Slurry solids			747							
		Total residue		902	0.058						

Time, hr	% Extracted U_3O_8
4	88.5
8	87.9
12	89.4

Remarks: 1/ 400 ml H_2O added to make pulp less viscous for adequate stirring.

H_2SO_4 Leach of Composite B

Test No. 4 Book No. 1070-10 Date 12/20/77 By BJ/JB

Grind, time, min	12 (ball mill)		
% +28 mesh	2.3	Acidity	pH 1.0-1.2
%-200 mesh	53	$NaClO_3$ added, g	12.8 total
Heads, total slurry, wt, g	2000	lb/ton	30 total
Spl. slurry wt, g	286.6	Temperature	79-81°C
solids, g	140.4	Time, total hr	12
% solids	49.0	Sampled at	4, 8, 12 hr
Solids in leach, g	857		

Leach data

Time hr	Reagents Added H_2SO_4 g	lb/ton	$NaClO_3$ g	lb/ton	Temp °C	pH	emf (-mv)	Slurry Sample g	Pulp % Solids	Remarks
0	191	446	5.1	11.9	77	1.8	430			1
2-1/4	217	506	8.6	20.0	81	1.0	380			
4	221	516	10.6	24.7	78	1.0	430	127.2	34.7	
8	230	538	12.8	30.1	81	1.1	420	128.1	35.0	
12	234	548	12.8	30.1	79	1.0	370	130.7	34.2	

Assay data

Time hr	Sample	No.	Amount ml	g	Assay, % or g/l U_3O_8	Mo	V_2O_5	PO_4	Fe	Cl	Amount, g U_3O_8
0	Heads	1070-10-1		857	0.092						
4	PF	10-2	79.1		0.42						0.0332
	Residue	-3		44.1	0.0079						0.0035
8	PF	-4	79.3		0.47						0.0373
	Residue	-5		44.8	0.0078						0.0035
12	PF	-6	81.9		0.46	0.003	0.14	0.35	2.68	2.39	0.0377
	Residue	-7		44.7	0.0074						0.0033
	Slurry solids			806							
	Total residue			940	0.089						

Time, hr	% Extracted U_3O_8
4	90.6
8	90.7
12	91.2

Remarks: 1/ 850 ml H_2O added to make slurry less viscous for adequate stirring.

H_2SO_4 Leach of Composite C

Test No. 5 Book No. 1070-12 Date 12/20/77 By BI/JB

Grind, time, min	12 (ball mill)	Acidity	pH 1.0-1.1
% +28 mesh	2.4	$NaClO_3$ added, g	12.9 total
%-200 mesh	50	lb/ton	32 total
Heads, total slurry, wt, g	2000	Temperature	78-81°C
Spl. slurry wt, g	281.7	Time, total hr	12
solids, g	132.8	Sampled at	4, 8, 12 hr
% solids	47.1		
Solids in leach, g	809		

Leach data

Time hr	Reagents Added H_2SO_4 g	lb/ton	$NaClO_3$ g	lb/ton	Temp °C	pH	emf (-mv)	Slurry Sample g	Pulp % Solids	Remarks
0	85	210	5.1	12.6	80	1.4	385			1
2	98	242	9.9	24.4	80	1.1	380			
4	101	250	12.9	21.9	79	1.0	430	138.4	43.3	
8	107	266	12.9	31.9	81	1.1	340	137.2	43.7	
12	111	278	12.9	31.9	80	1.0	330	126.7	42.1	

Assay data

Time hr	Sample	No.	Amount ml	g	Assay, % or g/l U_3O_8	Mo	V_2O_5	PO_4	Fe	Cl	Amount, g U_3O_8
0	Heads	1070-12-1			0.084						
4	PF	12-2	74.7		0.60						0.0448
	Residue	-3		60.0	0.0078						0.0047
8	PF	-4	73.5		0.59						0.0434
	Residue	-5		60.0	0.0095						0.0057
12	PF	-6	69.8		0.59	0.002	0.42	0.54	4.50	4.08	0.0412
	Residue	-7		53.4	0.0086						0.0046
	Slurry solids			640							
	Total residue			813	0.083						

Time, hr	% Extracted U_3O_8
4	90.7
8	88.7
12	89.8

Remarks: 1/ 130 ml H_2O added to make slurry less viscous for adequate stirring.

H_2SO_4 Leach of Composite D

Test No. 1 Book No. 1070-4 Date 12/16/77 By BJ/JB

Grind, time, min	10 (ball mill)		
% +28 mesh	2.5	Acidity	pH 0.9-1.1
% -200 mesh	62	$NaClO_3$ added, g	17.7 total
Heads, total slurry, wt, g	2083	lb/ton	44 total
Spl. slurry wt, g	282.1	Temperature	77-85°C
solids, g	131.3	Time, total hr	12
% solids	46.5	Sampled at	4, 8, 12 hr
Solids in leach, g	837		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	64.9	155	5.2	12.4	80	1.0				1
2	83.4	199	9.2	22.0	77	1.0	410			
4	85.3	204	12.7	30.3	77	1.1	390	135.0	40.7	
8	92.4	223			80	1.1→1.0	360	135.2	40.3	
8.1			17.7	44.1						
12	92.4	223	17.7	44.1	79	1.0	390	135.6	39.8	

Assay data

Time			Amount		Assay, % or g/l						Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	Fe	Cl	U_3O_8
0	Heads	1070-4-1		837	0.066						
4	PF	-2	76		0.42						0.032
	Residue	-3		55.0	0.0084						0.0046
8	PF	-4	77		0.43						0.033
	Residue	-5		54.5	0.0080						0.0044
12	PF	-6	78		0.44	0.002	0.24	0.42	4.23	5.85	0.0342
	Residue	-7		54.0	0.0081						0.0044
	Slurry solids			680							
		Total residue		844	0.069						

Time, hr	% Extracted U_3O_8
4	87.8
8	88.4
12	88.3

Remarks: 1/ 180 ml H_2O added to make pulp less viscous for adequate stirring.

H_2SO_4 Leach of Composite E

Test No. 6 Book No. 1070-14 Date 12/20/77 By BJ/JB

Grind, time, min	12 (ball mill)		
% +28 mesh	3.7	Acidity	pH 1.0-1.1
% -100 mesh	52	$NaClO_3$ added, g	12.8 total
Heads, total slurry, wt, g	2000	lb/ton	31 total
Spl. slurry wt, g	283.5	Temperature	79-82°C
solids, g	137.8	Time, total hr	12
% solids	48.6	Sampled at	4, 8, 12 hr
Solids in leach, g	834		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	127	305	5.1	12.2	77	1.0	490			1
2	152	365	8.9	21.3	80	1.1	410			
4	156	374	10.9	26.1	80	1.0	410	132.7	41.4	
8	165	397	12.8	31.0	81	1.1	390	135.3	40.0	
12	165	397	12.8	21.0	79	1.1	350	137.0	41.3	

Assay data

Time			Amount		Assay, % or g/l						Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	Fe	Cl	U_3O_8
0	Heads	1070-14-1		834	0.042						
4	PF	14-2	74.1		0.23						0.0170
	Residue	-3		54.9	0.0061						0.0033
8	PF	-4	77.2		0.25						0.0193
	Residue	-5		54.2	0.0061						0.0033
12	PF	-6	76.6		0.25	0.002	0.18	0.33	3.65	3.46	0.0192
	Residue	-7		56.6	0.0061						0.0035
	Slurry solids			730							
		Total residue		896	0.040						

Time, hr	% Extracted U_3O_8
4	84.4
8	84.4
12	84.4

Remarks: 1/ 400 ml H_2O added to make slurry less viscous for adequate stirring.

H_2SO_4 Leach of Composite F

Test No. 3 Book No. 1070-6 Date 12/16/77 By RJ/JB

Grind, time, min	7 (ball mill)	Acidity	pH 1.0-1.1
% +28 mesh	2.3	$NaClO_3$ added, g	5.2 total
% -200 mesh	68	lb/ton	12.3 total
Heads, total slurry, wt, g	2083	Temperature	75-80°C
Spl. slurry wt, g	283	Time, total hr	12
solids, g	133	Sampled at	4, 8, 12 hr
% solids	47.0		
Solids in leach, g	846		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	46.0	109	5.2	12.3	80	1.0				1
2.5	51.3	121	5.2	12.3	82	1.0	710			
4	51.3	121	5.2	12.3	75	1.1	720	129.5	42.6	
8	57.5	137	5.2	12.3	79	1.1	720	139.6	43.4	
12	60.2	144	5.2	12.3	79	1.0	710	135.8	43.7	

Assay data

Time			Amount		Assay, % or g/l						Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	Fe	Cl	U_3O_8
0	Heads	1070-6-1			0.049						
4	PF	-2	71		0.38						0.0270
	Residue	-3		55.2	0.0020						0.0011
8	PF	-4	75		0.38						0.0285
	Residue	-5		60.6	0.0024						0.0015
12	PF	-6	73		0.41	<0.001	0.19	0.87	1.12	0.14	0.0300
	Residue	-7		59.3	0.0024						0.0014
	Slurry solids			670							
	Total residue			845	0.051						

Time, hr	% Extracted U_3O_8
4	96.1
8	95.3
12	95.3

Remarks: 1/ 120 ml H_2O added to make pulp less viscous for adequate stirring.

H_2SO_4 Leach of 12652 Master Composite #1

Test No. 7 Book No. 1070-24 Date 12/22/77 By BJ/JB

Grind, time, min	7 (ball mill)		
% +28 mesh	7.5	Acidity	pH 1.0-1.1
% -200 mesh	45	$NaClO_3$ added, g	9.3 total
Heads, total slurry, wt, g	2000	lb/ton	
Spl. slurry wt, g	283.3	Temperature	79-81°C
solids, g	137.9	Time, total hr	12
% solids	48.6	Sampled at	4, 8, 12 hr
Solids in leach, g	834		

Leach data

Time	Reagents Added				Temp		emf	Slurry	Pulp	
	H_2SO_4		$NaClO_3$					Sample		
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	108	259	5.1	12.2	79	1.6	500			1
2-1/4	133	319	6.9	16.5	79	1.0	380			
4	135	324	7.6	18.2	79	1.0	385	131.8	39.2	
8	140	337	8.5	20.5	80	1.0	400	132.8	39.5	
12	147	356	9.3	22.7	81	1.0	390	132.7	38.2	

Assay data

Time			Amount		Assay, % or g/l						Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	Fe	Cl	U_3O_8
0	Heads	1070-24-1		834	0.064						
4	PF	-2	76.3		0.41						0.0313
	Residue	-3		51.7	0.0085						0.0044
8	PF	-4	76.5		0.40						0.0306
	Residue	-5		52.5	0.0082						0.0043
12	PF	-6	78.1		0.40	0.002	0.23	0.50	2.63	2.30	0.0312
	Residue	-7		50.7	0.0086						0.0044
	Slurry solids			714							
		Total residue		869	0.069						

Time, hr	% Extracted U_3O_8
4	87.5
8	88.1
12	87.5

Remarks: 1/ 430 ml H_2O added.

H_2SO_4 Leach of 12652 Master Composite #1

Test No. 8 Book No. 1070-26 Date 12/22/77 By JB/BJ

Grind, time, min	11 (ball mill)		
% +28 mesh	1.3	Acidity	pH 1.5-1.6
%-200 mesh	53	$NaClO_3$ added, g	11.4 total
Heads, total slurry, wt, g	2000	lb/ton	28 total
Spl. slurry wt, g	281.7	Temperature	80-81°C
solids, g	135.7	Time, total hr	12
% solids	48.2	Sampled at	4, 8, 12 hr
Solids in leach, g	828		

Leach data

Time	Reagents Added							Slurry		
	H_2SO_4		$NaClO_3$		Temp		emf	Sample	Pulp	
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	106	256	5.1	12.3	78	2.2→1.5	500			1
2	113	273	7.1	17.1	81	1.5	360			
4	114	275	8.4	20.3	80	1.5	420	130.3	38.9	
8	115	298	10.4	25.4	80	1.5	370	133.1	37.6	
12	116	281	11.4	28.1	81	1.5	360	131.1	38.7	

Assay data

Time			Amount		Assay, % or g/l						Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	Fe	Cl	U_3O_8
0	Heads	1070-26-1		828	0.064						
4	PF	-2	75.8		0.31						0.0235
	Residue	-3		50.7	0.010						0.0051
8	PF	-4	79.0		0.31						0.0245
	Residue	-5		50.1	0.011						0.0055
12	PF	-6	76.5		0.32	0.001	0.14	0.26	1.16	2.84	0.0245
	Residue	-7		50.8	0.012						0.0061
	Slurry solids			721							
		Total residue		873	0.059						

Time, hr	% Extracted U_3O_8
4	83.1
8	81.4
12	79.7

Remarks: 1/ 470 ml H_2O added.

H_2SO_4 Leach of 12652 Master Composite #1

Test No. 9 Book No. 1070-28 Date 12/22/77 By BJ/JB

Grind, time, min	11 (ball mill)		
% +28 mesh	1.3	Acidity	pH 1.0-1.1
% -200 mesh	53	$NaClO_3$ added, g	9.5 total
Heads, total slurry, wt, g	2000	lb/ton	23 total
Spl. slurry wt, g	273.9	Temperature	79-80°C
solids, g	132.2	Time, total hr	12
% solids	48.2	Sampled at	4, 8, 12 hr
Solids in leach, g	832		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	114	274	5.1	12.3	80	1.5	520			1
1.5	133	320	6.6	15.9	80	1.0	395			
4	138	332	7.3	17.5	79	1.0	370	131.7	37.4	
8	146	352	9.0	21.8	80	1.0	370	131.6	36.0	
12	153	371	9.5	23.2	80	1.0	390	132.8	37.3	

Assay data

Time			Amount		Assay, % or g/l						Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	Fe	Cl	U_3O_8
0	Heads	1070-28-1		832	0.063						
4	PF	-2	78.5		0.39						0.0306
	Residue	-3		49.3	0.0084						0.0041
8	PF	-4	80.5		0.38						0.0306
	Residue	-5		47.1	0.0083						0.0039
12	PF	-6	79.2		0.38	0.002	0.23	0.53	2.86	2.30	0.0301
	Residue	-7		49.6	0.0080						0.0040
	Slurry solids			719							
		Total residue		865	0.071						

Time, hr	% Extracted U_3O_8
4	88.2
8	88.3
12	88.7

Remarks: 1/ 470 ml H_2O added.

H_2SO_4 Leach of Master Composite No. 1

Test No. 10 Book No. 1070-36 Date 1/3/78 By JB/BJ

Grind, time, min	11 (ball mill)		
% +28 mesh	1.9	Acidity	pH 1.0-1.1
%-200 mesh	53	$NaClO_3$ added, g	0.90
Heads, total slurry, wt, g	2500	lb/ton	2.1
Spl. slurry wt, g	259.0	Temperature	75°C
solids, g	99.2	Time, total hr	10
% solids	38.3	Sampled at	2, 6, 10 hr
Solids in leach, g	858		

Leach data

Time	Reagents Added							Slurry		
	H_2SO_4		$NaClO_3$		Temp		emf	Sample	Pulp	
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	119	277	0.45	1.0	75	1.5/1.0	/380			
2	138	322	0.90	2.1	75	1.0	330→390			
4	147	343	0.90	2.1	75	1.0	350	134.1	39.1	
6	149	348	0.90	2.1	75	1.1	330	132.9	38.7	
10	157	369	0.90	2.1	76	1.0	330	134.3	38.3	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-36-1		858	0.064					
4	PF	-2	77.7		0.361					0.0280
	Residue	-3		52.5	0.0085					0.0045
8	PF	-4	77.6		0.346					0.0268
	Residue	-5		51.4	0.0081					0.0042
12	PF	-6	78.9		0.388	<0.001	0.23		13.5	0.0306
	Residue	-7		51.5	0.0084					0.0043
	Slurry solids									
				155.4	0.065					0.0984

Time, hr	% Extracted U_3O_8
4	86.9
6	87.5
10	87.1

Remarks:

H_2SO_4 Leach of Master Composite No. 1

Test No. 11 Book No. 1070-38 Date 1/3/78 By BJ/JB

Grind, time, min	11 (ball mill)			
% +28 mesh	1.9		Acidity	pH 1.0-1.1
% -200 mesh	53		$NaClO_3$ added, g	2.69
Heads, total slurry, wt, g	2500		lb/ton	6.3
Spl. slurry wt, g	262.1		Temperature	75°C
solids, g	99.8		Time, total hr	10
% solids	38.1		Sampled at	4, 6, 10 hr
Solids in leach, g	853			

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	118	277	1.35	3.1	73	1.6→1.0	440			
2	140	328	2.69	6.3	75	1.0	345→380			
4	145	340	2.69		74	1.0	365	133.0	38.9	
6	145	340	2.69		75	1.1→1.0	340	132.1	37.5	
10	153	361	2.69		76	1.0	340	134.7	37.9	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-38-1		853	0.065					
4	PF	-2	77.3		0.353					0.0273
	Residue	-3		51.8	0.0075					0.0039
6-1/4	PF	-4	78.6		0.361					0.0284
	Residue	-5		49.6	0.0075					0.0037
10	PF	-6	79.7		0.353	<0.001	0.219		12.6	0.0281
	Residue	-7		51.0	0.0085					0.0043
	Slurry solids	-8								
				152.4	0.065					0.0957

Time, hr	% Extracted U_3O_8
4	88.5
6	88.5
10	86.9

Remarks:

H_2SO_4 Leach of Master Composite No. 1

Test No. 12 Book No. 1070-40 Date 1/3/78 By BJ/JB

Grind, time, min	11 (ball mill)		
% mesh	1.9	Acidity	pH 1.0-1.1
%-200 mesh	53	$NaClO_3$ added, g	5.36
Heads, total slurry, wt, g	2500	lb/ton	12
Spl. slurry wt, g	259.3	Temperature	75°C
solids, g	98.5	Time, total hr	10
% solids	38.0	Sampled at	4, 6, 10 hr
Solids in leach, g	852		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	118	277	2.68	6.3	76	1.6→1.0	→460			
2	136	319	5.36	12.6	75	1.1→1.0	350→470			
4	143	336			75	1.1→1.0	370	133.0	38.9	
6	143	336			75	1.1→1.0	345	135.0	37.9	
10	151	357			75	1.1	345	135.2	37.6	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-40-1		852	0.066					
4	PF	-2	77.3		0.349					0.0270
	Residue	-3		51.8	0.0076					0.0039
6	PF	-4	79.9		0.353					0.0282
	Residue	-5		51.1	0.0081					0.0042
10	PF	-6	80.2		0.353	<0.001	0.210		12.1	0.0283
	Residue	-7		50.9	0.0076					0.0039
	Slurry solids	-8								
				153.8	0.063					0.0955

Time, hr	% Extracted U_3O_8
4	87.9
6	87.1
10	87.9

Remarks:

H_2SO_4 Leach of Master Composite No. 2

Test No. 13 Book No. 1070-48 Date 1/9/78 By BJ/JB

Grind, time, min	5 (rod mill)		
% +28 mesh	0.6	Acidity	355 lb H_2SO_4/ton
% -200 mesh	44	$NaClO_3$ added, g	2.70
Heads, total slurry, wt, g	2500	lb/ton	6.3
Spl. slurry wt, g	258.6	Temperature	75°C
solids, g	98.9	Time, total hr	6
% solids	38.2	Sampled at	4, 6 hr
Solids in leach, g	856		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0.25	152	355	1.35	3.2	75	0.8	440			
2	152	355	2.70	6.3	76	1.05	360			
4	152	355	2.70	6.3	75	1.2	350	131.1	39.1	
6	152	355	2.70	6.3	75	1.2	330	132.2	39.5	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-48-1		856	0.064					
4	PF	-2	76.1		0.356	<0.001	0.25		10.9	0.0271
	Residue	-3		51.2	0.0080					0.0041
6	PF	-4	76.2		0.382	<0.001	0.24	0.62	8.9	0.0291
	Residue	-5		52.2	0.0080					0.0042
	PF									
	Residue									
	Slurry solids									
				103.4	0.066					0.0645

Time, hr	% Extracted U_3O_8	H_2SO_4 Consumed lb/ton
4	87.2	323
6	87.2	329

H_2SO_4 Leach of Master Composite No. 2

Test No. 14 Book No. 1070-50 Date 1/9/78 By BJ/JB

Grind, time, min	5 (rod mill)		
% +28 mesh	0.6	Acidity	416 lb H_2SO_4/ton
% -200 mesh	44	$NaClO_3$ added, g	2.70
Heads, total slurry, wt, g	2500	lb/ton	6.3
Spl. slurry wt, g	263.7	Temperature	75°C
solids, g	101.4	Time, total hr	6
% solids	38.5	Sampled at	4, 6 hr
Solids in leach, g	861		

Leach data

Time	Reagents Added				Temp		emf	Slurry	Pulp	
	H_2SO_4		$NaClO_3$					Sample		
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0.25	179	416	1.35	3.1	75	0.45	410			
2	179	416	2.70	6.3	75	0.75	415			
4	179	416	2.70	6.3	75	0.8	370	135.8	38.4	
6	179	416	2.70	6.3	76	0.85	350	131.4	38.5	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-50-1		861	0.062					
4	PF	-2	79.6		0.365	0.001	0.29		20.1	0.0291
	Residue	-3		52.2	0.0066					0.0034
6	PF	-4	77.0		0.365	0.001	0.28	0.72	18.6	0.0281
	Residue	-5		50.6	0.0063					0.0032
12	PF									
	Residue									
	Slurry solids									
				102.8	0.064					0.0638

Time, hr	% Extracted U_3O_8	H_2SO_4 Consumed lb/ton
4	89.3	355
6	89.9	359

H_2SO_4 Leach of Master Composite No. 2

Test No. 15 Book No. 1070-52 Date 1/9/78 By BJ/JB

Grind, time, min	5 (rod mill)		
% +28 mesh	0.6	Acidity	418 lb H_2SO_4/ton
%-200 mesh	44	$NaClO_3$ added, g	12.1
Heads, total slurry, wt, g	2500	lb/ton	28
Spl. slurry wt, g	261.6	Temperature	75°C
solids, g	100.0	Time, total hr	6
% solids	38.2	Sampled at	4, 6 hr
Solids in leach, g	856		

Leach data

Time	Reagents Added				Temp		emf	Slurry	Pulp	
	H_2SO_4		$NaClO_3$					Sample		
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0.25	179	418	6.05	14.1	74	0.5	460			
2	179	418	12.1	28.3	75	0.7	390			
4	179	418	12.1	28.3	75	0.75	410	132.4	38.3	
6	179	418	12.1	28.3	76	0.8	385	132.4	38.2	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-52-1		856	0.062					
4	PF	-2	77.8		0.374	0.004	0.29		20.9	0.0289
	Residue	-3		50.7	0.0057					0.0029
6	PF	-4	77.7		0.385	0.003	0.29	0.72	19.1	0.0299
	Residue	-5		50.6	0.0055					0.0028
12	PF									
	Residue									
	Slurry solids									
				101.3	0.065					0.0645

Time, hr	% Extracted U_3O_8	H_2SO_4 Consumed lb/ton
4	91.0	354
6	91.3	359

H_2SO_4 Leach of Master Composite No. 2

Test No. 16 Book No. 1070-58 Date 1/12/78 By IB

Grind, time, min	3-1/2 (Rod)		
% +28 mesh	3.7	Acidity	355 lb/ton
% -200 mesh	45	$NaClO_3$ added, g	2.64
Heads, total slurry, wt, g	2500	lb/ton	6.3
Spl. slurry wt, g	259.2	Temperature	75°C
solids, g	96.9	Time, total hr	6
% solids	37.4	Sampled at	4, 6 hr
Solids in leach, g	838		

Leach data

Time hr	Reagents Added H_2SO_4 g	lb/ton	$NaClO_3$ g	lb/ton	Temp °C	pH	emf (-mv)	Slurry Sample g	Pulp % Solids	Remarks
0	149	356	1.32	3.2	75	0.9	425			
2	149	356	2.64	6.3	75	1.1	415			
4	149	356			75	1.2	345	130.5	37.2	
6	149	356			75	1.3	335	130.1	37.6	

Assay data

Time hr	Sample	No.	Amount ml	g	Assay, % or g/l U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	Amount, g U_3O_8
0	Heads	1070-58-1		838	0.065					
4	PF	-2	78.1		0.377				9.4	0.0294
	Residue	-3		48.5	0.0087					0.0042
6	PF	-4	77.3		0.384	<0.001	0.22		8.1	0.0297
	Residue	-5		48.9	0.0087					0.0043
12	PF									
	Residue									
	Slurry solids									
				97.4	0.069					0.0676

Time, hr	% Extracted U_3O_8
4	87.0
6	87.0

*Based on average of calculated and assay heads.

H_2SO_4 Leach of Master Composite No. 2

Test No. 17 Book No. 1070-60 Date 1/12/78 By JB

Grind, time, min	3-1/2 (Rod)		
% +28 mesh	3.7	Acidity	417 lb/ton
% -200 mesh	45	$NaClO_3$ added, g	2.67
Heads, total slurry, wt, g	2500	lb/ton	6.3
Spl. slurry wt, g	261.3	Temperature	75°C
solids, g	99.1	Time, total hr	6
% solids	37.9	Sampled at	4, 6 hr
Solids in leach, g	849		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	177	417	1.34	3.2	74	0.7	410			
2	177		2.68	6.3	76	0.7	430			
4	177		2.68	6.3	76	0.8	370	129.9	36.3	
6	177		2.68	6.3	77	0.9	350	132.6	36.7	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-60-1		849	0.063					
4	PF	-2	75.2		0.397				19.7	0.0299
	Residue	-3		47.2	0.0072					0.0034
6	PF	-4	76.3		0.410	0.001	0.28		18.2	0.0312
	Residue	-5		48.7	0.0071					0.0035
12	PF									
	Residue									
	Slurry solids									
				95.9	0.071					0.0680

Time, hr	% Extracted U_3O_8
4	89.4
6	89.6

*Based on average of calculated and assay heads

H_2SO_4 Leach of Master Composite No. 2

Test No. 18 Book No. 1070-62 Date 1/12/78 By IB

Grind, time, min	3-1/2 (Rod)		
% +28mesh	3.7	Acidity	417 lb/ton
% -200 mesh	45	$NaClO_3$ added, g	12.2
Heads, total slurry, wt, g	2500	lb/ton	28.3
Spl. slurry wt, g	262.4	Temperature	75°C
solids, g	101.1	Time, total hr	6
% solids	38.5	Sampled at	4, 6 hr
Solids in leach, g	862		

Leach data

Time hr	Reagents Added H_2SO_4 g	lb/ton	$NaClO_3$ g	lb/ton	Temp °C	pH	emf (-mv)	Slurry Sample g	Pulp % Solids	Remarks
0	180	417	6.1	14.2	76	0.6	460			
2	180		12.2	28.3	76	0.7	530			
4	180		12.2	28.3	75	0.8	410	132.2	35.6	
6	180		12.2	28.3	75	0.85	390	132.3	36.7	

Assay data

Time hr	Sample	No.	Amount ml	Amount g	Assay, % or g/l U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	Amount, g U_3O_8
0	Heads	1070-62-1		862	0.063					
4	PF	-2	77.4		0.380				20.9	0.0294
	Residue	-3		47.1	0.0063					0.0030
6	PF	-4	76.1		0.384	0.004	0.28		20.1	0.0292
	Residue	-5		48.5	0.0062					0.0030
12	PF									
	Residue									
	Slurry solids									
				95.6	0.068					0.0645

Time, hr	% Extracted* U_3O_8
4	90.5
6	90.6

*Based on average of calculated and assay heads.

H_2SO_4 Leach of Master Composite No. 2

Test No. 19 Book No. 1070-66 Date 1/13/78 By JB

Grind, time, min	6-1/2 (Rod)		
% +35 mesh	0.2	Acidity	355 lb/ton
% -200 mesh	53	$NaClO_3$ added, g	2.80
Heads, total slurry, wt, g	2500	lb/ton	6.3
Spl. slurry wt, g	253.0	Temperature	75°C
solids, g	100.2	Time, total hr	6
% solids	39.6*	Sampled at	4, 6 hr
Solids in leach, g	890		

*Increased to 41% solids prior to leaching by removing 75 ml H_2O.

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	158	355	1.40	3.1	77	0.8	390			
2	158	355	2.80	6.3	75	0.95	410			
4	158	355	2.80	6.3	76	1.05	355	132.3	38.5	
6	158	355	2.80	6.3	75	1.15	330	133.4	38.5	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-66-1		890	0.063					
4	PF	-2	77.5		0.382				12.5	0.0296
	Residue	-3		50.9	0.0069					0.0035
6	PF	-4	78.1		0.378	<0.001	0.26		10.9	0.0295
	Residue	-5		51.4	0.0067					0.0034
12	PF									
	Residue									
	Slurry solids									
				102.3	0.065					0.0660

Time, hr	% Extracted U_3O_8	H_2SO_4 Consumed lb/ton
4	89.4	317
6	89.7	322

H_2SO_4 Leach of Master Composite No. 2

Test No. 20 Book No. 1070-68 Date 1/13/78 By JB

Grind, time, min	6-1/2 (Rod)		
% +35 mesh	0.2	Acidity	417 lb/ton
%-200 mesh	53	$NaClO_3$ added, g	2.80
Heads, total slurry, wt, g	2500	lb/ton	6.3
Spl. slurry wt, g	252.5	Temperature	75°C
solids, g	100.3	Time, total hr	6
% solids	39.7*	Sampled at	4, 6 hr
Solids in leach, g	893		

*Increased to 41% solids prior to leaching by removing 57 ml H_2O.

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	186	417	1.40	3.1	74	0.6	420			
2	186	417	2.80	6.3	75	0.7	425			
4	186	417	2.80	6.3	0.75		375	134.2	37.6	
6	186	417	2.80	6.3	75	0.8	355	132.8	37.6	

Assay data

Time	Sample	No.	Amount		Assay, % or g/l					Amount, g
hr			ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-68-1		893	0.062					
4	PF	-2	78.3		0.385				23.5	0.0301
	Residue	-3		50.4	0.0057					0.0029
6	PF	-4	77.5		0.395	0.003	0.30		21.4	0.0306
	Residue	-5		49.9	0.0058					0.0029
12	PF									
	Residue									
	Slurry solids									
				100.3	0.066					0.0665

Time, hr	% Extracted U_3O_8	H_2SO_4 Consumed lb/ton
4	91.4	344
6	91.2	351

H_2SO_4 Leach of Master Composite No. 2

Test No. 21 Book No. 1070-70 Date 1/13/78 By JB

Grind, time, min	6-1/2 (Rod)		
% +35 mesh	0.2	Acidity	417 lb/ton
%-200 mesh	53	$NaClO_3$ added, g	11.82
Heads, total slurry, wt, g	2500	lb/ton	27.3
Spl. slurry wt, g	245.5	Temperature	75°C
solids, g	94.3	Time, total hr	6
% solids	38.4*	Sampled at	4,6 hr
Solids in leach, g	866		

*Increased to 41% solids prior to leaching by removing 144 ml H_2O.

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	181	417	5.90	13.6	77	0.6	445			
2	181	417	11.8	27.3	80	0.7	450			
4	181	417	11.8	27.3	77	0.75	400	135.2	38.8	
6	181	417	11.8	27.3	75	0.8	385	135.7	39.4	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-70-1		866	0.063					
4	PF	-2	77.3		0.428				21.7	0.0331
	Residue	-3		52.5	0.0054					0.0028
6	PF	-4	76.9		0.436	0.001	0.32		20.2	0.0335
	Residue	-5		53.4	0.0056					0.0030
12	PF									
	Residue									
	Slurry solids									
				105.9	0.068					0.0724

Time, hr	% Extracted U_3O_8	H_2SO_4 Consumed lb/ton
4	92.1	353
6	91.8	359

H_2SO_4 Leach of Composite B & C

Test No. 22 Book No. 1070-74 Date 1/17/78 By JB

Grind, time, min	5 (Rod)		
% +28 mesh	0.5	Acidity	372 lb H_2SO_4/ton
%-200 mesh	47	$NaClO_3$ added, g	2.52
Heads, total slurry, wt, g	2500	lb/ton	6.3
Spl. slurry wt, g	258.4	Temperature	75°C
solids, g	95.4	Time, total hr	6
% solids	36.9*	Sampled at	2, 4, 6 hr
Solids in leach, g	827		

*Increased to 41% solids prior to leaching by removing 225 ml H_2O.

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	147	356	1.30	3.1	78	1.0	370			
2	154	372	2.52	6.3	75	1.3	310	135.2	42.8	
4		372			76	1.2	330	136.0	43.2	
6		372			75	1.3	305	135.3	41.9	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-74-1			0.088					
2	PF	-2	73.7		0.620				8.53	0.0457
	Residue	-3		57.8						
4	PF	-4	73.6		0.600				10.1	0.0442
	Residue	-5		58.7	0.0106					0.0062
6	PF	-6	74.9		0.604	<0.001	0.30		8.2	0.0452
	Residue	-7		56.7	0.0108					0.0061
	Slurry solids									
				115.4	0.088					0.1017

Time, hr	% Extracted U_3O_8
4	88.0
6	87.7

H_2SO_4 Leach of Composite B&C

Test No. 23 Book No. 1070-76 Date 1/17/78 By JB

Grind, time, min	5 (Rod)		
% +28mesh	0.5	Acidity	434 lb H_2SO_4/ton
% -200 mesh	47	$NaClO_3$ added, g	2.59
Heads, total slurry, wt, g	2500	lb/ton	6.3
Spl. slurry wt, g	259.9	Temperature	75°C
solids, g	98.2	Time, total hr	6
% solids	37.8*	Sampled at	2, 4, 6 hr
Solids in leach, g	847		

*Increased to 41% solids prior to leaching by removing 175 ml H_2O.

Leach data

Time hr	Reagents Added H_2SO_4 g	lb/ton	$NaClO_3$ g	lb/ton	Temp °C	pH	emf (-mv)	Slurry Sample g	Pulp % Solids	Remarks
0	177	418	1.34	3.2						
2	184	434	2.59	6.3	76	0.85	335	135.1	41.2	
4					76	0.8	350	135.2	40.6	
6					75	0.9	335	136.6	40.8	

Assay data

Time hr	Sample	No.	Amount ml	Amount g	Assay, % or g/l U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	Amount, g U_3O_8
0	Heads	1070-76-1			0.086					
2	PF	-2	74.2		0.629				20.6	0.0467
	Residue	-3		55.7						
4	PF	-4	75.0		0.620				21.5	0.0465
	Residue	-5		54.9	0.0073					0.0040
6	PF	-6	75.6		0.600	0.002	0.38		18.8	0.0454
	Residue	-7		55.7	0.0080					0.0045
	Slurry solids									
				110.6	0.091					0.1004

Time, hr	% Extracted U_3O_8
4	92.0
6	91.2

H_2SO_4 Leach of Composite B&C

Test No. 24 Book No. 1070-78 Date 1/17/78 By JB

Grind, time, min	5 (Rod)
% +28mesh	0.5
% -200 mesh	47
Heads, total slurry, wt, g	2500
Spl. slurry wt, g	258.4
solids, g	94.8
% solids	36.7*
Solids in leach, g	±850

Acidity	421 lb H_2SO_4/ton
$NaClO_3$ added, g	11.17
lb/ton	27
Temperature	75°C
Time, total hr	6
Sampled at	2, 4, 6 hr

*Increased to 41% solids prior to leaching by removing 235 ml H_2O.

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	172	405	5.76	13.6						
2	179	421	11.2	27	75	0.85	350	136.0	43.1	
4	179		11.2		77	0.8	390	136.9	42.9	
6	179		11.2		75	0.9	365	136.8	40.9	

Assay data

Time hr	Sample	No.	Amount ml	Amount g	Assay, % or g/l U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	Amount, g U_3O_8
0	Heads	1070-78-1			0.086					
2	PF	-2	72.3		0.639				20.0	0.0462
	Residue	-3		58.6						
4	PF	-4	73.0		0.674				21.0	0.0492
	Residue	-5		58.7	0.0071					0.0042
6	PF	-6	75.5		0.668	0.004	0.40		18.9	0.0504
	Residue	-7		56.0	0.0070					0.0039
	Slurry solids									
				114.7	0.094					0.1077

Time, hr	% Extracted[1/] U_3O_8
4	92.1
6	92.2

1/ Based on 0.090% U_3O_8 heads.

H_2SO_4 Leach of Composite B&C

Test No. 25 Book No. 1070-84 Date 1/18/78 By JB

Grind, time, min	3-1/2 (Rod)	Acidity	366 lb H_2SO_4/ton
% +20 mesh	1.6	$NaClO_3$ added, g	
%-200 mesh	41	lb/ton	6.3
Heads, total slurry, wt, g	2500	Temperature	75°C
Spl. slurry wt, g	257.0	Time, total hr	6
solids, g	95.9	Sampled at	2, 4, 6 hr
% solids	37.3*		
Solids in leach, g	837		

*Increased to 41% solids prior to leaching by removing 201 ml H_2O.

Leach data

Time hr	Reagents Added H_2SO_4 g	H_2SO_4 lb/ton	$NaClO_3$ g	$NaClO_3$ lb/ton	Temp °C	pH	emf (-mv)	Slurry Sample g	Pulp % Solids	Remarks
0	149		1.32		76	0.9	380			
2	153	366	2.56	6.3	75	1.15	325	135.2	40.4	
4					75	1.15	340	134.6	41.6	
6					75	1.3	315	134.0	42.4	

Assay data

Time hr	Sample	No.	Amount ml	Amount g	Assay, % or g/l U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	Amount, g U_3O_8
0	Heads	1070-84-1		837	0.086					
2	PF	-2	76.8		0.540				11.6	
	Residue	-3		54.6						
4	PF	-4	74.9		0.569				11.2	0.0426
	Residue	-5		56.0	0.012					0.0067
6	PF	-6	73.5		0.551	<0.001	0.30		8.7	0.0405
	Residue	-7		56.8	0.012					0.0068
	Slurry solids									
				112.8	0.086					0.0966

Time, hr	% Extracted U_3O_8
4	86.0
6	86.0

H_2SO_4 Leach of Composite B&C

Test No. 26 Book No. 1070-86 Date 1/18/78 By JB

Grind, time, min	3-1/2 (Rod)		
% +20 mesh	1.6	Acidity	429 lb H_2SO_4/ton
%-200 mesh	41	$NaClO_3$ added, g	
Heads, total slurry, wt, g	2500	lb/ton	6.3
Spl. slurry wt, g	258.4	Temperature	75°C
solids, g	98.1	Time, total hr	6
% solids	37.9*	Sampled at	2, 4, 6 hr
Solids in leach, g	849		

*Increased to 41% solids prior to leaching by removing 170 ml H_2O.

Leach data

Time	Reagents Added									
	H_2SO_4		$NaClO_3$		Temp		emf	Slurry Sample	Pulp	
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	177		1.34		75	0.6	410			
2	182	429	2.60	6.3	75	0.75	325	134.0	39.6	
4					75	0.75	350	134.2	39.3	
6					74	0.9	330	137.5	40.7	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-86-1		849	0.090					
2	PF	-2	75.7		0.600				24.4	
	Residue	-3		53.0						
4	PF	-4	76.1		0.562				22.2	0.0428
	Residue	-5		52.8	0.0097					0.0051
6	PF	-6	76.2		0.611	0.002	0.36		19.9	0.0466
	Residue	-7		56.0	0.0087					0.0049
	Slurry solids									
				108.8	0.091					0.0994

Time, hr	% Extracted U_3O_8
4	89.3
6	90.4

H_2SO_4 Leach of Composite B&C

Test No. 27 Book No. 1070-88 Date 1/18/78 By JB

Grind, time, min	3-1/2 (Rod)		
% +20mesh	1.6	Acidity	416 lb H_2SO_4/ton
% -200 mesh	41	$NaClO_3$ added, g	
Heads, total slurry, wt, g	2500	lb/ton	27
Spl. slurry wt, g	258.6	Temperature	75°C
solids, g	95.5	Time, total hr	6
% solids	36.9*	Sampled at	2, 4, 6 hr
Solids in leach, g	850		

*Increased to 41% solids prior to leaching by removing 222 ml H_2O.

Leach data

Time	Reagents Added H_2SO_4		$NaClO_3$		Temp		emf	Slurry Sample	Pulp	
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	173		5.80		77	0.6	440			
2	177	416	11.2	27	76	0.75	350	134.9	40.1	
4	177		11.2	27	75	0.8	390	136.1	39.8	
6	177		11.2	27	74	0.85	365	136.5	42.3	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-88-1		(850)	0.090					
2	PF	-2	75.5		0.622				23.3	
	Residue	-3		54.1						
4	PF	-4	76.5		0.611				21.4	0.0467
	Residue	-5		54.2	0.0075					0.0041
6	PF	-6	73.6		0.657	0.004	0.40		19.7	0.0484
	Residue	-7		57.8	0.0078					0.0045
	Slurry solids									
				112.0	0.093					0.1037

Time, hr	% Extracted U_3O_8
4	91.8
6	91.5

H_2SO_4 Leach of Weathered Composite B&C

Test No. 28 Book No. 1070-144 Date 2/17/78 By RI

Grind, time, min	5, rod	Acidity	374 lb/ton
% mesh		$NaClO_3$ added, g	0.44
% -200 mesh		lb/ton	2
Heads, total slurry, wt, g	1189	Temperature	60°C
Spl. slurry wt, g	134.1	Time, total hr	6
solids, g	54.0	Sampled at	6 hr
% solids	40.3		
Solids in leach, g	435		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	81.4	374	0.22	1.0	58					
1					61	0.7	400			
2			0.22	2.0	61	0.75	380			
4			-		60	0.8	390			
6			-		60	0.95	375	980	41.1	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-144-1		435	0.069					
					0.003					
6	PF	-2	234		0.438	0.002	0.26		15.8	0.102
	Wash	-4	1010		0.136					0.137
	Residue	-3		402.5*	0.0082					0.033
					0.068					0.272

Time, hr	% Extracted U_3O_8
6	88.0

Remarks: H_2SO_4 consumed = 331 lb/ton

*Some solids lost during leach.

H_2SO_4 Leach of Weathered Composite B&C

Test No. 29 Book No. 1070-146 Date 2/17/78 By RJ

Grind, time, min	5, rod	Acidity	446 lb/ton
% mesh		$NaClO_3$ added, g	1.34
%-200 mesh		lb/ton	6
Heads, total slurry, wt, g	1190	Temperature	60°C
Spl. slurry wt, g	132.6	Time, total hr	6
solids, g	53.3	Sampled at	6 hr
% solids	40.2		
Solids in leach, g	435		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	97.1	446	0.67	3.1						
1			-		61	0.4	425			
2			0.67	6.2	61	0.45	405			
4			-		60	0.5	420			
6			-		60	0.65	400	1101	39.4	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-146-1		435	0.067					0.291
	Grind filtrate	-0			0.003					
6	PF	-2	252		0.427	0.004	0.32		30.3	0.108
	Wash	-4	870		0.172					0.150
	Residue	-3		433.5	0.0070					0.030
					0.066					0.288

Time, hr	% Extracted U_3O_8
6	89.4

Remarks: H_2SO_4 consumed = 362 lb/ton.

H_2SO_4 Leach of Control Composite B&C

Test No. 30 Book No. 1070-148 Date 2/17/78 By RJ

Grind, time, min	5, rod		Acidity	448 lb/ton
% mesh			$NaClO_3$ added, g	0.44
% -200 mesh			lb/ton	2
Heads, total slurry, wt, g	1190		Temperature	60°C
Spl. slurry wt, g	133.9		Time, total hr	6
solids, g	53.6		Sampled at	6 hr
% solids	40.0			
Solids in leach, g	433			

Leach data

Time	Reagents Added H_2SO_4		$NaClO_3$		Temp		emf	Slurry Sample	Pulp	
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	97.1	448	0.22	1.0						
1			-		61	0.35	395			
2			0.22	2.0	61	0.35	380			
4					60	0.5				
6					60	0.55	380	1101	38.7	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-148-1		433	0.064					0.277
	Grind filtrate	-0			0.010					
6	PF	-2	263		0.415	0.002	0.32		32.2	0.109
	Wash	-4	970		0.155					0.150
	Residue	-3		426.5	0.0067					0.028
					0.068					0.288

Time, hr	% Extracted U_3O_8
6	89.8

Remarks: H_2SO_4 consumed = 354 lb/ton

H_2SO_4 Leach of Control Composite B&C

Test No. 31 Book No. 1070-150 Date 2/17/78 By RJ

Grind, time, min	5, rod	Acidity	373 lb/ton
% mesh		$NaClO_3$ added, g	1.34
%-200 mesh		lb/ton	6
Heads, total slurry, wt, g	1190	Temperature	60°C
Spl. slurry wt, g	133.7	Time, total hr	6
solids, g	54.1	Sampled at	6 hr
% solids	40.5		
Solids in leach, g	437		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	81.4	373	0.67	3.1						
1			-		61	0.6	412			
2			0.67	6.1	61	0.7	390			
4					60	0.8	400			
6					60	0.9	380	1083	39.8	

Assay data

Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-150-1		428	0.064					0.274
	Grind filtrate	-0			0.011					
6	PF	-2	257		0.428	0.001	0.28		16.8	0.110
	Wash	-4	960		0.159					0.153
	Residue	-3		431.0	0.0077					0.033
					0.069					0.296

Time, hr	% Extracted U_3O_8
6	88.4

Remarks: H_2SO_4 consumed = 325 lb/ton

H_2SO_4 Leach of Weathered Composite B&C

Test No. 32 Book No. 1070-153 Date 2/20/78 By RJ

Grind, time, min	5, rod	Acidity	441 lb/ton
% mesh		$NaClO_3$ added, g	0.44
%-200 mesh		lb/ton	2
Heads, total slurry, wt, g	1190	Temperature	75°C
Spl. slurry wt, g	131.3	Time, total hr	6
solids, g	53.5	Sampled at	6 hr
% solids	40.7		
Solids in leach, g	431		

Leach data

Time	Reagents Added				Temp	pH	emf	Slurry Sample	Pulp	Remarks
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C		(-mv)	g	% Solids	
0	96.6	441	0.22	1.0	74					
1	-		-		75	0.4	390			
2	-		0.22	2.0	75	0.5	375			
4	-		-		75	0.6	375			
6	-		-		74	0.7	365	1088	40.3	

Assay data

Time hr	Sample	No.	Amount ml	Amount g	Assay, % or g/l U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	Amount, g U_3O_8
0	Heads	1070-153-1		431	0.066					0.284
6	PF	-2	241		0.435	0.002	0.33		28	0.105
	Wash	-4	895		0.176					0.158
	Residue	-3		438.0	0.0070					0.031
					0.067					0.294

Time, hr	% Extracted U_3O_8
6	89.5

Remarks: H_2SO_4 consumed = 364 lb/ton

H_2SO_4 Leach of Weathered Composite B&C

Test No. 33 Book No. 1070-155 Date 2/20/78 By RJ

Grind, time, min	5, rod	Acidity	375 lb/ton
% mesh		$NaClO_3$ added, g	1.34
%-200 mesh		lb/ton	6
Heads, total slurry, wt, g	1190	Temperature	75°C
Spl. slurry wt, g	136.1	Time, total hr	6
solids, g	55.8	Sampled at	6 hr
% solids	41.0		
Solids in leach, g	432		

Leach data

Time hr	Reagents Added H_2SO_4 g	H_2SO_4 lb/ton	$NaClO_3$ g	$NaClO_3$ lb/ton	Temp °C	pH	emf (-mv)	Slurry Sample g	Pulp % Solids	Remarks
0	81.0	375	0.67	3.1	74					
1	-		-		75	0.8	390			
2	-		0.67	6.2	75	0.8	370			
4	-		-		75	0.9	380			
6	-		-		74	1.0	365	1075	43.0	

Assay data

Time hr	Sample	No.	Amount ml	Amount g	Assay, % or g/l U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	Amount, g U_3O_8
0	Heads	1070-155-1		432	0.066					0.285
6	PF	-2	251		0.440	0.002	0.28		14	0.110
	Wash	-4	1000		0.150					0.150
	Residue	-3		462.8	0.0070					0.032
					0.063					0.292

Time, hr	% Extracted U_3O_8
6	89.1

Remarks: H_2SO_4 consumed = 339 lb/ton

H_2SO_4 Leach of Control Composite B&C

Test No. 34 Book No. 1070-157 Date 2/20/78 By RJ

Grind, time, min	5, rod	Acidity	374 lb/ton
% mesh		$NaClO_3$ added, g	0.44
%-200 mesh		lb/ton	2
Heads, total slurry, wt, g	1190	Temperature	75°C
Spl. slurry wt, g	136.7	Time, total hr	6
solids, g	54.6	Sampled at	6 hr
% solids	39.9		
Solids in leach, g	433		

Leach data

Time hr	Reagents Added H_2SO_4 g	H_2SO_4 lb/ton	$NaClO_3$ g	$NaClO_3$ lb/ton	Temp °C	pH	emf (-mv)	Slurry Sample g	Pulp % Solids	Remarks
0	81.0	374	0.22	1.0	74					
1	-		-		75	0.8	360			
2	-		0.22	2.0	75	0.95	345			
4	-		-		75	0.95	350			
6	-		-		74	1.0	335	1083	41.9	

Assay data

Time hr	Sample	No.	Amount ml	Amount g	Assay, % or g/l U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	Amount, g U_3O_8
0	Heads	1070-157-1		433	0.064					0.277
6	PF	-2	263		0.416	<0.001	0.27		13	0.109
	Wash	-4	1060		0.146					0.155
	Residue	-3		454	0.0066					0.030
					0.065					0.294

Time, hr	% Extracted U_3O_8
6	89.8

Remarks: H_2SO_4 consumed = 338 lb/ton

H_2SO_4 Leach of Control Composite B&C

Test No. 35 Book No. 1070-159 Date 2/20/78 By RJ

Grind, time, min	5, rod		
% mesh		Acidity	445 lb/ton
%-200 mesh		$NaClO_3$ added, g	1.34
Heads, total slurry, wt, g	1190	lb/ton	6
Spl. slurry wt, g	134.0	Temperature	75°C
solids, g	53.7	Time, total hr	6
% solids	40.1	Sampled at	6 hr
Solids in leach, g	434		

Leach data

Time	Reagents Added				Temp		emf	Slurry Sample	Pulp	
	H_2SO_4		$NaClO_3$							
hr	g	lb/ton	g	lb/ton	°C	pH	(-mv)	g	% Solids	Remarks
0	96.6	445	0.67	3.1	74					
1	-		-		75	0.5	390			
2	-		0.67	6.2	75	0.5	375			
4	-		-		75	0.5	390			
6	-		-		74	0.65	370	1098	41.3	

Assay data

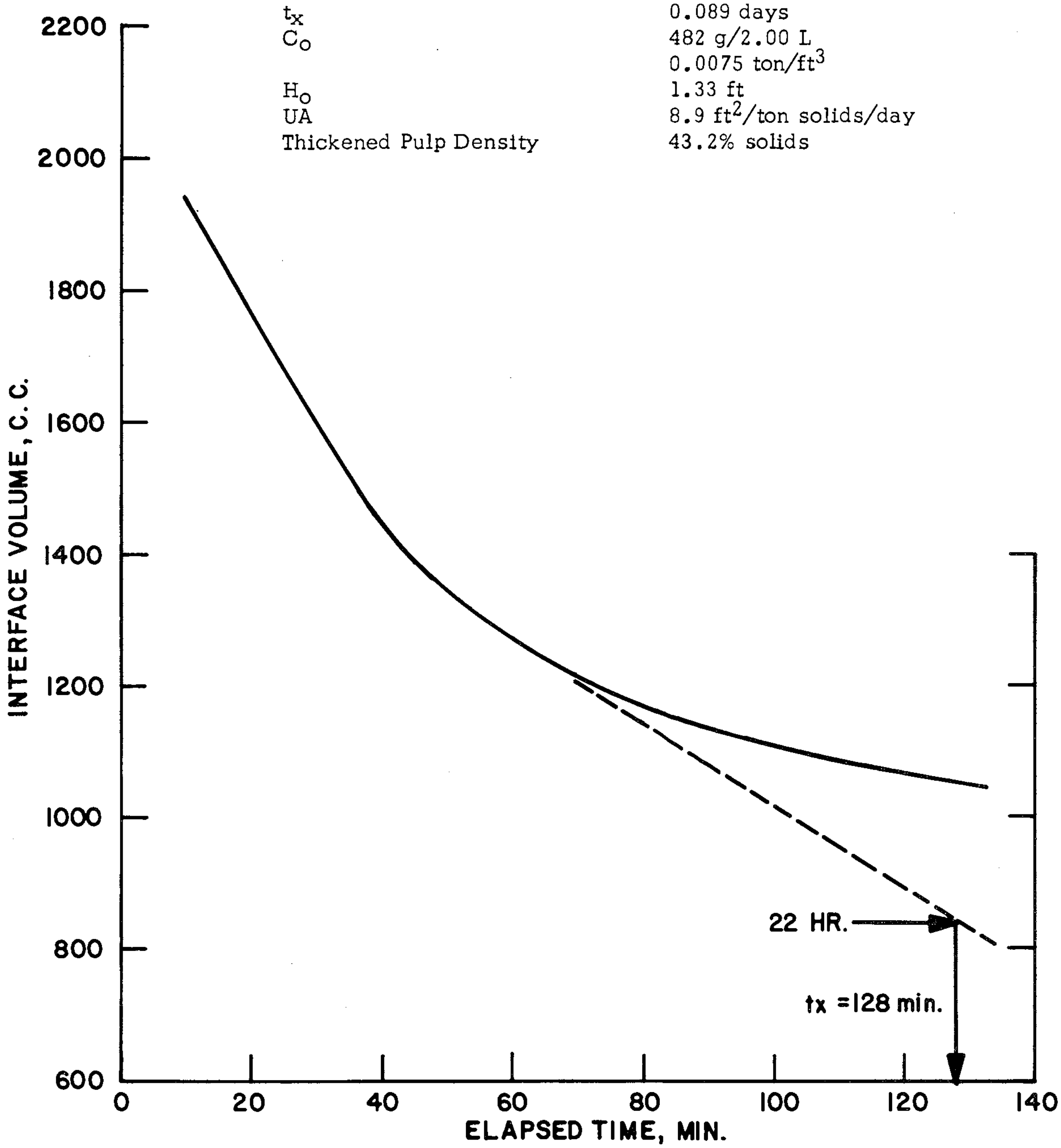
Time			Amount		Assay, % or g/l					Amount, g
hr	Sample	No.	ml	g	U_3O_8	Mo	V_2O_5	PO_4	H_2SO_4	U_3O_8
0	Heads	1070-159-1		434	0.066					0.286
6	PF	-2	265		0.434	0.002	0.33		27	0.115
	Wash	-4	945		0.149					0.141
	Residue	-3		454	0.0058					0.026
					0.062					0.282

Time, hr	% Extracted U_3O_8
6	90.9

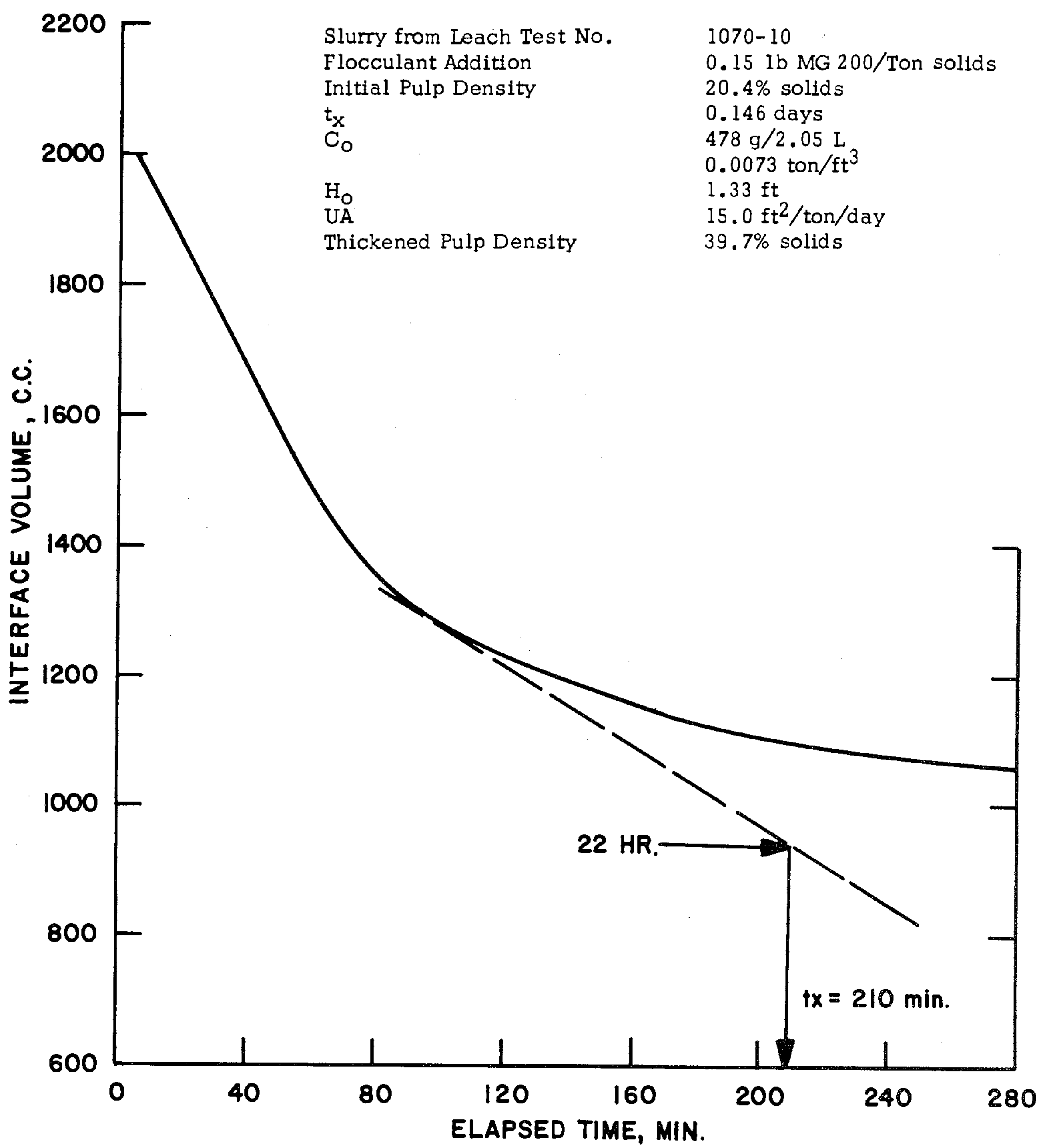
Remarks: H_2SO_4 consumed = 375 lb/ton

THICKENING TEST, COMPOSITE A

Slurry from Leach Test No.	1070-5
Flocculant Addition	0.14 lb MG 200/ton solids
Initial Pulp Density	20.8% solids
t_x	0.089 days
C_o	482 g/2.00 L
	0.0075 ton/ft^3
H_o	1.33 ft
UA	8.9 ft^2/ton solids/day
Thickened Pulp Density	43.2% solids

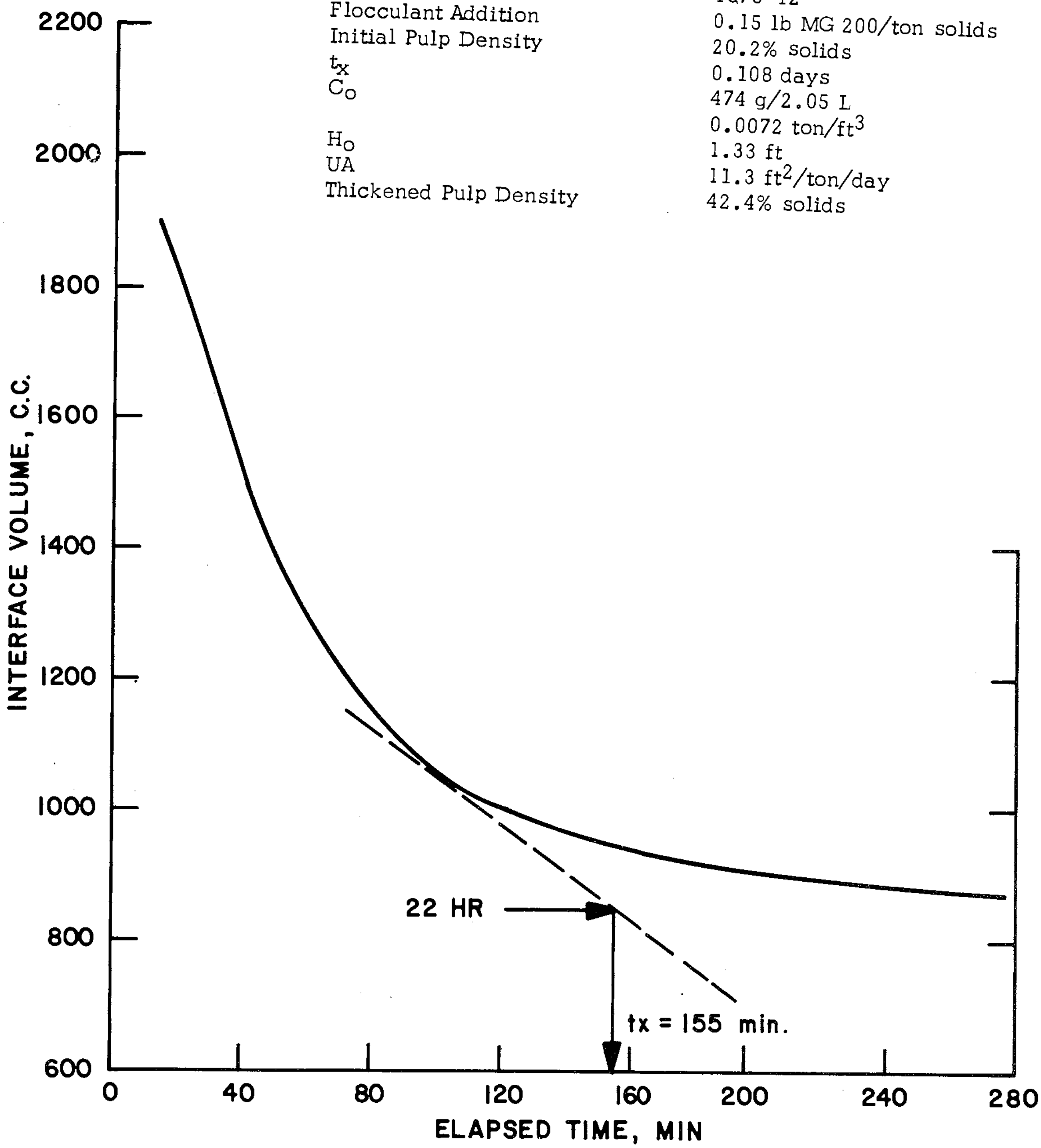


THICKENING TEST, COMPOSITE B



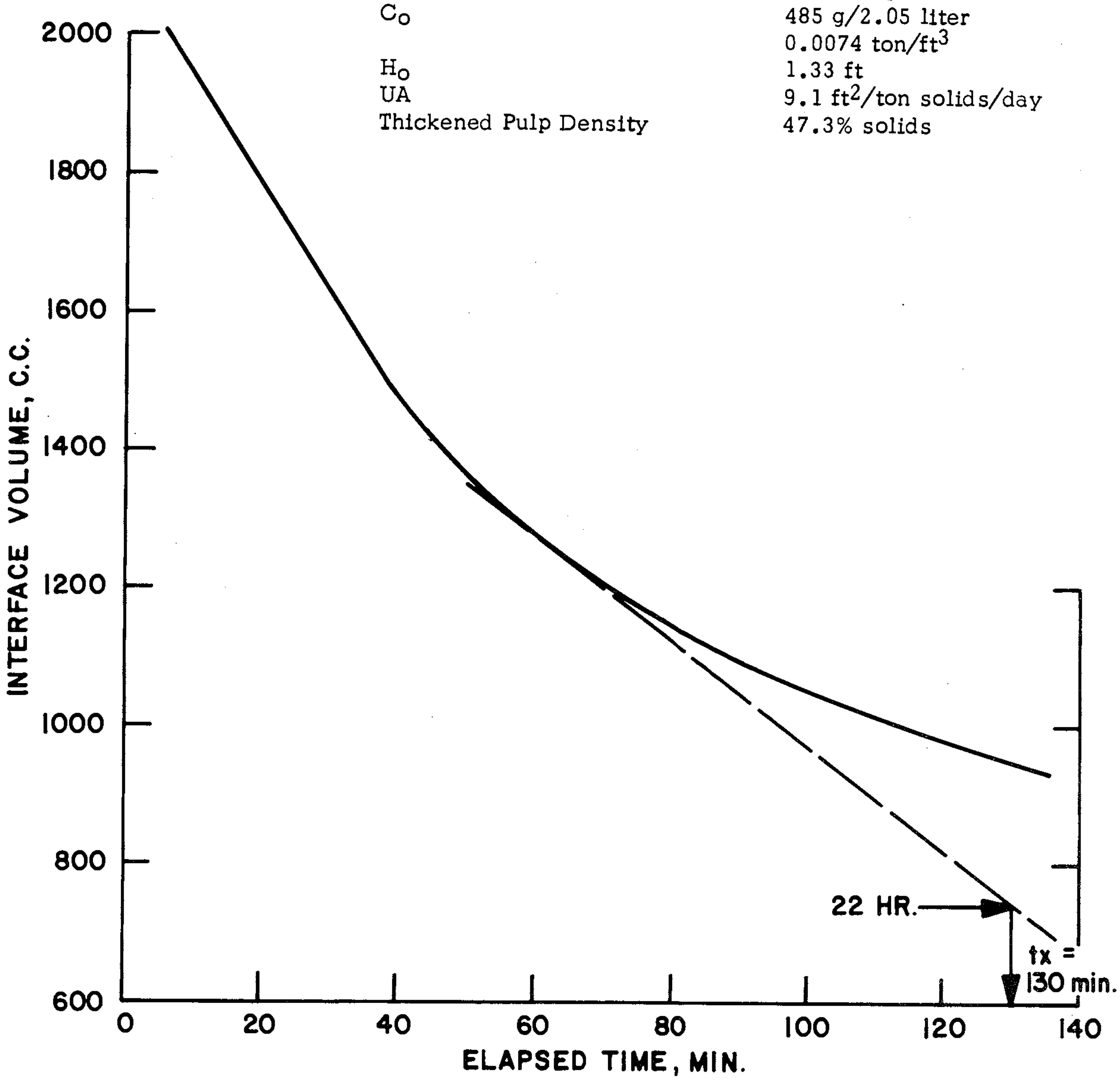
THICKENING TEST, COMPOSITE C

Slurry from Leach Test No.	1Q70-12
Flocculant Addition	0.15 lb MG 200/ton solids
Initial Pulp Density	20.2% solids
t_x	0.108 days
C_o	474 g/2.05 L
	0.0072 ton/ft^3
H_o	1.33 ft
UA	11.3 ft^2/ton/day
Thickened Pulp Density	42.4% solids



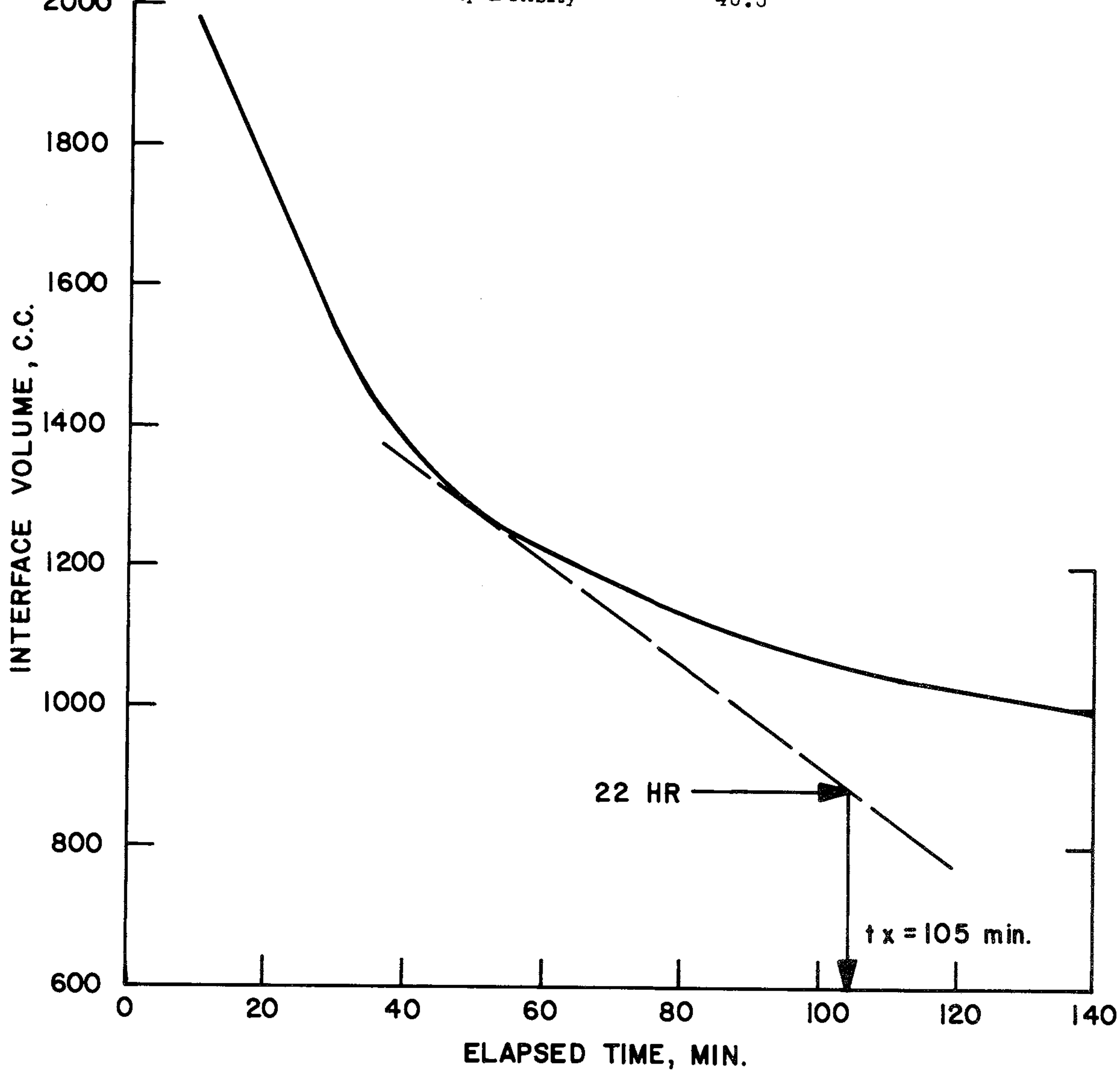
THICKENING TEST, COMPOSITE D

Slurry from Leach Test No.	1070-4
Flocculant Addition	0.14 lb MG 200/ton solids
Initial Pulp Density	20.8% solids
t_x	0.090 days
C_o	485 g/2.05 liter
	0.0074 ton/ft^3
H_o	1.33 ft
UA	9.1 ft^2/ton solids/day
Thickened Pulp Density	47.3% solids



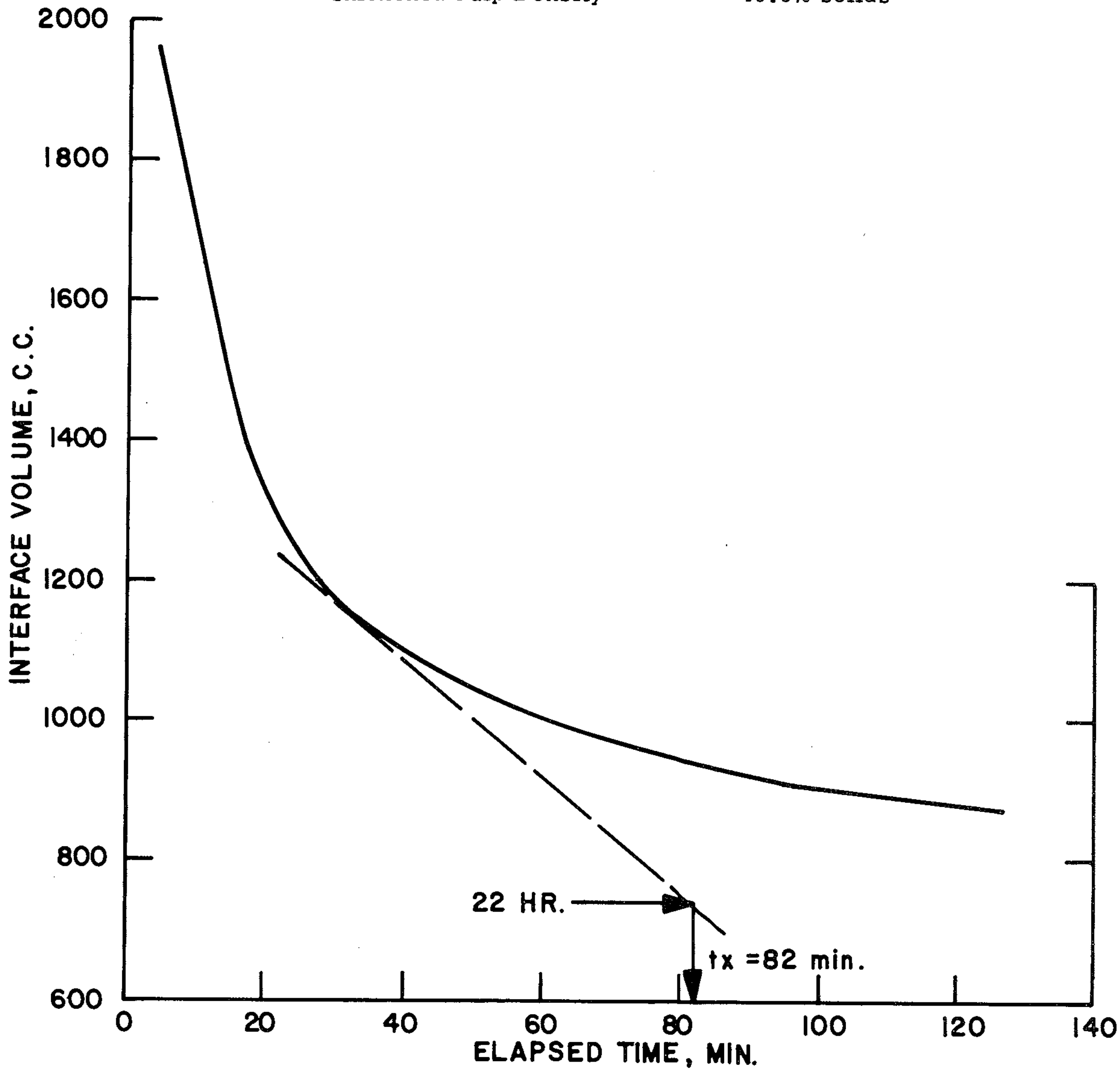
THICKENING TEST, COMPOSITE E

Slurry from Leach Test No.	1070-14
Flocculant Addition	0.15 lb MG200/ton solids
Initial Pulp Density	19.8% solids
t_x	0.073 days
C_o	461 g/2.05 liter
	0.0070 ton/ft^3
H_o	1.33 ft
UA	7.8 ft^2/ton/day
Thickened Pulp Density	40.5



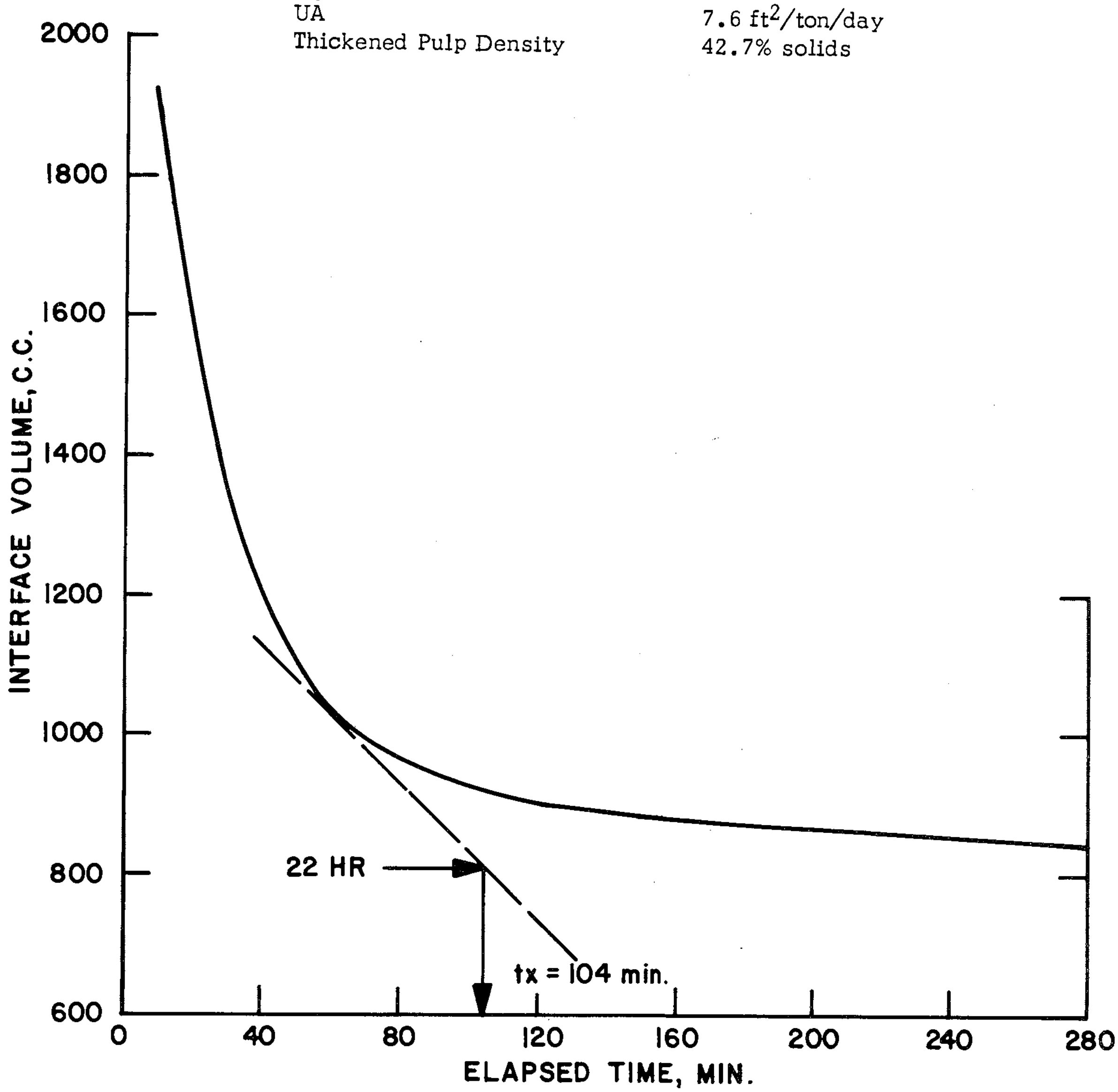
THICKENING TEST, COMPOSITE F

Slurry from Leach Test No.	1070-6
Flocculant Addition	0.15 lb MG200/ton solids
Initial Pulp Density	20.3% solids
t_x	0.057 days
C_o	469 g/2.05 liter
	0.0071 ton/ft^3
H_o	1.33 ft
UA	6.0 ft^2/ton solids/day
Thickened Pulp Density	46.3% solids



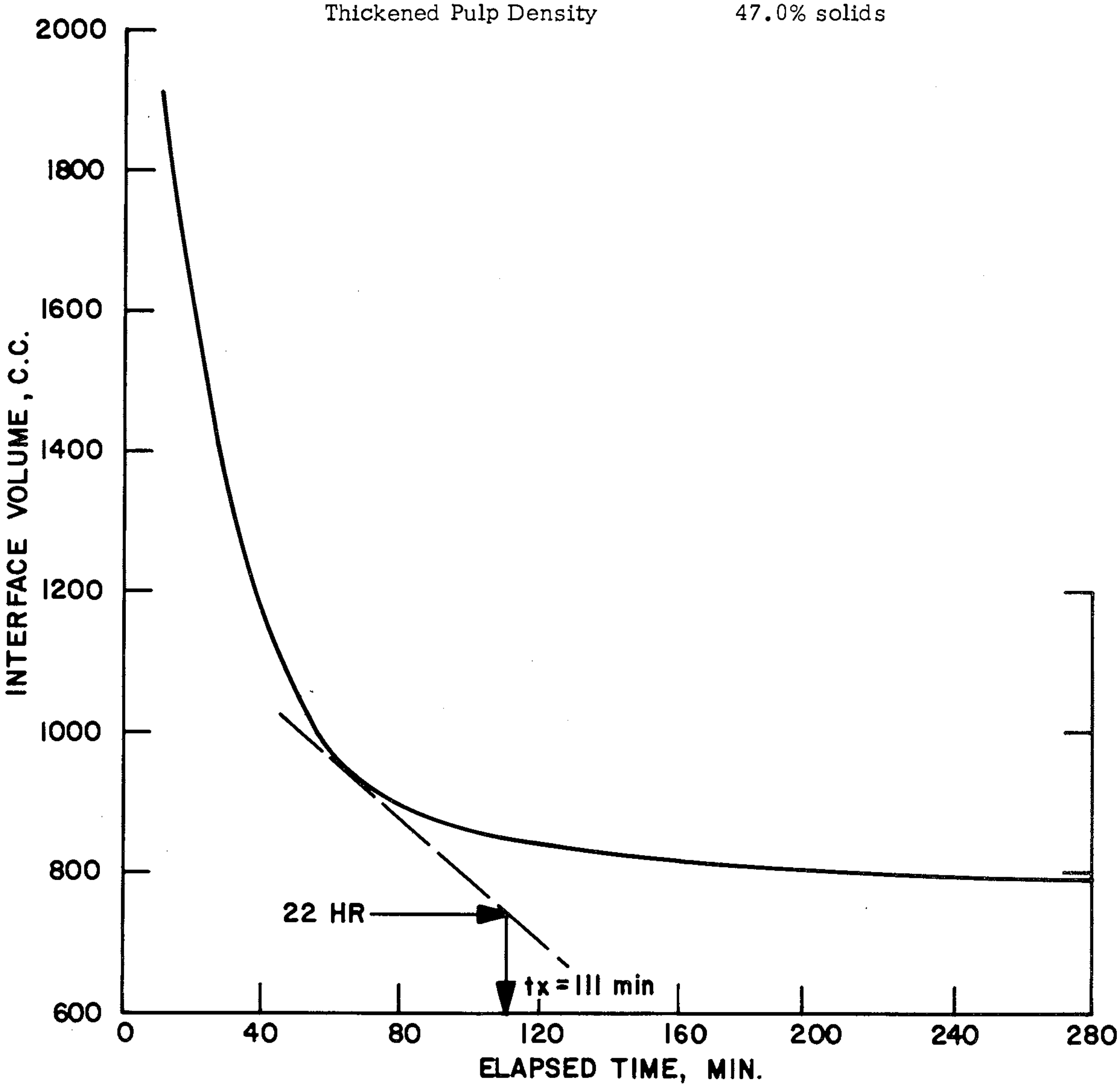
THICKENING TEST, MASTER COMPOSITE NO. 1

Slurry from Leach Test No.	1070-24
Flocculant Addition	0.15 lb MG 200/ton solids
Initial Pulp Density	19.9% solids
t_x	0.072 days
C_o	465 g/2.05 liter
	0.0071 ton/ft^3
H_o	1.33 ft
UA	7.6 ft^2/ton/day
Thickened Pulp Density	42.7% solids



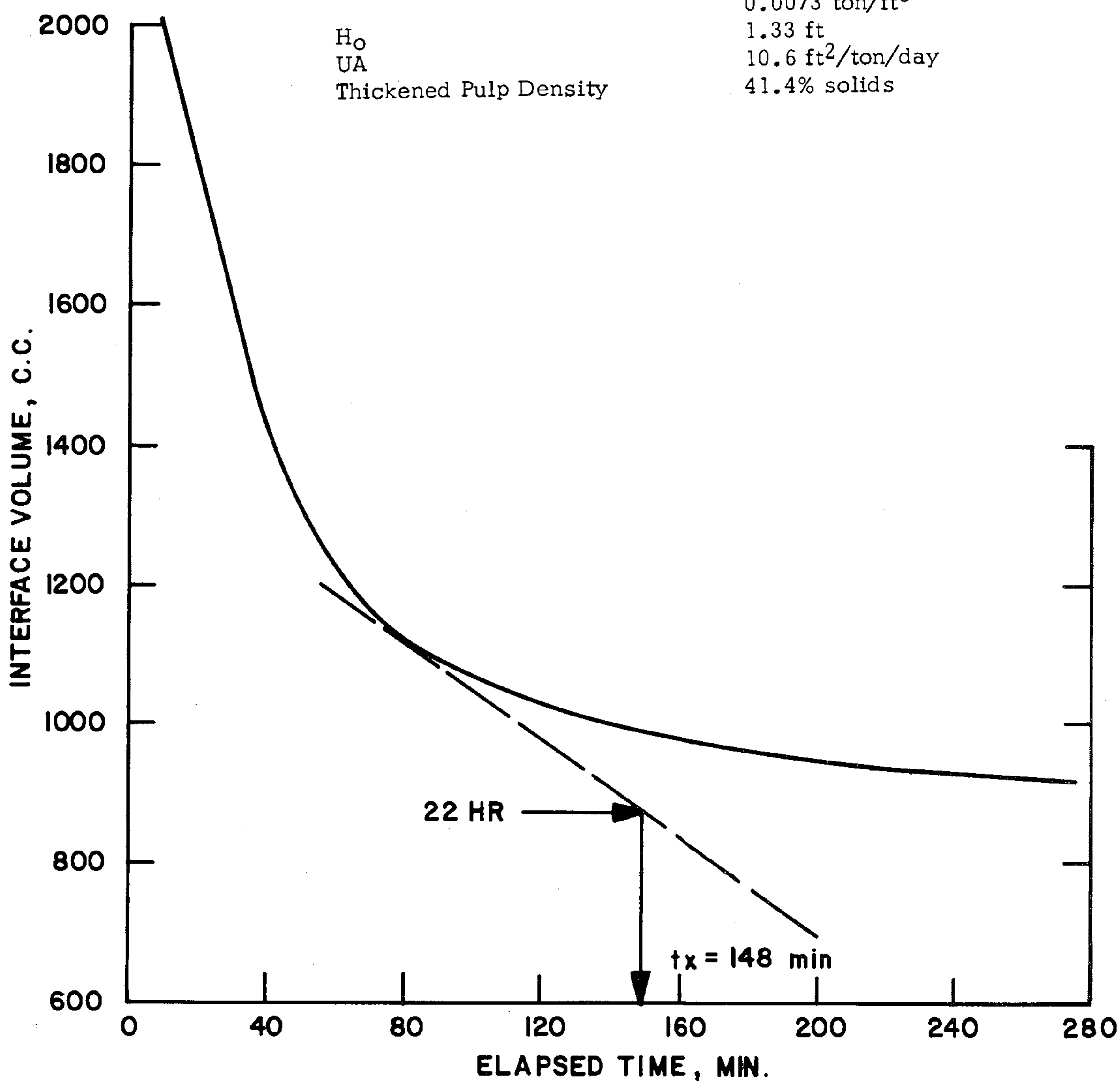
THICKENING TEST, MASTER COMPOSITE NO. 1

Slurry from Leach Test No.	1070-26
Flocculant Addition	0.15 lb MG 200/ton solids
Initial Pulp Density	20.4% solids
t_x	0.077 days
C_o	476 g/2.05 liter
	0.0072 ton/ft^3
H_o	1.33 ft
UA	8.0 ft^2/ton/day
Thickened Pulp Density	47.0% solids



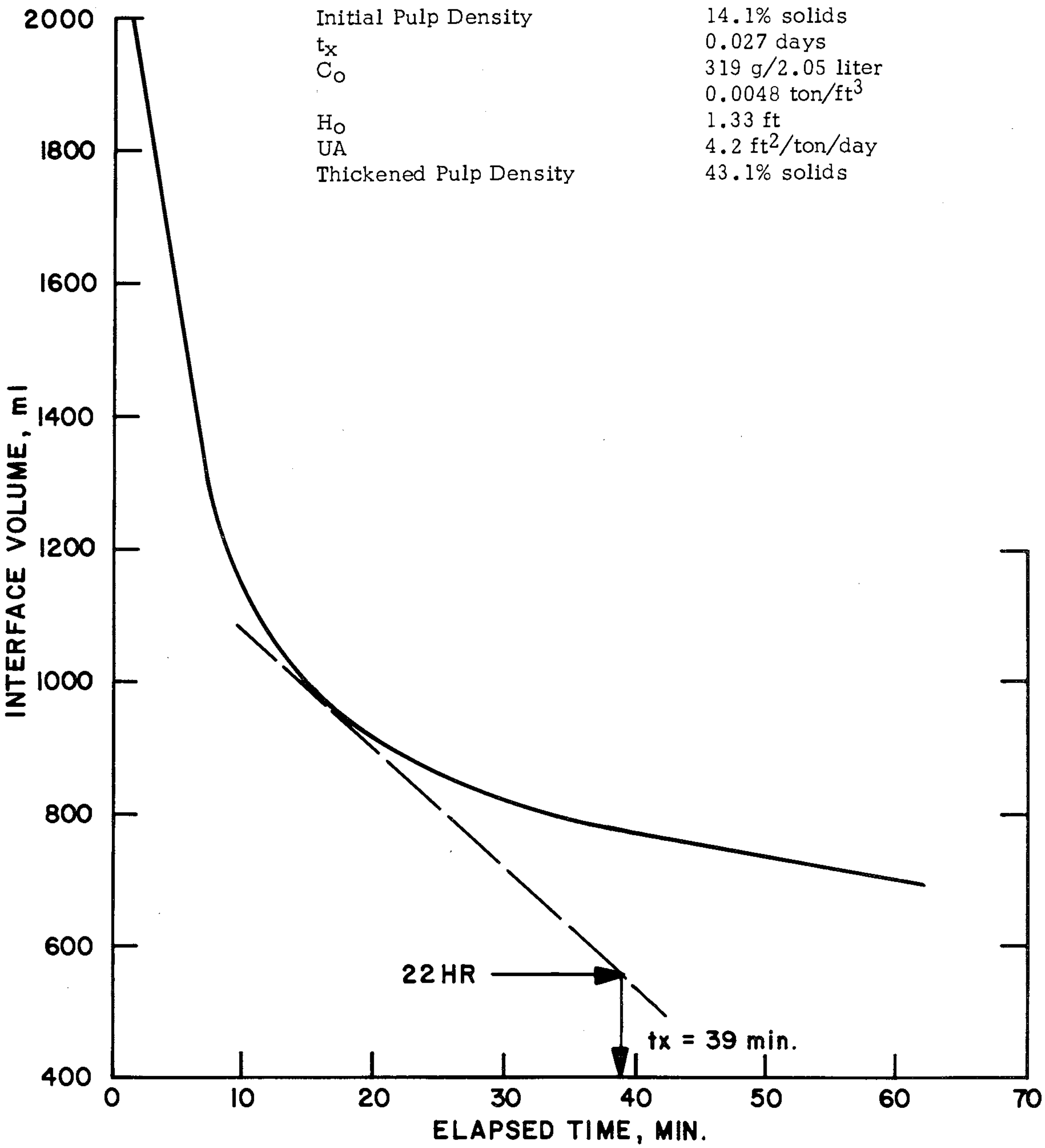
THICKENING TEST, MASTER COMPOSITE NO. 1

Slurry from Leach Test No.	1070-28
Flocculant Addition	0.15 lb MG 200/ton solids
Initial Pulp Density	20.4% solids
t_x	0.103 days
C_o	480 g/2.05 liter
	0.0073 ton/ft^3
H_o	1.33 ft
UA	10.6 ft^2/ton/day
Thickened Pulp Density	41.4% solids



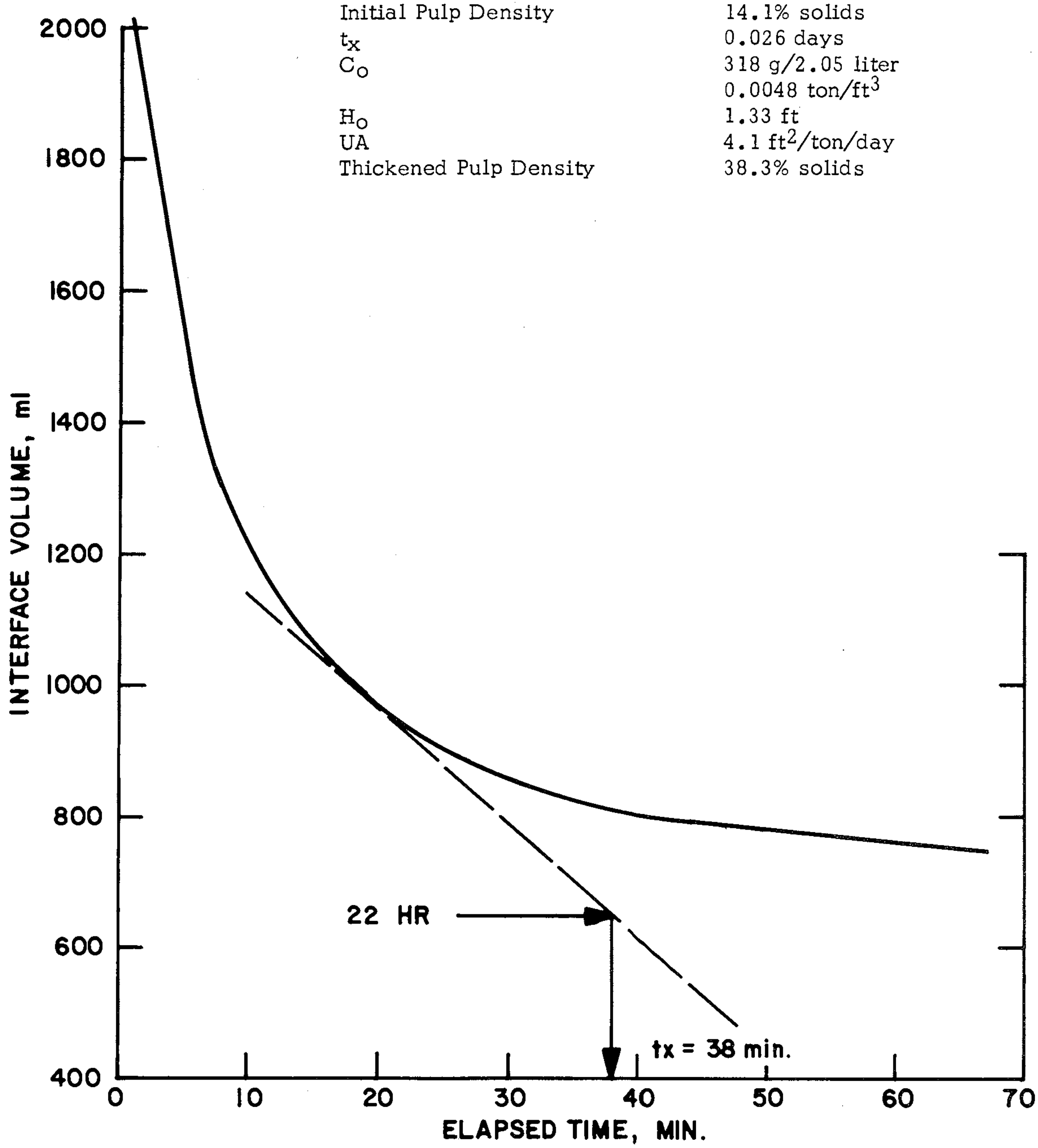
THICKENING TEST, MASTER COMPOSITE NO. 2

Slurry from Leach Test No.	13 (1070-48)
Flocculant Addition	0.21 lb MG 200/ton
Initial Pulp Density	14.1% solids
t_x	0.027 days
C_o	319 g/2.05 liter
	0.0048 ton/ft^3
H_o	1.33 ft
UA	4.2 ft^2/ton/day
Thickened Pulp Density	43.1% solids



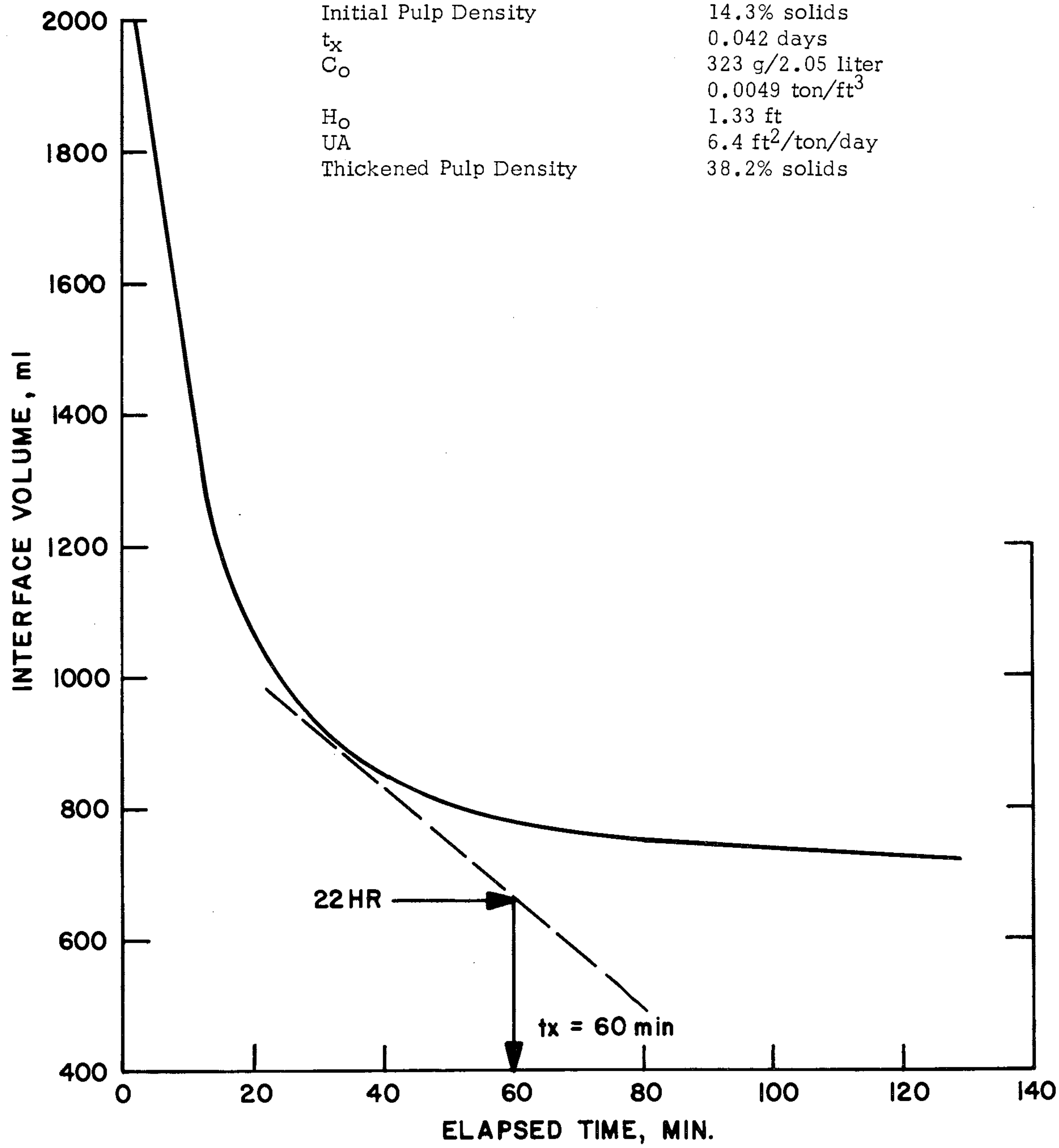
THICKENING TEST, MASTER COMPOSITE NO. 2

Slurry from Leach Test No.	14 (1070-50)
Flocculant Addition	0.21 lb MG 200/ton
Initial Pulp Density	14.1% solids
t_x	0.026 days
C_o	318 g/2.05 liter
	0.0048 ton/ft^3
H_o	1.33 ft
UA	4.1 ft^2/ton/day
Thickened Pulp Density	38.3% solids



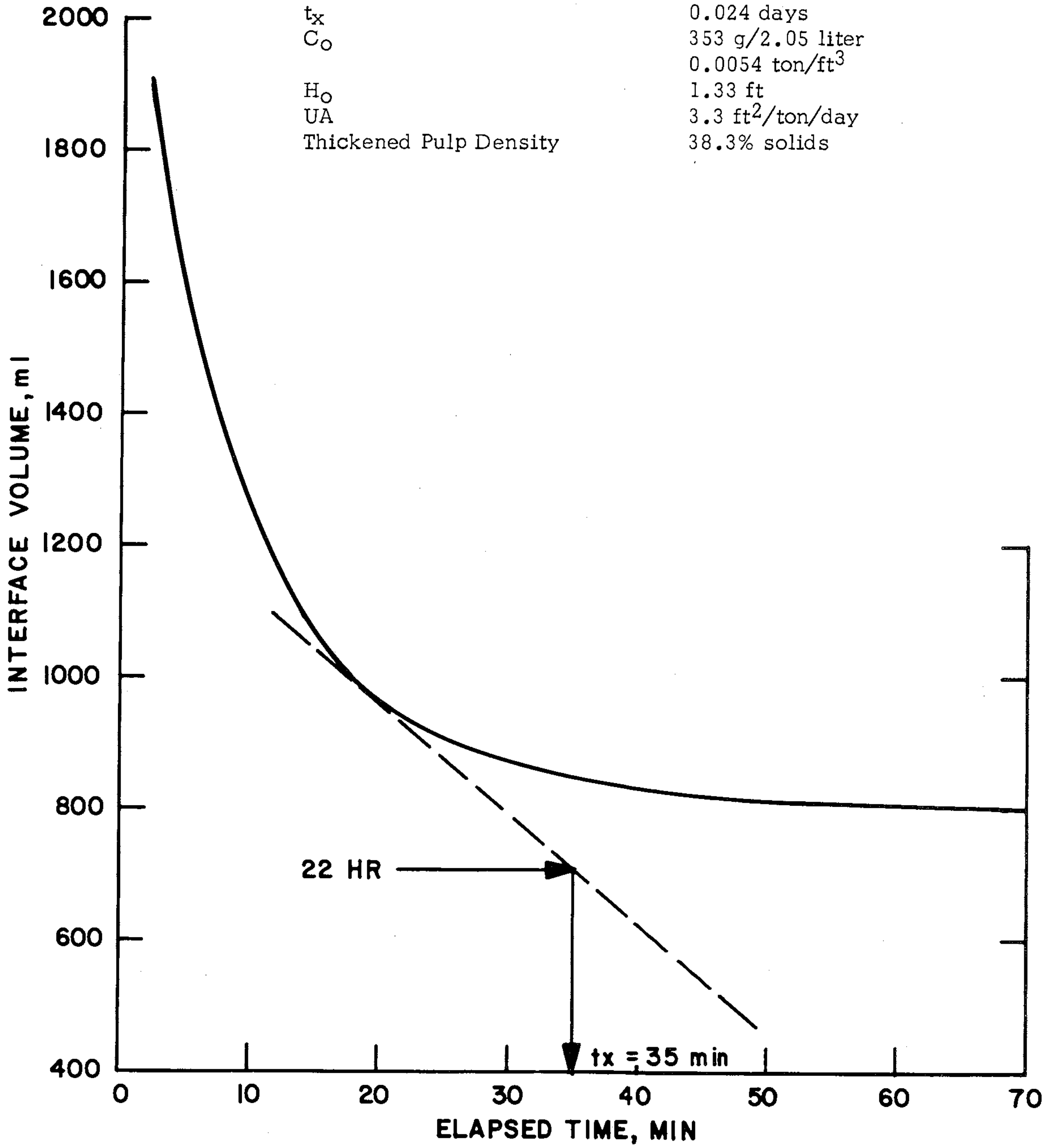
THICKENING TEST, MASTER COMPOSITE NO. 2

Slurry from Leach Test No.	15 (1070-52)
Flocculant Addition	0.21 lb MG 200/ton
Initial Pulp Density	14.3% solids
t_x	0.042 days
C_o	323 g/2.05 liter
	0.0049 ton/ft^3
H_o	1.33 ft
UA	6.4 ft^2/ton/day
Thickened Pulp Density	38.2% solids



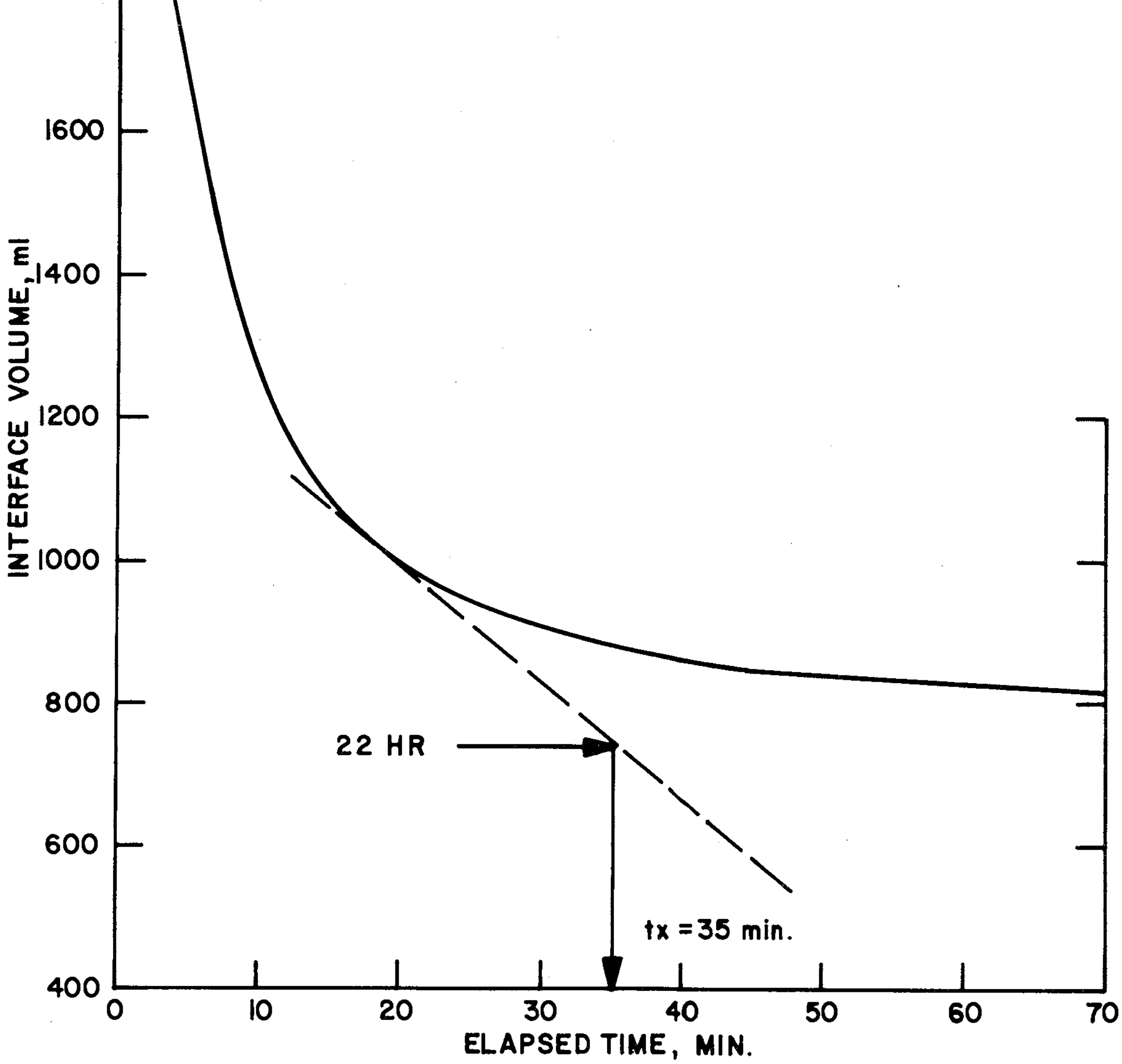
THICKENING TEST, MASTER COMPOSITE NO. 2

Slurry from Leach Test No.	16 (1070-58)
Flocculant Addition	0.20 lb MG 200/ton
Initial Pulp Density	15.5% solids
t_x	0.024 days
C_o	353 g/2.05 liter
	0.0054 ton/ft^3
H_o	1.33 ft
UA	3.3 ft^2/ton/day
Thickened Pulp Density	38.3% solids

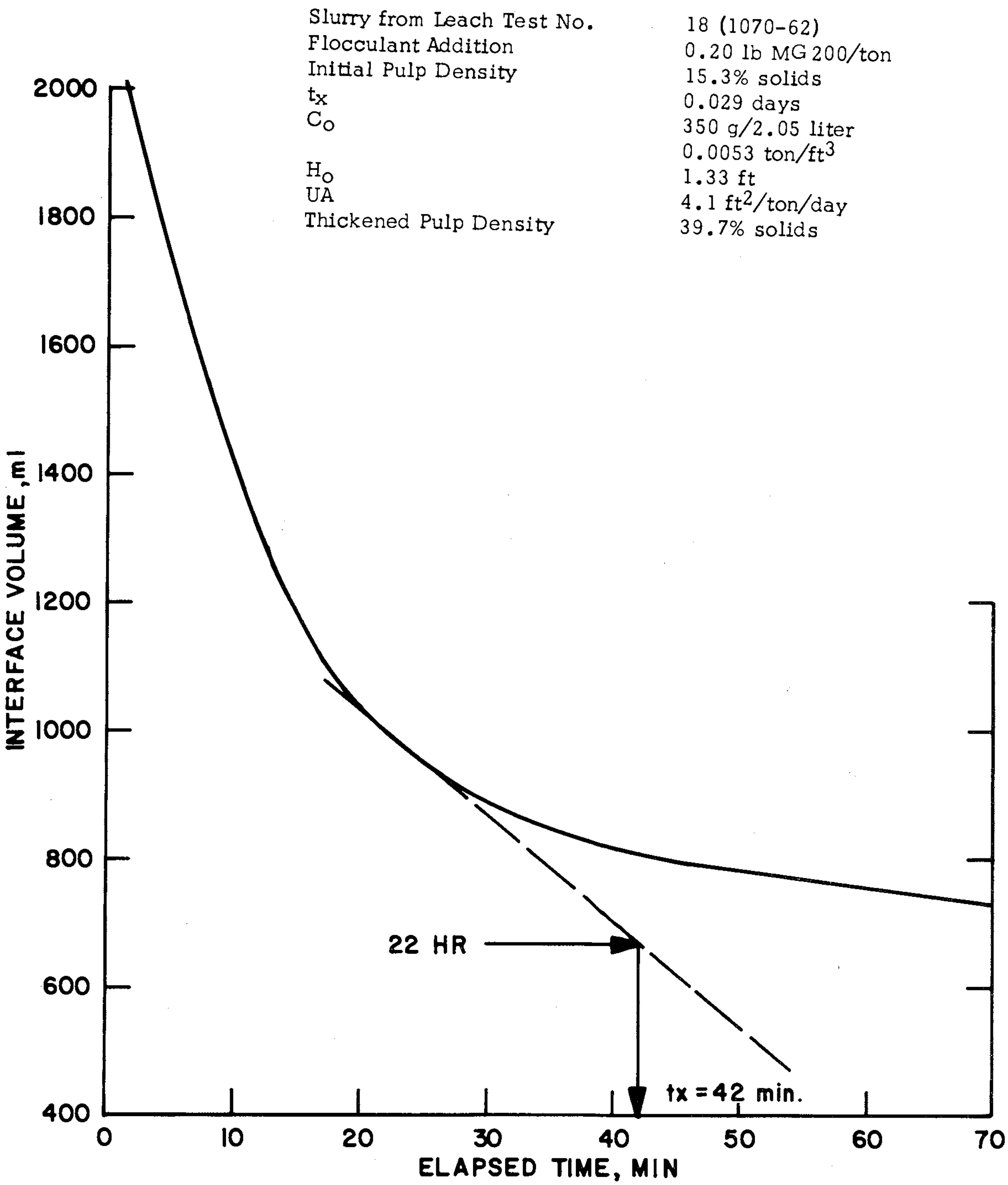


THICKENING TEST, MASTER COMPOSITE NO. 2

Slurry from Leach Test No.	17 (1070-60)
Flocculant Addition	0.20 lb MG 200/ton
Initial Pulp Density	15.4% solids
t_x	0.024 days
C_o	352 g/2.05 liter
	0.0054 ton/ft^3
H_o	1.33 ft
UA	3.3 ft^2/ton/day
Thickened Pulp Density	37.0% solids

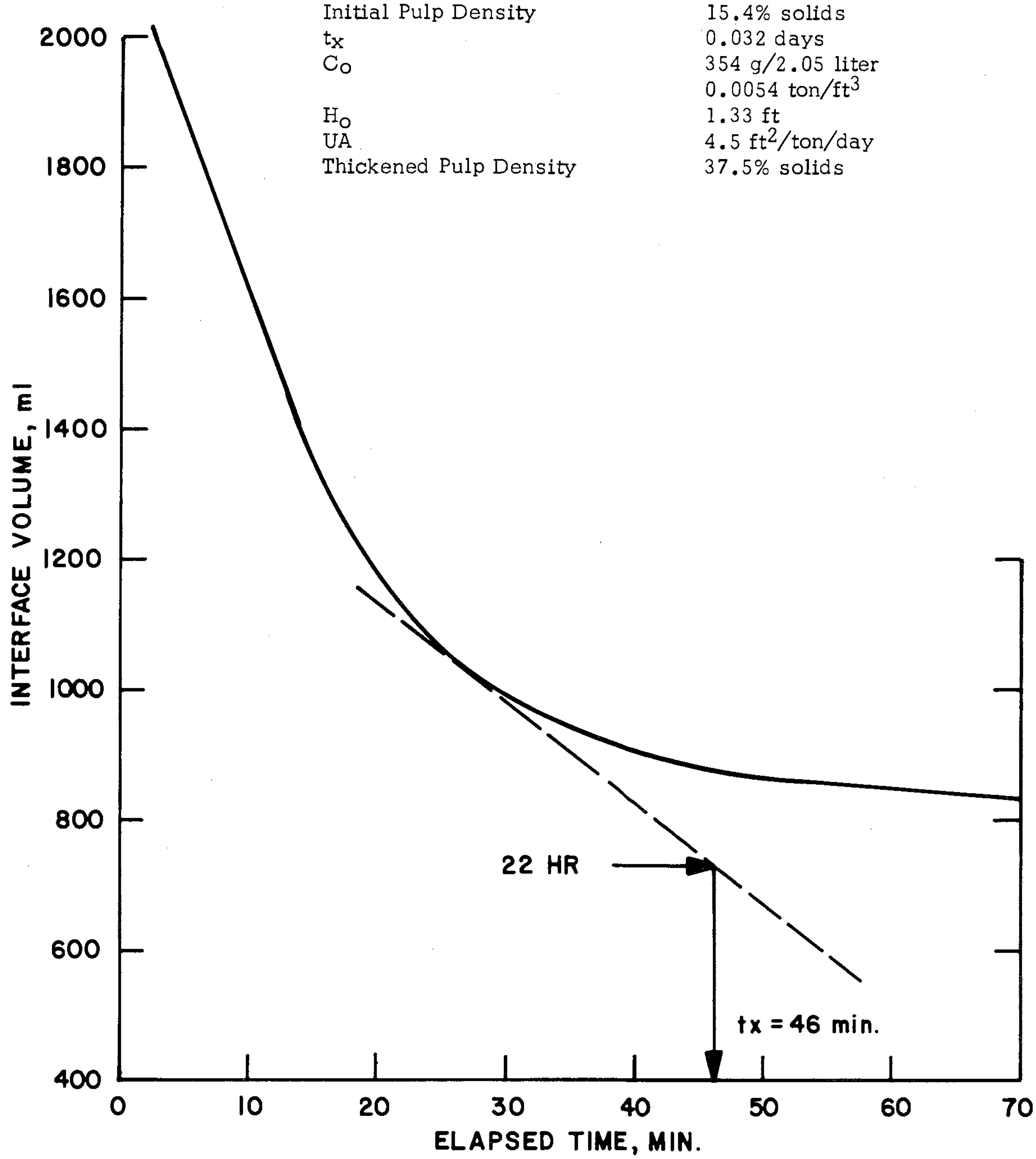


THICKENING TEST, MASTER COMPOSITE NO. 2



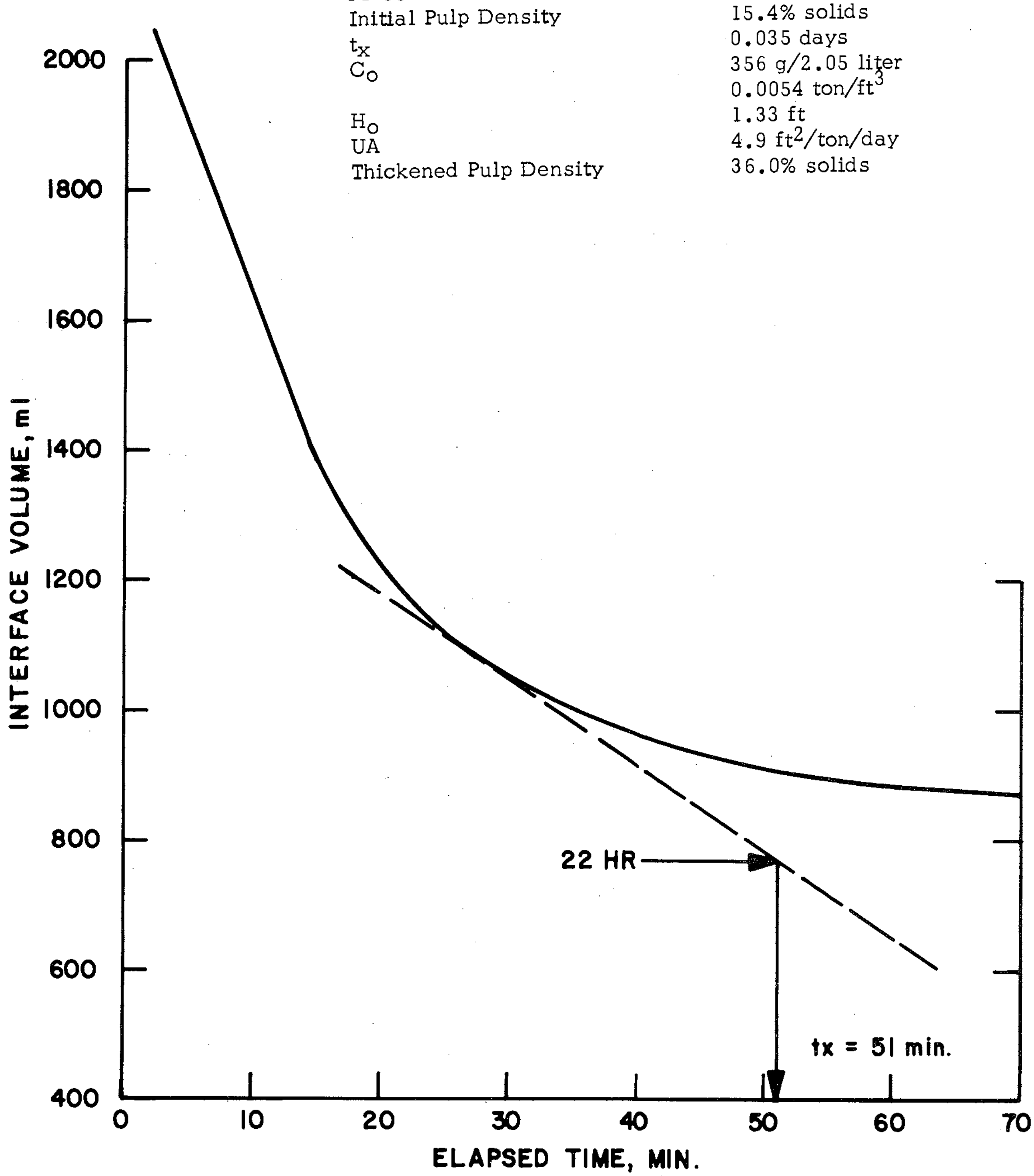
THICKENING TEST, MASTER COMPOSITE NO. 2

Slurry from Leach Test No.	19 (1070-66)
Flocculant Addition	0.20 lb MG 200/ton
Initial Pulp Density	15.4% solids
t_x	0.032 days
C_o	354 g/2.05 liter
	0.0054 ton/ft^3
H_o	1.33 ft
UA	4.5 ft^2/ton/day
Thickened Pulp Density	37.5% solids



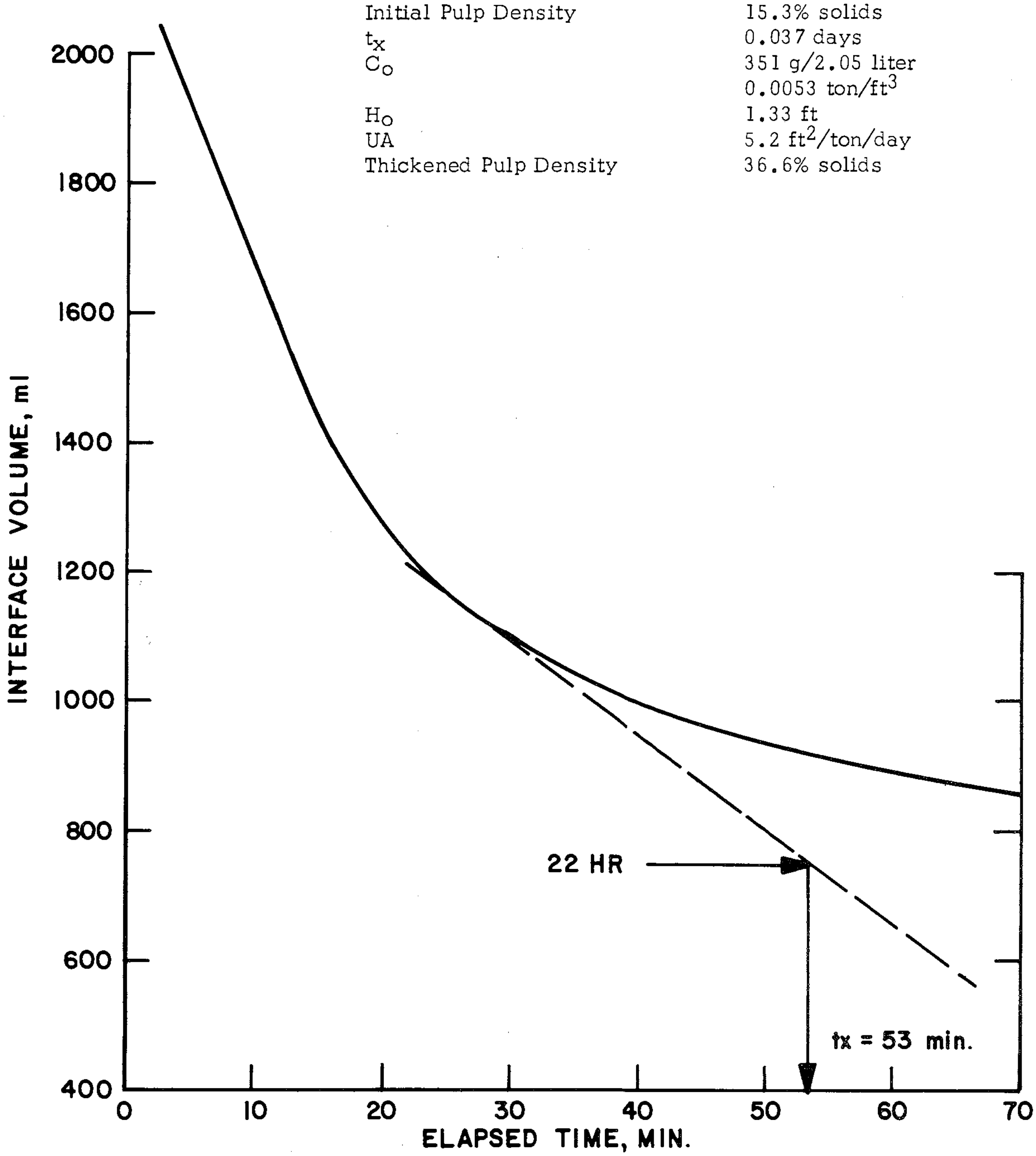
THICKENING TEST, MASTER COMPOSITE NO. 2

Slurry from Leach Test No.	20 (1070-68)
Flocculant Addition	0.20 lb MG 200/ton
Initial Pulp Density	15.4% solids
t_x	0.035 days
C_o	356 g/2.05 liter
	0.0054 ton/ft^3
H_o	1.33 ft
UA	4.9 ft^2/ton/day
Thickened Pulp Density	36.0% solids



THICKENING TEST, MASTER COMPOSITE NO. 2

Slurry from Leach Test No.	21 (1070-70)
Flocculant Addition	0.20 lb MG 200/ton
Initial Pulp Density	15.3% solids
t_x	0.037 days
C_o	351 g/2.05 liter
	0.0053 ton/ft^3
H_o	1.33 ft
UA	5.2 ft^2/ton/day
Thickened Pulp Density	36.6% solids



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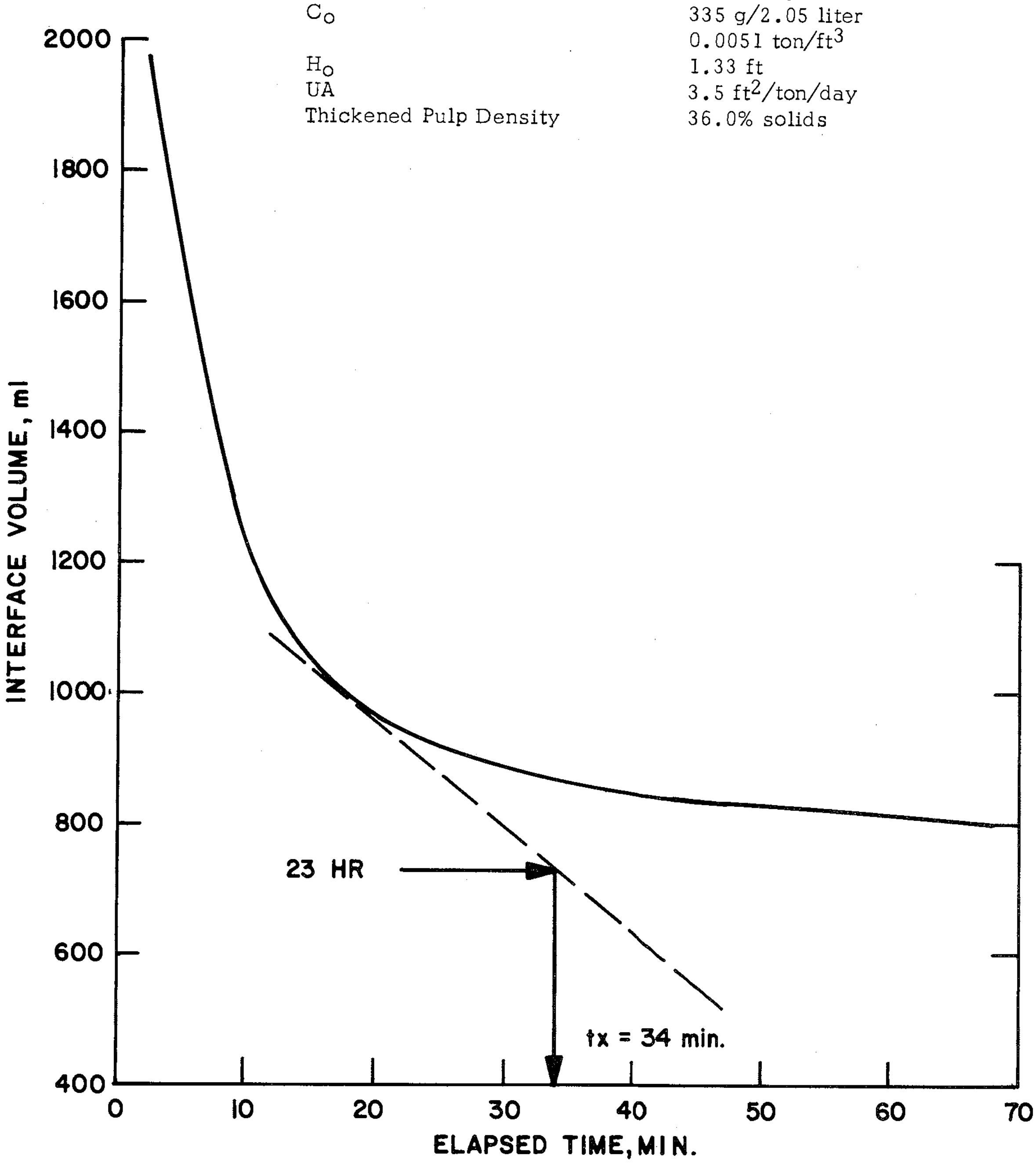
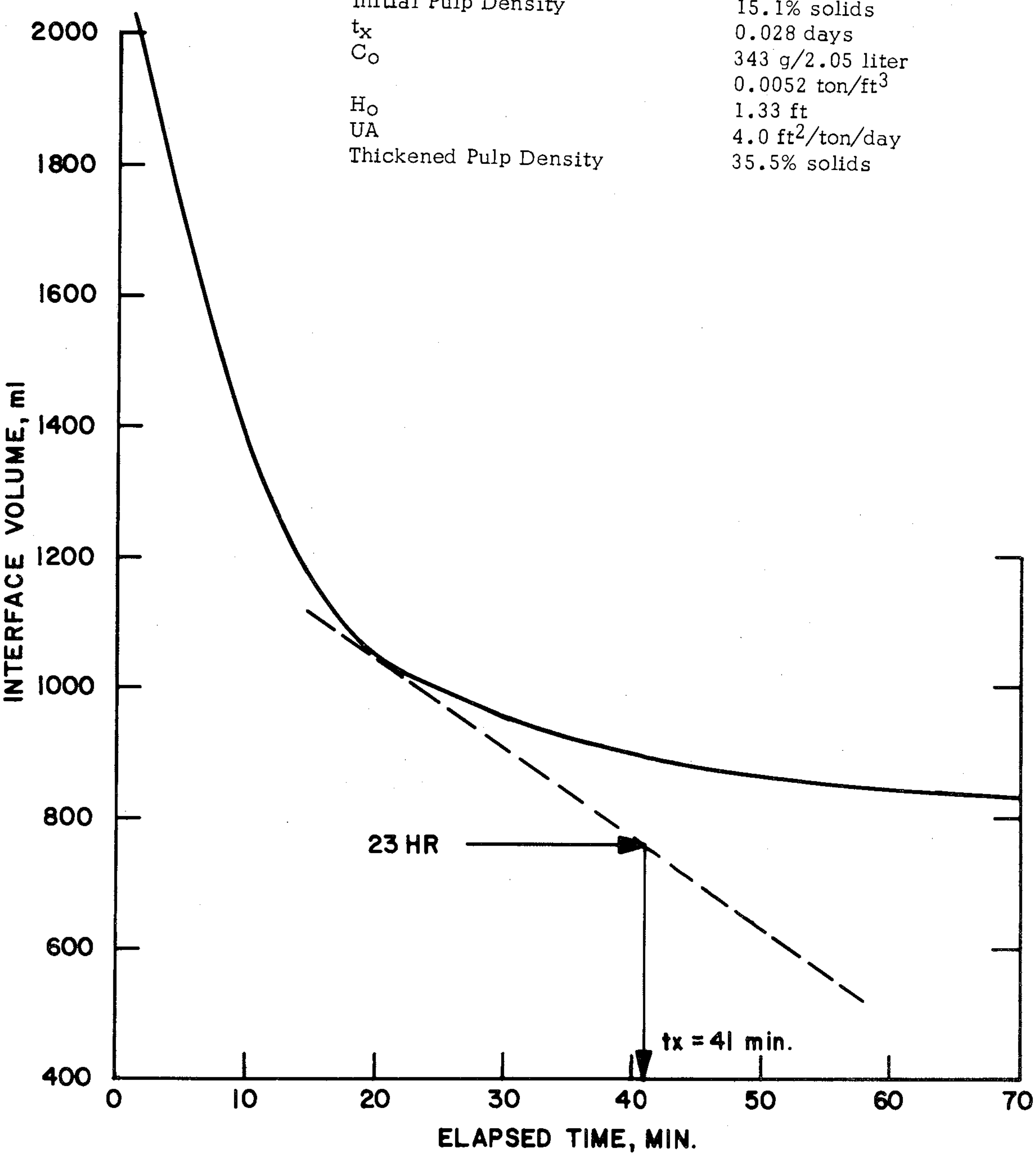
THICKENING TEST, COMPOSITE B + C

Slurry from Leach Test No.	22 (1070-74)
Flocculant Addition	0.21 lb MG 200/ton
Initial Pulp Density	14.8% solids
t_x	0.024 days
C_o	335 g/2.05 liter
	0.0051 ton/ft^3
H_o	1.33 ft
UA	3.5 ft^2/ton/day
Thickened Pulp Density	36.0% solids

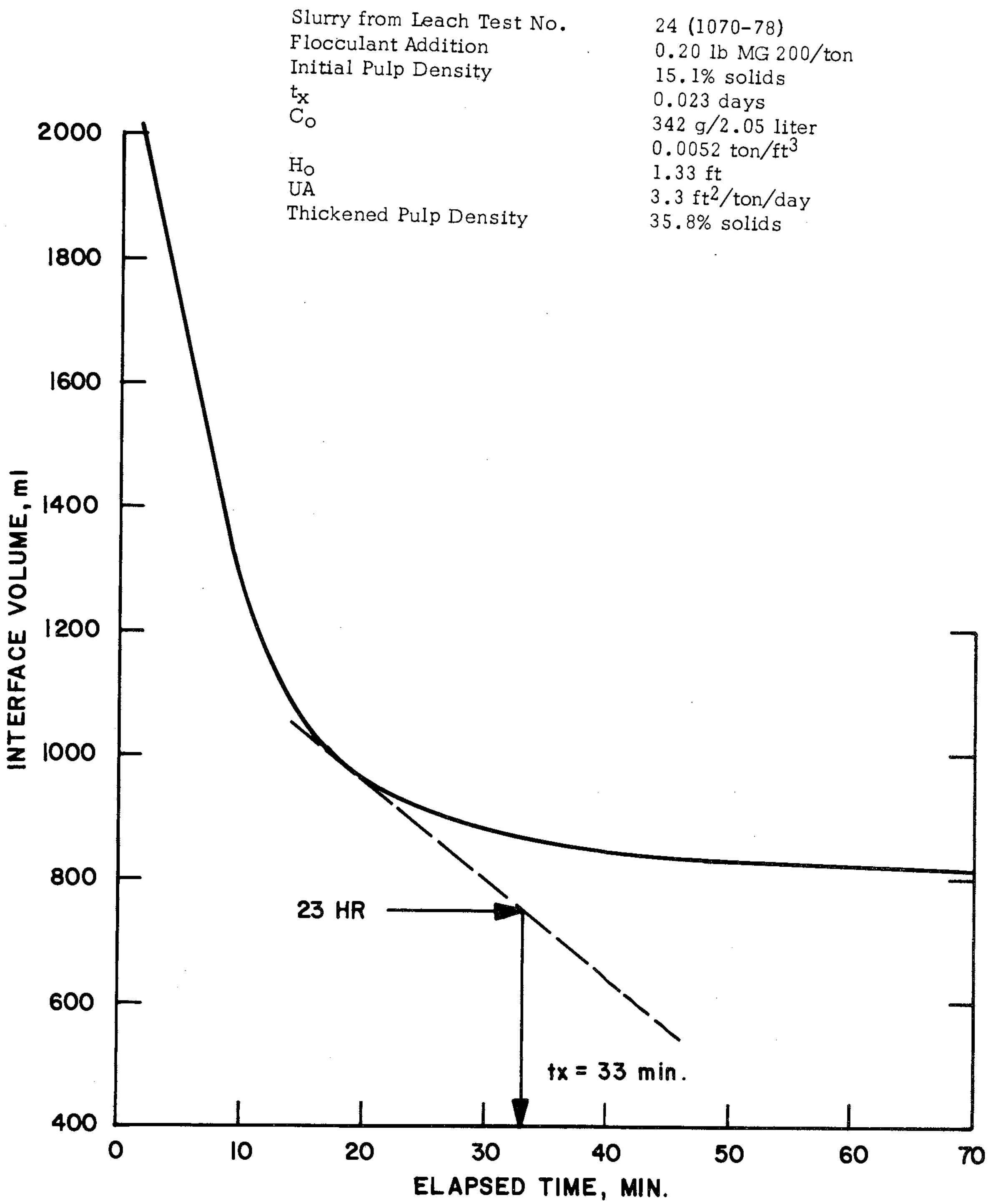


THICKENING TEST, COMPOSITE B + C

Slurry from Leach Test No.	23 (1070-76)
Flocculant Addition	0.20 lb MG 200/ton
Initial Pulp Density	15.1% solids
t_x	0.028 days
C_o	343 g/2.05 liter
	0.0052 ton/ft^3
H_o	1.33 ft
UA	4.0 ft^2/ton/day
Thickened Pulp Density	35.5% solids

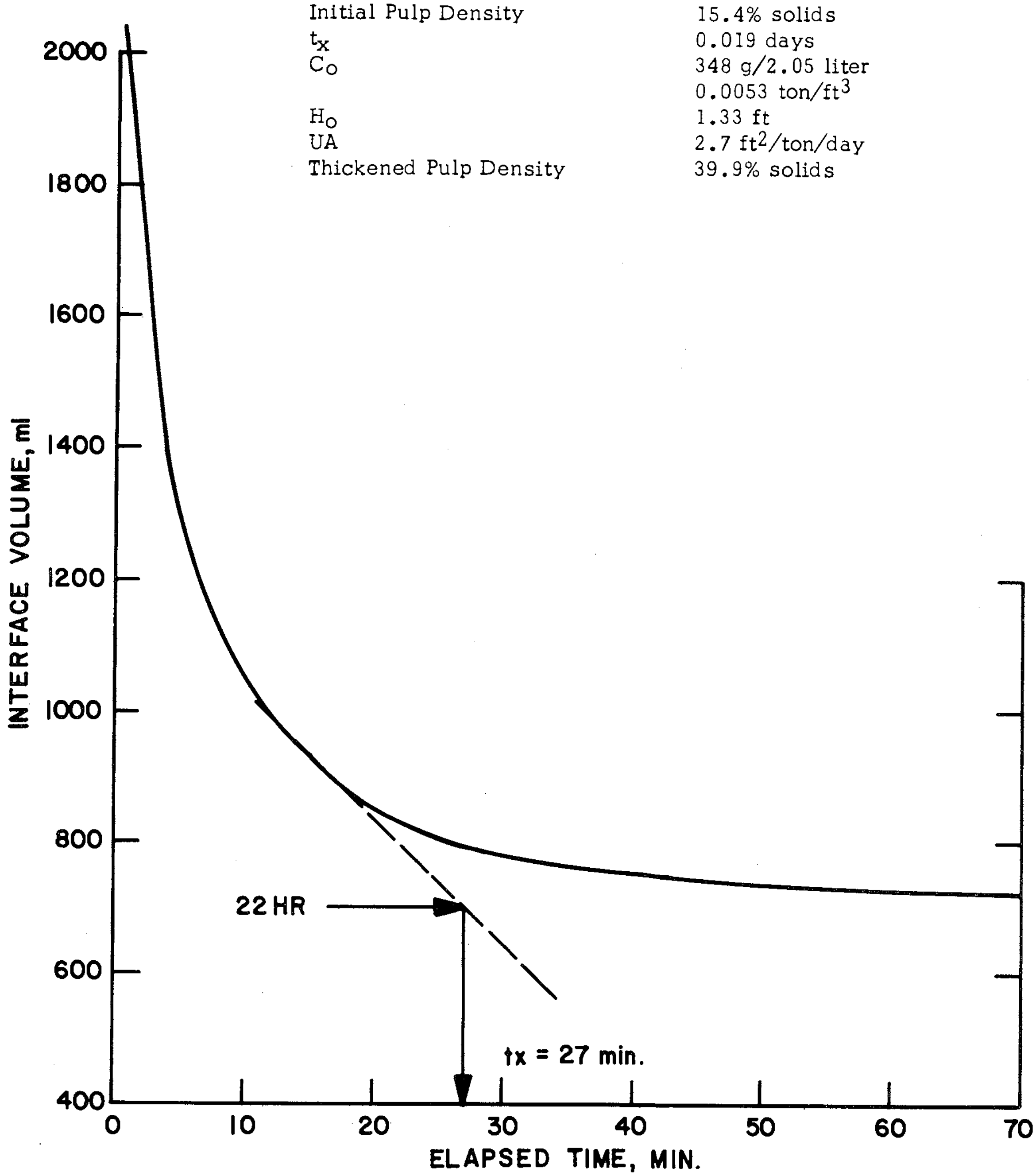


THICKENING TEST, COMPOSITE B + C



THICKENING TEST, COMPOSITE B + C

Slurry from Leach Test No.	25 (1070-84)
Flocculant Addition	0.20 lb MG 200/ton
Initial Pulp Density	15.4% solids
t_x	0.019 days
C_o	348 g/2.05 liter
	0.0053 ton/ft^3
H_o	1.33 ft
UA	2.7 ft^2/ton/day
Thickened Pulp Density	39.9% solids



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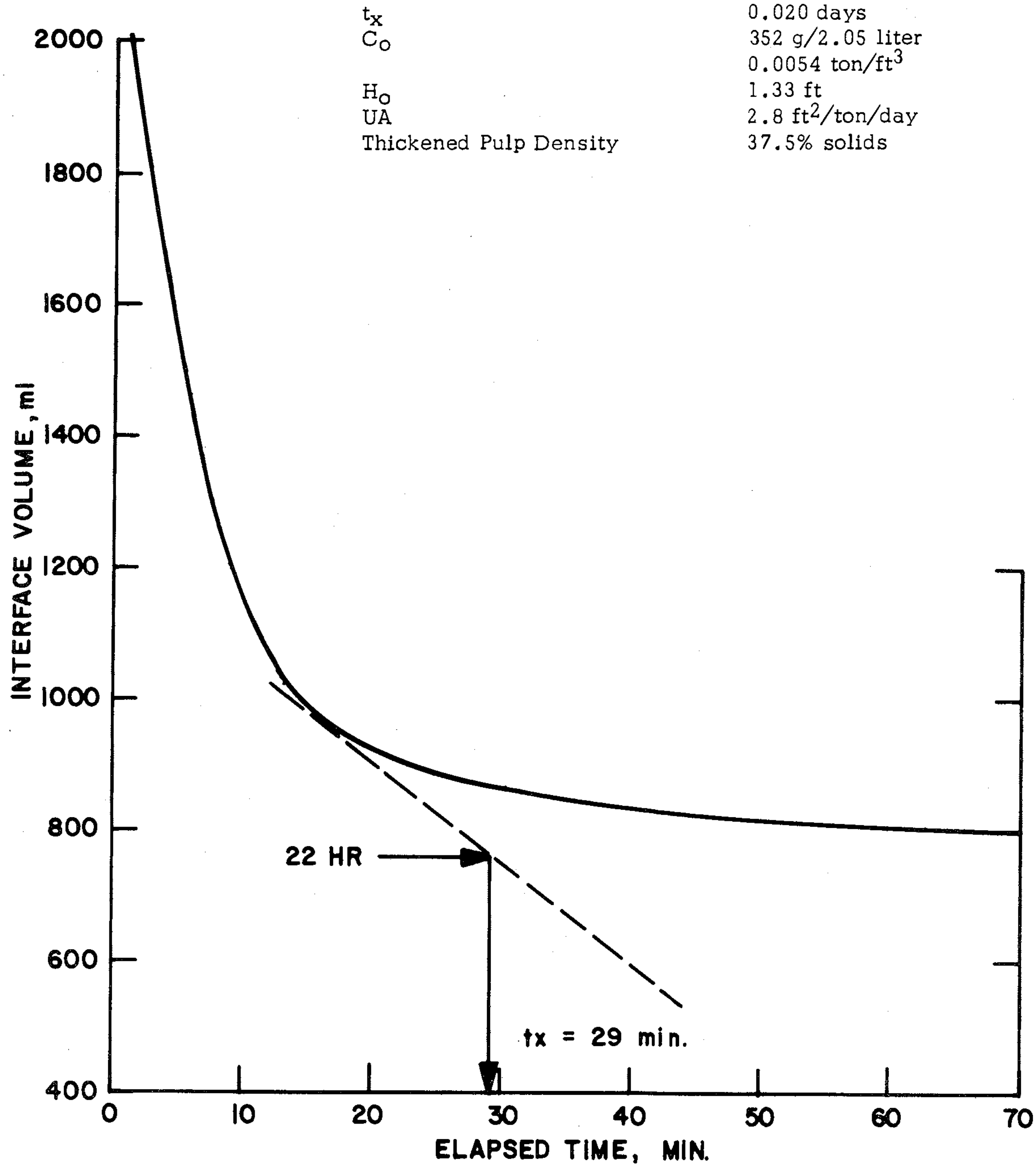
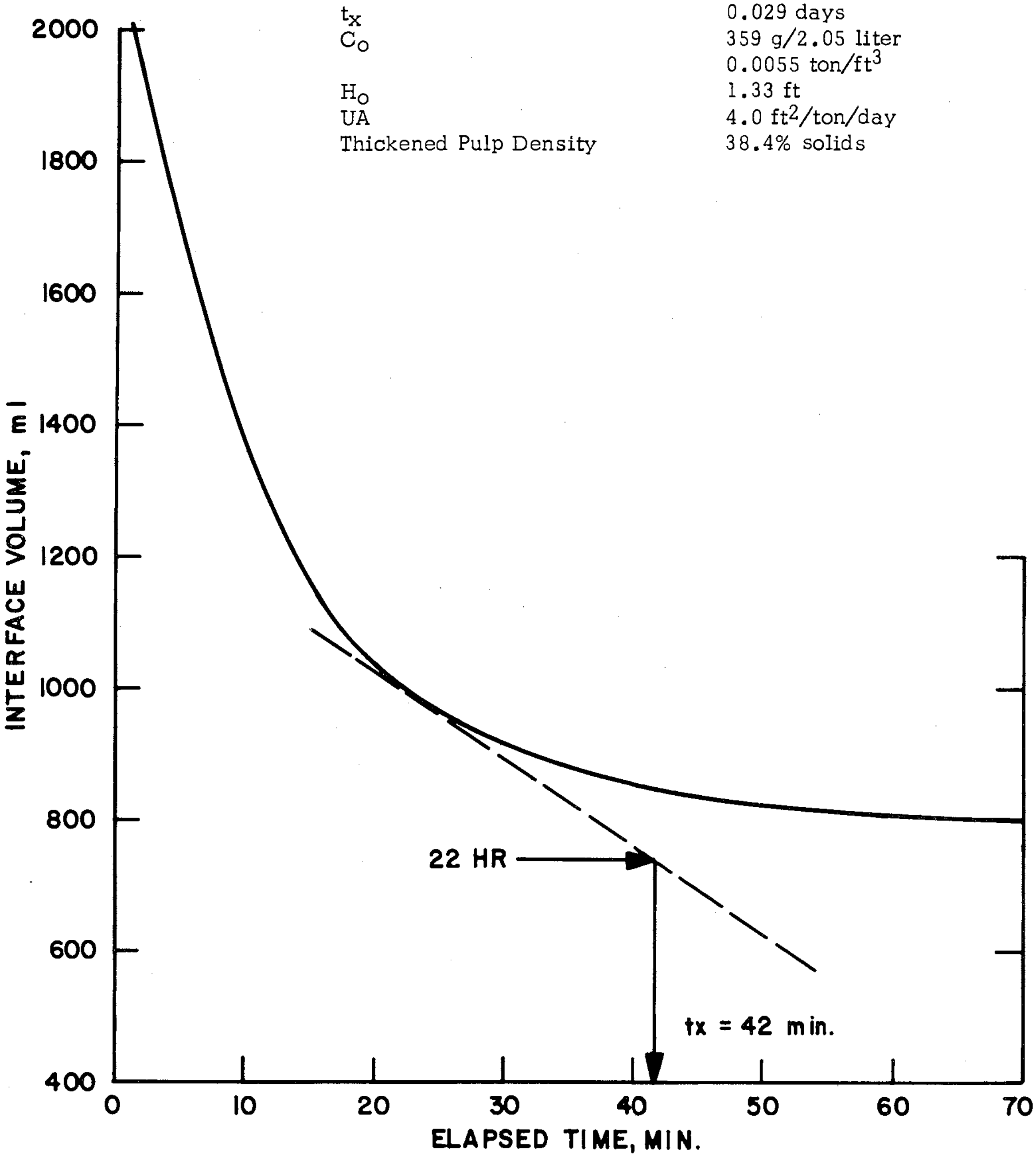
THICKENING TEST, COMPOSITE B + C

Slurry from Leach Test No.	26 (1070-86)
Flocculant Addition	0.20 lb MG 200/ton
Initial Pulp Density	15.4% solids
t_x	0.020 days
C_o	352 g/2.05 liter
	0.0054 ton/ft^3
H_o	1.33 ft
UA	2.8 ft^2/ton/day
Thickened Pulp Density	37.5% solids



THICKENING TEST, COMPOSITE B + C

Slurry from Leach Test No.	27 (1070-88)
Flocculant Addition	0.20 lb MG 200/ton
Initial Pulp Density	15.8% solids
t_x	0.029 days
C_o	359 g/2.05 liter
	0.0055 ton/ft^3
H_o	1.33 ft
UA	4.0 ft^2/ton/day
Thickened Pulp Density	38.4% solids



Agglomeration-Percolation Leach of Composite C

Book No. 1070-32/34

Grind	1070-32 Minus 28-mesh[1]	1070-34 Minus 6-mesh
Agglomeration		
Sample wt, g	910	800
H_2O, g	150	115
%	14.2	12.6
MnO_2, g	13.0	11.4
lb/ton	28.6	28.5
96% H_2SO_4, g	120	105
lb/ton	253	252
Agglomerate wt, g	1138	1000
Cure time, hr	47	46
temperature, °C	22-25	22-25
Percolation		
Leach solution, g/l H_2SO_4	3, 10, 30	3, 10
Flow rate, gpm/ft^2	0.004	0.017
Bed height, cm	79	64.5
Column diameter, cm	4.4	4.4

1/ 10-min grind screen fractions recombined.

Results:

Minus 6-mesh (1070-34)

Time	Feed Solution			Effluent						
	g/l H_2SO_4	Vol, L	ml/min	Vol, L Inc	Vol, L Cum	pH	emf (-mv)	Assay, g/l U_3O_8	g U_3O_8 Inc	g U_3O_8 Cum
1-1/2 hr	3	0.18	1.6			<0	495	Breakthrough		
6 hr	3	0.56		0.300	0.300	0.7	495	1.54	0.462	0.462
9 hr	3	0.78		0.230	0.530	1.9	455	0.275	0.063	0.525
22 hr	3→10	1.58	1.0	0.770	1.30	3.0	390	0.0054	0.004	0.529
2 days	10	3.07	1.01	1.47	2.77	2.2	420	0.032	0.048	0.577
2-1/2 days	10	3.63	1.02	0.55	3.32	1.5	450	0.027	0.015	0.592
3 days	10	4.54	1.01	0.90	4.22	1.3	440	0.012	0.011	0.603
3-1/3 days	10	5.05	1.02	0.50	4.72	1.2	440	0.0078	0.004	0.607
4 days	10	5.99	1.01	0.93	5.65	1.2	430	0.0053	0.005	0.612
4-1/3 days	10	6.48	1.02	0.49	6.14	1.1	425	0.0039	0.002	0.614
5-2/3 days	10	8.48		1.97	8.11	1.1	420	0.0025	0.005	0.619
7 days	10	10.5		1.98	10.1	1.1	415	0.0016	0.003	0.622

Product	Amount	Assay, % or g/l U_3O_8	Assay, % or g/l H_2SO_4	Amount, g U_3O_8	Amount, g H_2SO_4
Heads	800 g	0.084		0.672	
Leach solution	10.5 L				94
Effluent	10.1 L		7.5	0.622	76
Residue, moist	1089				
dry	749	0.0048		0.036	
Calculated heads		0.082		0.658	18

Residue, Mesh	Wt, %	% U_3O_8	
+20	41.5	0.0062	0.00257
20x100	27.9	0.0049	0.00137
100x200	7.7	0.0042	0.00032
-200	22.9	0.0042	0.00096
Calculated	100.0	0.0052	0.00522

% U_3O_8 extracted = 94.5

H_2SO_4 consumed	lb/ton
Agglomeration	252
Leach	45
Total	297

Results:

Minus 28-mesh (1070-32)

	Feed Solution			Effluent						
				Vol, L					g U_3O_8	
Time	g/l H_2SO_4	Vol, L	ml/min	Inc	Cum	pH	emf (-mv)	Assay, g/l U_3O_8	Inc	Cum
9 hr	3	0.56				1.1	490	Breakthrough		
22 hr	3→10	0.78	0.28	0.250	0.250	1.7	480	1.29	0.323	0.323
2 days		1.17	0.26	0.375	0.625	2.8	405	0.25	0.092	0.415
2-1/3 days	10	1.31	0.26	0.140	0.765	4.3	240	0.001	<0.001	0.415
3 days	10	1.54	0.26	0.230	0.995	5.4	150	<0.001	<0.001	0.415
3-1/3 days	10→30									
4 days	30	1.92	0.27	0.380	1.38	5.9		<0.001	<0.001	
5 days	30	2.31		0.365	1.74	6.7	180	<0.001	<0.001	
5-2/3 days	30	2.57		0.250	2.00	4.2	180	0.079	0.020	0.435
7 days	30	3.12		0.500	2.50	1.0	440	0.219	0.110	0.544
8 days	30			0.365	2.87	0.8	445	0.0050	0.0018	0.546
9 days	30	3.63		0.320	3.19			0.0020	0.0006	0.546
12 days	1	Drained		0.200	3.39			0.0018	0.0004	0.547
14 days				0.410	3.80			0.0021	0.0009	0.548

Product	Amount	U_3O_8 Assay	g U_3O_8	% U_3O_8 Extracted
Effluent	3.80 L		0.548	93.5 1/
Residue	895 g	0.0042	0.038	
Calculated heads 2/		0.065 2/	0.586	

1/ Based on U_3O_8 in effluent and residue.
2/ Low U_3O_8 value for calculated heads - test should be repeated.

Preparation of Leach Slurries for Thickening/Filtration Tests

A. For Enviro-Clear, January 25, 1978

Book No. 1070-102

Conditions:

Material	Composite 39% B + 61% C
Grind	Rod mill, 1.0 kg batches, 6 min at 75 rpm Screened out plus 20-mesh fraction
Leach	
Amount	42.6 kg solids
% solids	41
H_2SO_4	411 lb/ton, added at start
$NaClO_3$	6.5 lb/ton, 1/2 added at start and 1/2 at 2 hr
Temperature	75°C
Time	6 hr
6-hr slurry	40.6% solids pH 0.9 ($\approx$20 g/l H_2SO_4) emf -340 mv

Screen analysis feed to leach

Mesh (Tyler)	Wt, %	Cum Wt, % Retained	Cum Wt, % Passing
+28	0.3	0.3	99.7
28x35	3.3	3.6	96.4
35x48	10.1	13.7	86.3
48x65	12.3	26.0	74.0
65x100	9.0	35.0	65.0
100x150	8.6	43.6	56.4
150x200	7.3	50.9	49.1
200x270	6.6	57.5	42.5
270x325	3.2	60.7	39.3
-325	39.3		

Cont'd

Assays:

	Assay, % or g/l					
	U_3O_8	H_2SO_4	Mo	V_2O_5	pH	emf
Heads	0.090					
Residue	0.0089					
Liquor	0.58	17	0.002	0.40	0.9	-340 mv

% U_3O_8 extracted = 90.1
H_2SO_4 consumed = 365 lb/ton

B. For Envirotech, January 24, 26, 1978

1. Slurry for January 24 tests (Book No. 1070-98/100)

Material	Composite 39% B + 61% C
Grind	Rod, 5 min at 85/90 rpm
Leach	
Amount	5 kg solids
% solids	42
H_2SO_4	423 lb/ton, added at start
$NaClO_3$	6.6 lb/ton, 1/2 added at start, 1/2 at 2 hr.
Temperature	75°C
Time	6 hr
6-hr slurry	41.7% solids pH 0.9 emf -350 mv

2. Slurry for January 26 tests (Book No. 1070-104)

Material	Composite 39% B + 61% C
Grind	Rod, 6 min at 75 rpm
Leach	
Amount	10.4 kg
% solids	43
H_2SO_4	437 lb/ton, added at start
$NaClO_3$	6.6 lb/ton, 1/2 added at start, 1/2 at 2 hr
Temperature	75°C
Time	6 hr
6-hr slurry	43.3% solids pH 0.95 emf -360 mv

Screen analysis of feed

Mesh (Tyler)	Weight, % January 24 Slurry	Weight, % January 26 Slurry
20	0	0
20x28	0.5	0.2
28x35	3.6	2.0
35x48	13.5	9.4
48x65	12.9	12.3
65x100	5.9	9.4
100x150	9.4	8.3
150x200	7.5	7.4
200x270	6.1	6.8
270x325	1.4	3.5
-325	39.2	40.7
	100.0	100.0

Assays

	January 24 Slurry	January 26 Slurry
Heads, % U_3O_8	0.087	0.090
Residue, % U_3O_8	0.0078	0.0074
Liquor, g/l U_3O_8	0.70	0.76
g/l H_2SO_4	23	18
% U_3O_8 extracted	91.0	91.8
H_2SO_4 consumed, lb/ton	366	395

Screen analysis on thickened solids

Mesh	Weight, % Test 1	Weight, % Test 6
20	0.0	0.0
20x28	1.1	1.0
28x35	4.2	4.0
35x48	10.5	9.7
48x65	9.8	8.9
65x100	7.8	7.4
100x150	6.3	6.1
150x200	5.7	5.6
200x270	5.8	5.5
270x325	2.3	3.0
-325	46.5	48.8
	100.0	100.0

Continuous SX Test

1. Preparation of leach liquors

Batch No.		1&2	3	4	5
Ore used, kg		42.6	43.6	44	44
Wt % Composite	A		20	22	25
	B	39	9	6	
	C	61	11	9	
	D		23	25	35
	E		24	27	25
	F		13	11	15
Grind		Rod/5 min	CBM2/	CBM2/	CBM2/
% solids		41	41	41	41
H_2SO_4 lb/ton		411	404	402	405
$NaClO_3$, lb/ton		6.5	6.1	6.1	6.3
Temperature, °C		75	75	75	75
Time, hr		6	6	6	6
Residue wash		pH 1.5 H_2SO_4	SX raffinate3/	SX raffinate4/	SX raffinate5/
Diluted with1/		Dilute H_2SO_4	SX raffinate3/	SX raffinate4/	SX raffinate5/

1/ To 0.15-0.17 g/l H_2SO_4 and 14 g/l H_2SO_4.
2/ Dry grind in ceramic ball mill to 2% plus 28-mesh.
3/ From SX run 1/30 + 1/31
4/ From SX run 2/1 + 2/2
5/ From SX run 2/7

2. SX conditions

Organic	2.5 vol % Alamine 336[1/] + 2.5 vol % isodecanol diluted in Napoleum 470B. Preconditioned with 10 g/l H_2SO_4, 25 g/l Na_2CO_3, then 10 g/l H_2SO_4. Amine normality = 0.048N.
Leach liquor	Prepared by leaching Anderson ores at minus 28-mesh grind, ±42% solids, pH 0.7-0.9, 6 lb $NaClO_3$/ton, 75°C for 6 hours. The slurries were filtered, and the residues washed with pH 1.5 H_2SO_4 (Batch 1 & 2) or SX raffinate (Batch 3, 4, 5). The liquors were diluted to ±0.16 g/l U_3O_8 with Dem H_2O, and adjusted to 14 g/l H_2SO_4.

Batch	Ore Used
1, 2	Composite B+C
3,4	Composite A, B, C, D, E, F
5	Composite A, D, E, F

Equipment	Extraction	Wash	Strip
Stages	4	1	3
Mixers, diam-inch	2-1/4	2-1/4	2-1/4
vol-cc	150	150	150
Settlers, diam-inch	2-1/4	2-1/4	1-1/2
vol-cc	1000	1000	60
Recycle	Organic	Aqueous	Aqueous

Solutions

Organic wash	pH 1.8 H_2SO_4	
Strip	150 g/l $(NH_4)_2SO_4$	
NH_4OH solutions	Stage 1	3.7 N NH_4OH
	2	0.37 N NH_4OH
	3	0.37 N NH_4OH

1/ Lot No. 6H620.

Summary of Uranium SX Conditions/Results

Date	1/30	1/31	2/1	2/2	2/3	2/6	2/7
Liquor feed							
Batch	1	2	2	2	2/3	3/4	4/5
g/l U_3O_8	0.144	0.149	0.149	0.149	0.149/0.166	0.166/0.168	0.168/0.173
Flow rates, ml/min							
Organic	±14	8.3	8.5	8.4	9.0/9.4	9.13	9.33
Liquor	144	103	103	103	101	99.4	101
Scrub solution	1	1.1	1.1	0.86	1.1	1.13	1.03
Strip solution		0.79	0.66	0.47	0.46	0.472	0.464
NH_4OH, stage 1		0.085	0.089	0.084	0.086	0.091	0.089
2		0.16	0.11	0.086	0.11	0.109	0.118
3		0.089	0.073	0.084	0.078	0.074	0.088
O/A ratio							
Extraction (organic continuous)		0.6	0.6	0.6	0.6	0.6	0.6
Wash		2	2	2	2	1-2	2
Strip		1-2	1-4	2	2-4	2-3	1-3
Strip pH, stage 1 (range)		3.6/4.0	3.5/4.0	3.5/4.1	3.6/4.2	3.6/3.9	3.7/4.0
2 (range)		3.7/4.3	3.8/4.9	3.8/4.5	3.6/4.4	3.8/4.1	3.9/4.1
3 (range)		4.4/4.8	4.2/5.1	3.6/5.3	4.0/4.8	4.2/5.0	4.2/4.6
Operating time, hr	2.83	7.42	6.58	15.3	15.0	15.1	15.0
Liquor used, L	24.5	45.9	40.7	94.4	90.7	89.7	90.8
Strip solution produced, ml		230	500	662	635	620	680
Organic inventory, L	4.0	4.0	3.5	3.4	3.3	3.2	3.0
Organic cycles, incr.	0.71	0.93	0.96	2.26	2.53	2.58	2.80
cum	0.71	1.64	2.60	4.86	7.39	9.97	12.8
Scum vol, cc (approximate)							
Extraction, pregnant stage		1	<1	2	2	5	5 (grey)
Wash			1	<1	1/2	1	
Strip, stage 1		3	3-5	5-10	15	20-25	10-15 (brow
2		1	1-2	1-2	2-5	1	2-5
3		1/2	<1	<1	1-2	1	1-3
Assays, g/l U_3O_8							
Raffinate composite		0.0005	0.0009	0.0008	0.0005	0.0004	0.0005
Loaded organic 1/		1.68	1.92	1.75	1.87	2.00	2.04
Barren organic 1/		0.38	0.46	0.13	0.17	0.17	0.10
Pregnant strip composite		14.4	13.0	17.9	20.8	24.8	24.6
Wash solution composite			0.011	0.015	0.014	0.018	0.017

1/ At end of period.

Other assays

Date	Sample	U_3O_8	Mo	V_2O_5	Fe	Cl
2/3/78	Strip solution	20.8	0.0098	≈0.001		
	L. organic	1.87	0.023			
	B. organic	0.17	0.010			
2/7/78	Strip solution	24.6	0.018	<0.001		
	L. organic	2.04	0.038			
	B. organic	0.10	0.015			
	Raffinate composite	0.0005			1.73	0.31
	Liq. 1070-106-3	0.168	<0.001	0.14	1.92	0.31
	-4	0.174	<0.001	0.13	1.71	0.31
	-5	0.173	<0.001	0.13	1.68	0.31

Profile on end of 2/8/78

Stage	Assay, g/l U_3O_8 Organic	Aqueous
Feed liquor		
Extraction, E4	0.20	0.0006
3	0.14	0.0007
2	0.53	0.0033
1	2.04	0.038
Scrub	2.09	0.012
Strip, S1	0.61	20.5
2	0.22	9.41
3		3.31

Entrainment

2/6/78

Raffinate	<0.01 vol % organic entrainment
L. organic	0.07 vol % aqueous entrainment
Scrub organic	0.1 vol % aqueous entrainment
Barren organic	0.05 vol % aqueous entrainment

NH_3 consumption

2/6/78

82.2 ml x 3.72 N NH_4OH = 5.20 g NH_3
165 ml x 0.36 N NH_4OH = 1.01 g NH_3

6.21 g NH_3

U_3O_8 extracted = 15.0 g

NH_3 consumption = 0.414 lb NH_3/lb U_3O_8

U_3O_8 material balance

		Amount Liter	Assay, g/l U_3O_8	U_3O_8 g
Feed liquor,	1/30	24.5	0.144	3.53
	1/31	45.9	0.149	6.84
	2/1	40.7	0.149	6.06
	2/2	94.4	0.149	14.07
	2/3	90.7	0.158	14.33
	2/6	89.7	0.167	14.98
	2/7	90.8	0.170	15.44
				75.25
Strip solution,	1/30			
	1/31	0.230	14.4	3.31
	2/1	0.500	13.0	6.50
	2/2	0.662	17.9	11.85
	2/3	0.635	20.8	13.21
	2/6	0.620	24.8	15.38
	2/7	0.680	24.6	16.73
Raffinates		476.7	0.0006	0.29
Scrub solution				
Inventory				
Organic				1.6
Strip solution				3.8
				72.67
Discrepancy				3.4%

Analysis of Scums Obtained During Continuous SX Run

Spectrographic[1/] (emission, qualitative)

	Solids Assay, %		
	Extraction Scum	Stripping Scum	Na_2CO_3 Scrub Scum
Si	Major	1	0.1
U	5	Major	
Zr	0.1	1	
Na	1		Major
Al	10	0.1	0.01
Fe	3	0.05	0.05
Ca	0.05	0.001	0.01
Mg	0.5	0.01	0.01
Ti	1	0.005	
Mn	0.01		
Cr	0.01	0.001	0.001
Cu	0.005	0.001	0.0003
Ni	0.002		
Pb	0.001		
Mo	0.05	0.05	
Ag	0.0002		0.0002
V	0.1		
B	0.001		
Ba	0.01		
Sr	0.002		

1/ By Spectran Labs, Denver, Colorado.

Extraction Isotherms, Comparison of Cycled Organic to Fresh Organic

Aqueous — Batch 5 leach liquor, 0.17 g/l U_3O_8, 14 g/l H_2SO_4

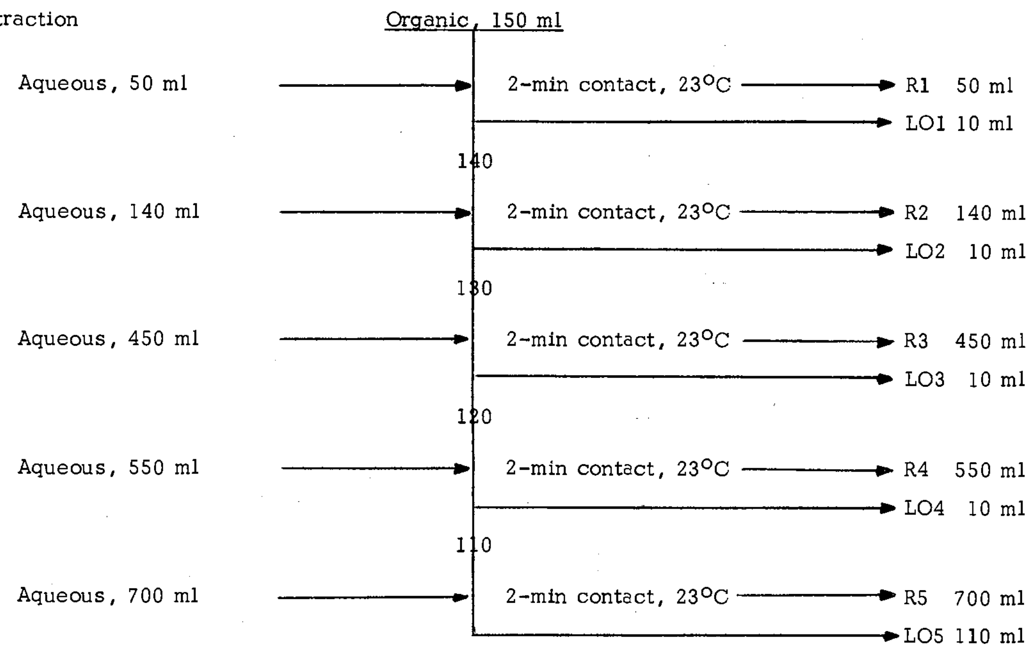
Organics

No. 1 — Fresh, initial organic to SX test.

No. 2 — Cycled-$(NH_4)_2SO_4$ stripped, 12-cycle organic scrubbed with pH 1.8 H_2SO_4 and stripped with 150 g/l $(NH_4)_2SO_4$ at pH 4.5.

No. 3 — Cycled-Na_2CO_3 scrubbed, No. 2 organic above contacted with 100 g/l Na_2CO_3, O/A = 2/1, 5 min at 23°C
Note: Stable emulsion formed when organic was contacted with Na_2CO_3. Emulsion did not completely collapse even on standing overnight (centrifuging at 750 rpm gave 10 cc emulsion). The emulsion was filtered and solids (only trace amount < 10 mg solids from 200 ml original or ganic was submitted for spectrographic analysis).

Extraction



Assays

Organic	Contact	Assay, g/l U_3O_8 Raffinate	Organic
Fresh	Feed	0.17	0.00
	1	0.0003	0.065
	2	0.0012	0.24
	3	0.0061	0.87
	4	0.018	1.62
	5	0.071	2.18
Cycled $(NH_4)_2SO_4$ stripped	Feed	0.17	<0.02
	1	0.0002	0.057
	2	0.0016	0.24
	3	0.0050	0.86
	4	0.016	1.55
	5	0.069	2.32
Cycled Na_2CO_3 stripped	Feed	0.17	<0.02
	1	0.0001	0.057
	2	0.0012	0.24
	3	0.0048	0.86
	4	0.016	1.58
	5	0.061	2.31

Amine normality

Organic	Normality
Fresh	0.0484
Cycled - $(NH_4)_2SO_4$ stripped	0.0471
Cycled - Na_2CO_3 stripped	0.0474

Stripping Isotherm

Book No. 1070-130

Organic	From SX circuit at end of run
Aqueous	From SX circuit at end of run
O/A ratio	2/1 (150 ml/75 ml)
pH	Adjusted to appropriate pH with NH_4OH/H_2SO_4
Contact time	5 min at pH
Temperature	23°C

Stage	Assay, g/l U_3O_8 Organic	Assay, g/l U_3O_8 Aqueous	Aqueous pH	Scum Vol cc
1	0.11	20.2	3.9	≈2
2	0.071	8.59	4.1	Trace
3	0.019	1.74	4.5	Trace

Extraction/Stripping Rates

Extraction

Book No.	1070-141
Organic	12-cycle organic from SX run, 0.74 g/l U_3O_8
Aqueous	Batch 5 liquor, 0.17 g/l U_3O_8
O/A ratio	1.2/1 (550 ml/458 ml)
Contact	In 2 L baffled beaker, impeller at 1500 rpm
Time	Emulsion sampled at 0.25, 0.50, 1, 2, 4 min
Temperature	23°C

Contact Time	Assay, g/l U_3O_8	
min	Aqueous	Organic
0.25	0.0045	
0.50	0.0046	
1	0.0047	
2	0.0049	
4	0.0051	0.93

Stripping

Book No.	1070-142
Organic	12-cycle organic assaying 1.72 g/l U_3O_8
Strip solution	From SX run assaying 9.51 g/l U_3O_8
pH adjustment	8.3 ml 3 N NH_4OH added during first 1 minute of O/A contact
O/A ratio	2/1 (600 ml/300 ml)
Contact	In 1-liter baffled beaker, impeller at 1000 rpm
Time	Emulsion sampled at 0.5, 1, 2, 4, and 8 minutes after NH_4OH was added
Temperature	23°C

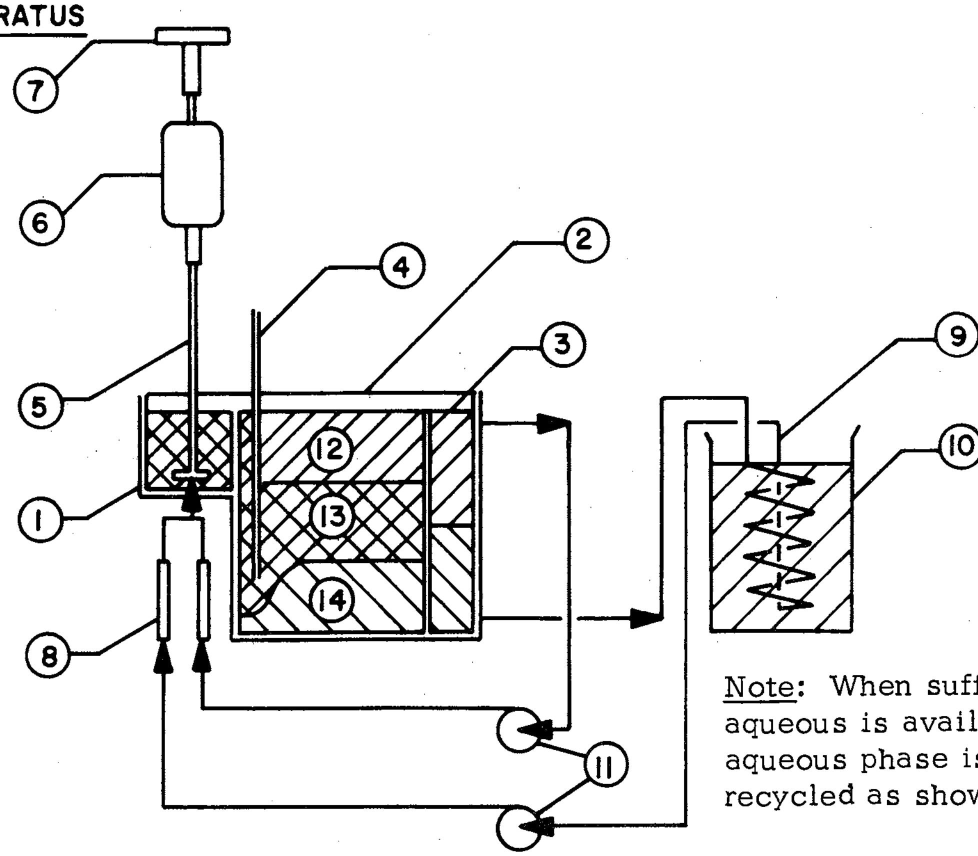
Cont'd

Contact Time min 1/	Assay, g/l U_3O_8		Aqueous pH
	Organic	Aqueous	
0.5	0.13		
1	0.11		
2	0.11		
4	0.11		
8	0.11	12.4	4.0

1/ Does not include first 1-minute during which NH_4OH was added.

Determination of Settler Area Requirements
by Dynamic Method

APPARATUS



Note: When sufficient aqueous is available, the aqueous phase is not recycled as shown above.

1. Mixer section of lucite cell, 2-1/2" square x 2-1/4" deep, 230 ml volume.
2. Settler section of lucite cell, 2-1/2" x 4-3/4" x 10" deep, 1800 ml volume.
3. Moveable baffle, fits into vertical slots cut into sides of settler.
4. Baffle, positioned 3/8" from mixer overflow to cut down turbulence.
5. Impeller, 1-1/4" diam x 1/4" disc welded to 1/4" diam shaft, disc has three 1/8" wide x 3/32" deep radial slots across bottom face of disc.
6. Motor, variable speed.

7. Tachometer.
8. Rotameters, 0-500 ml/min.
9. Cooling coil, to cool/heat aqueous to test temperature.
10. Bath, for temperature control.
11. Pumps, 316 ss micro-gear pumps.
12. Organic phase.
13. Emulsion band.
14. Aqueous phase.

Procedure

The appropriate organic flow was started, the stirrer was switched on, and appropriate aqueous flow was started to ensure an organic continuous emulsion. After 10-15 minutes, the emulsion band thickness was noted. The moveable baffle or O/A flow rates were changed to determine effect of O+A flow rate/ unit area on band thickness.

Phase Separation Data

A. Dynamic method

1. Extraction - loaded stage (Book No. 1070-139)

Organic: 2-1/2 vol % Alamine 336 + 2-1/2 vol % isodecanol in Napoleum 470B loaded to 1.9 g/l U_3O_8.

Aqueous: Batch 4 leach liquor, 0.17 g/l U_3O_8, aqueous was recycled in apparatus.

Conditions:

O/A ratio	1.2/1
Impeller speed	1500 rpm
Phase continuous	Organic
Temperature	24°C

Flow Aqueous	ml/min Organic	Meter Aqueous	Meter Organic	Flow O+A gpm	Baffle Position	Area ft^2	Band Inches	Collapse Rate gpm/ft^2
233	280	0.245	0.295	0.136	7	0.061	4-1/2	2.23
233	280	0.245	0.295	0.136	8	0.070	2-5/8	1.94
233	280	0.245	0.295	0.136	9	0.078	1-3/8	1.74
233	280	0.245	0.295	0.136	6	0.052	7-1/2	2.62
167	200	0.175	0.220	0.097	9	0.078	1/2	1.24
167	200	0.175	0.220	0.097	7	0.061	1-1/2	1.59
167	200	0.175	0.220	0.097	6	0.052	2-1/2 (1-3/8)	1.86
167	200	0.175	0.220	0.097	5	0.043	4-3/8 (2-3/4)	2.26
167	200	0.175	0.220	0.097	4	0.034	7-1/2 (6-1/2)	2.85

Note: Emulsion band measured with Turbulence reducing baffle 3/8" from end of cell and bottom of baffle at the same level as the bottom of the emulsion band. Values in ( ) obtained with the bottom of the baffle at the middle of the emulsion layer.

2. Extraction - barren stage (Book No. 1070-134)

Organic: 2-1/2% Alamine 336 + 2-1/2% isodecanol from SX unit at end of run, 0.1 g/l U_3O_8.

Aqueous: Raffinate from 2/7 SX run, not recycled in cell, but fresh passed through, <0.001 g/l U_3O_8.

Conditions:

O/A ratio	1.2/1
Impeller speed	1500 rpm
Phase continuous	Organic
Temperature	23-25°C

Flow Aqueous	ml/min Organic	Meter Aqueous	Meter Organic	Flow O+A gpm	Baffle Position	Area ft^2	Band Inches		Collapse Rate gpm/ft^2
233	280	0.245	0.295	0.136	7	0.061	6-1/2		2.23
233	280	0.245	0.295	0.136	8	0.070	4-1/2		1.94
233	280	0.245	0.295	0.136	9	0.078	3		1.74
167	200	0.175	0.220	0.097	9	0.078	1		1.24
167	200	0.175	0.220	0.097	8	0.070	1-5/8		1.39
167	200	0.175	0.220	0.097	7	0.061	2-5/8		1.59
167	200	0.175	0.220	0.097	5	0.043	6	(4-1/2)	2.26
125	150	0.133	0.175	0.073	5	0.043	3		1.70
125	150	0.133	0.175	0.073	4	0.034	5	(3-7/8)	2.15
125	150	0.133	0.175	0.073	3	0.025	≈8-3/4	(7-3/4)	2.9
125	150	0.133	0.175	0.073	7	0.061	1		1.20
125	150	0.133	0.175	0.073	9	0.078	3/8		0.94
167	200	0.175	0.220	0.097	9	0.078	7/8		1.24
167	200	0.175	0.220	0.097	6	0.052	3-1/4	(2-3/8)	1.87
167	200	0.175	0.220	0.097	5	0.043	5-1/2	(3-1/2)	2.26
167	200	0.175	0.220	0.097	4	0.034	>8	(7-1/2)	2.85

Note: Emulsion band measured with Turbulence reducing baffle 3/8" from end of cell and bottom of baffle at the same level as the bottom of the emulsion band. Values in ( ) obtained with bottom of baffle at the middle of the emulsion layer.

3. Stripping - pregnant/barren stages (Book No. 1070-133)

Pregnant stage

Organic	Loaded organic from SX unit at end of run, scrubbed with pH 1.8 H_2SO_4 then stripped with 150 g/l $(NH_4)_2SO_4$ at pH 4.0.
Aqueous	From SX unit, diluted to 10 g/l U_3O_8 with 150 g/l $(NH_4)_2SO_4$, and contacted with above organic at pH 4.0.

Barren stage

Organic	From pregnant stage test.
Aqueous	From pregnant stage test, diluted to 3 g/l U_3O_8 with 150 g/l $(NH_4)_2SO_4$ at pH 4.5.

Conditions:		
	O/A ratio	2/1
	Impeller speed	1500 rpm
	Phase continuous	Organic
	Temperature	25°C

	Flow ml/min Aqueous	Flow ml/min Organic	Meter Aqueous	Meter Organic	Flow O+A gpm	Baffle Position	Area ft^2	Band Inches		Collapse Rate gpm/ft^2
Pregnant	100	200	0.11	0.22	0.079	5	0.043	1/2		1.8
	140	280	0.155	0.295	0.111	5	0.043	1-1/4		2.6
	140	280	0.155	0.295	0.111	4	0.034	?	Not	
	60	120	0.065	0.15	0.048	4	0.034	1/8	distinct	1.4
	100	200	0.11	0.22	0.079	3	0.025	4-3/4		3.2
Barren	100	200	0.11	0.22	0.079	4	0.034	?		
	50	100	0.055	0.133	0.040	4	0.034	?		
	75	150	0.083	0.175	0.059	4		?		
	140	280	0.155	0.295	0.111	9	0.078	1/4		1.4
	140	280	0.155	0.295	0.111	7	0.061	3/4		1.8
	140	280	0.155	0.295	0.111	5	0.043	≈1-1/2	Not	2.6
	140	280	0.155	0.295	0.111	4	0.034	≈3-1/4	distinct	3.3
	140	280	0.155	0.295	0.111	6	0.052	3/4		2.1

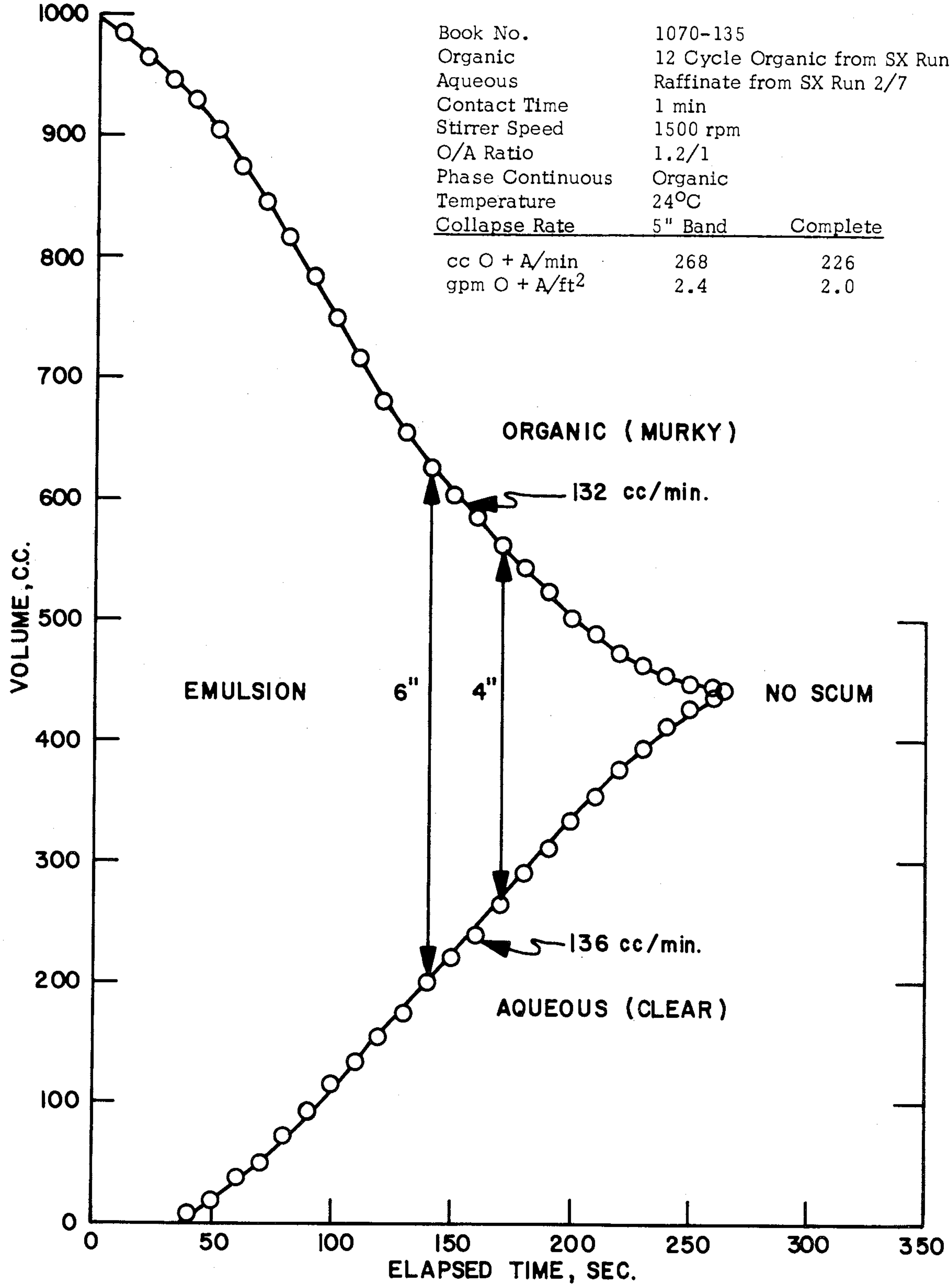
B. Static method

The appropriate amount of aqueous and organic phases (O+A = 1000 ml) was contacted in a 2-liter baffled beaker for the appropriate time at 23/24°C, the emulsion was transferred quickly to a 1000-ml graduated cylinder (area = 0.030 ft^2), and the collapse rates of the organic/aqueous phases were measured.

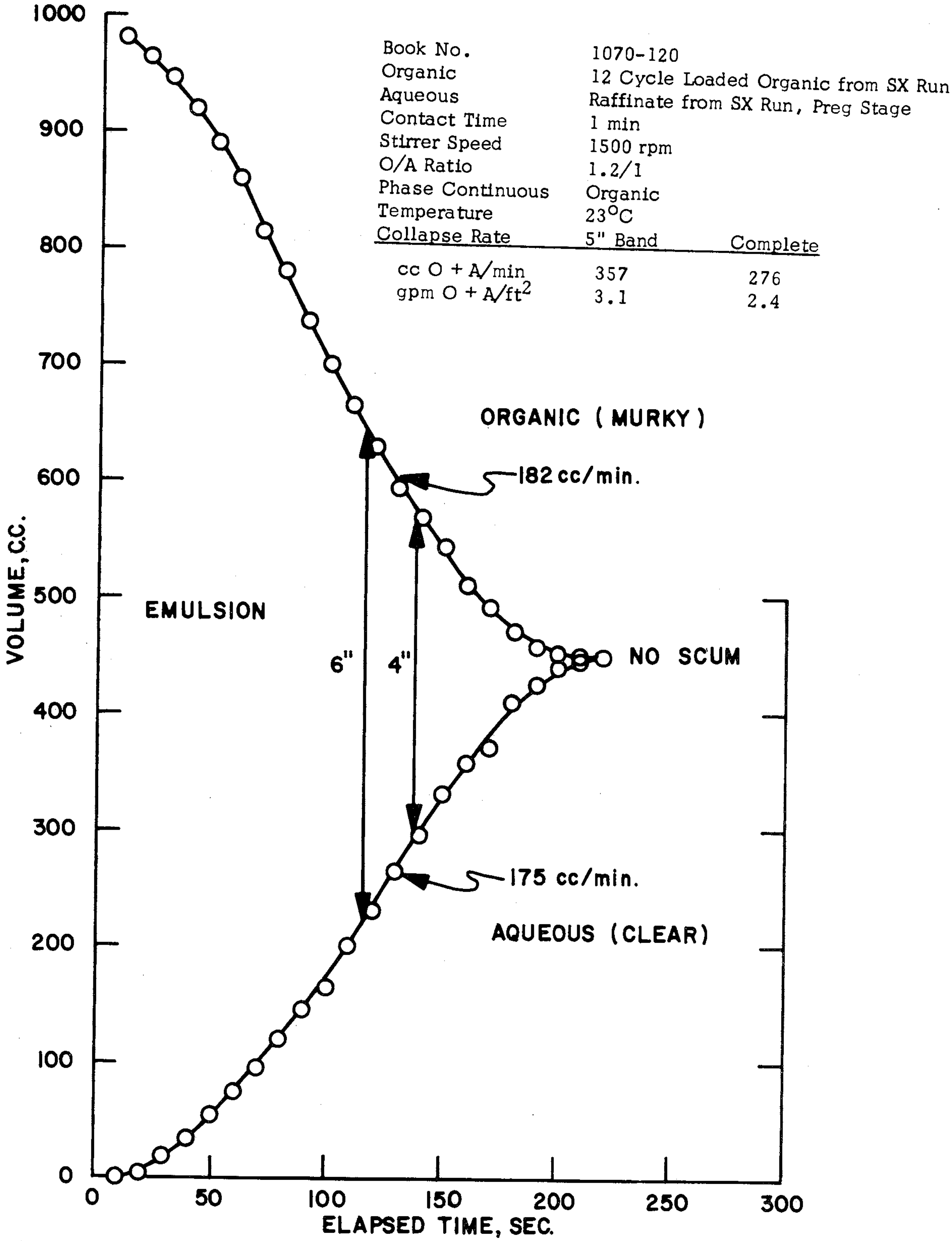
The collapse rate at 5" emulsion band and for total collapse were calculated.

Collapse rate data are given graphically in following pages.

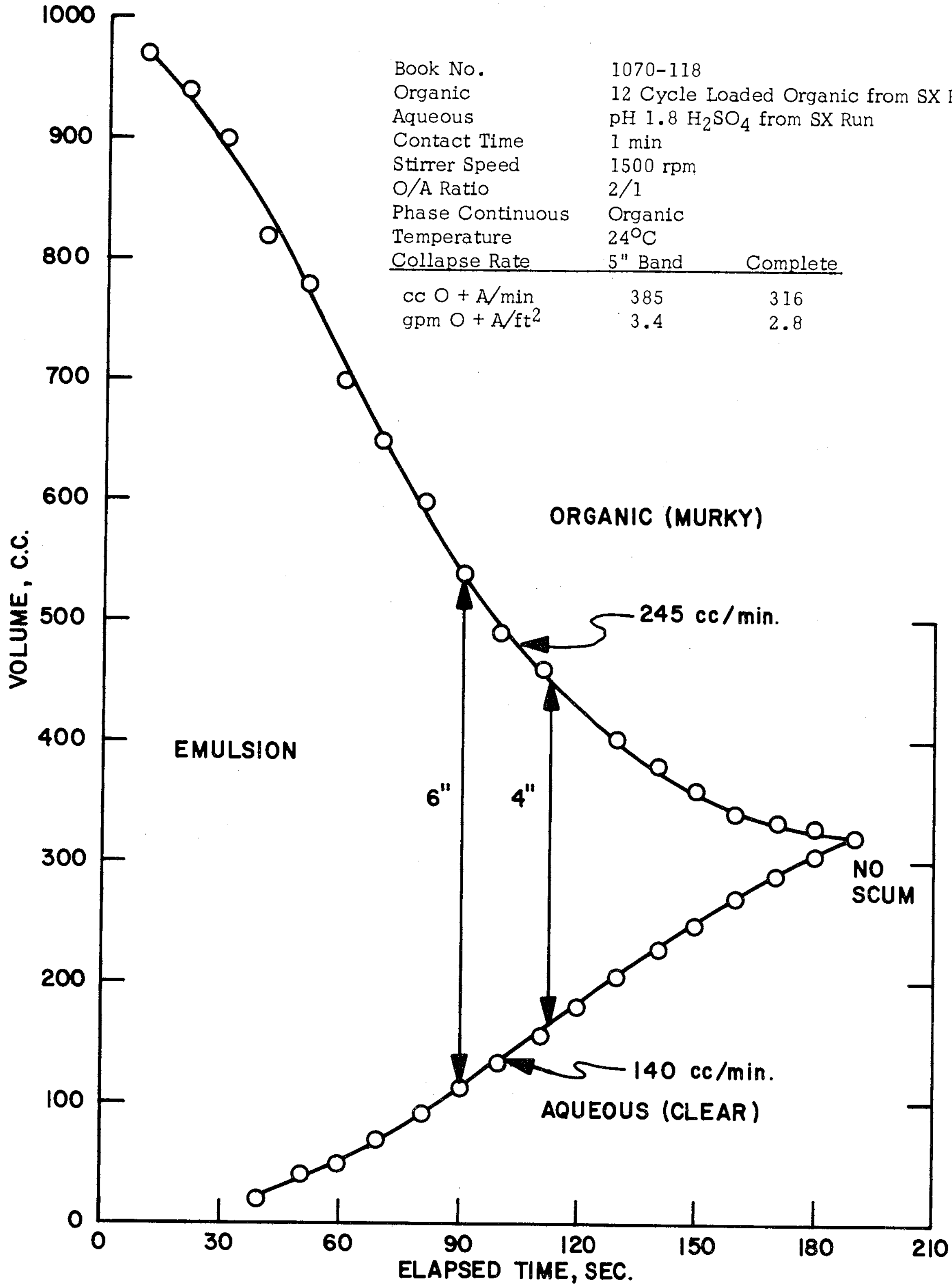
PHASE SEPARATION RATE - BARREN EXTRACTION STAGE



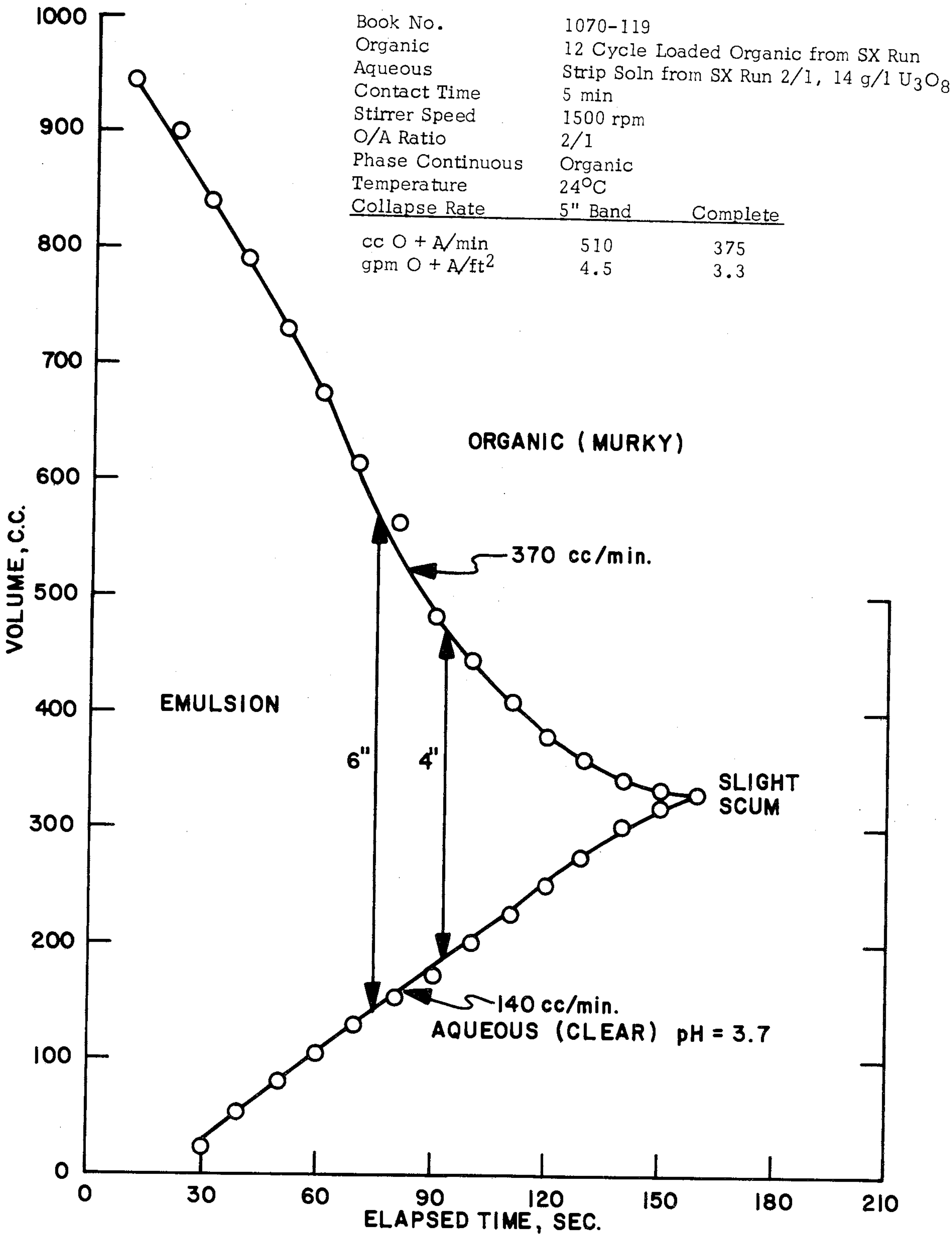
PHASE SEPARATION RATE - LOADED EXTRACTION STAGE



PHASE SEPARATION RATE - pH 1.8 H_2SO_4 SCRUB STAGE



PHASE SEPARATION RATE - PREGNANT STRIP STAGE



hri

Organic Regeneration - Scrubbing with $NaHCO_3/Na_2CO_3$

Book No. 1070-152/161

Preliminary tests

Organic		12 cycle, $(NH_4)_2SO_4$ stripped to 0.11 g/l U_3O_8	
Scrub solutions	1.	50 g/l Na_2CO_3, pH 12	
	2.	30 g/l Na_2CO_3 + 20 g/l $NaHCO_3$, pH 10	
	3.	47 g/l $NaHCO_3$ + 6.5 g/l Na_2CO_3, pH 8.9	
	4.	50 g/l $NaHCO_3$, pH 8.2	
Contact	O/A ratio	2/1 (50 ml O/25 ml A)	
	C. time	3 min in 125 ml separatory funnel	
	Temperature	23°C	

	Scrub Solution	Primary Separation, min	Stable Emulsion	Aqueous pH
1.	50 g/l Na_2CO_3	Slow	Yes >30 min	± 12
2.	30 g/l Na_2CO_3 + 20 g/l $NaHCO_3$	Slow	Yes >30 min, collapsed in ≈ 2 hr	10
3.	47 g/l $NaHCO_3$ + 6.5 g/l	1.3	None, trace brownish scum	9.0
4.	50 g/l $NaHCO_3$	1.3	None, trace brownish scum	8.3
			Organic = murky Aqueous = slightly murky Scum = trace	

Contacted scrubbed organic from 4. with 40 ml Batch #4 leach liquor for 1 min.

Phases disengaged rapidly - < 1 min
No physical problems.
A = clear
O = slightly murky

Cont'd

Phase Separation Test Using 50 g/l $NaHCO_3$

Organic	12 cycle organic, stripped with 150 g/l $(NH_4)_2SO_4$ + 3 g/l U_3O_8 to pH 4.6, 333 ml
Scrub solution	50 g/l $NaHCO_3$, 167 ml
Contact	In 1000-ml baffled beaker, stirrer = 1000 rpm 5-min contact at 23°C
Cylinder	4.65 cm diam, (0.0182 ft^2 area), 500 cc
Data	

Time min:sec	Vol, cc Organic	Aqueous
0:20	No distinct organic/ emulsion interface	0
:40		±5/20
1:00		35/40
:20		60
:40		90/100
2:00		115/120
:20		135
:40		145/150
3:00		150/155
:20		153/157
:40		155

O = murky (brown coloration removed)
A = slightly murky (slight brown color)
Scum = trace, brown colored

Collapse rate = 500 cc/3.33 min = 150 cc/min
= 0.040 gpm
= 2.2 gpm O+A/ft^2

Assays	Assay, g/l U_3O_8	Mo
Feed organic	0.008	0.01
Scrubbed organic	<0.0005	<0.01
Scrub solution	0.020	<0.01

Yellow Cake Precipitation

Book No. 1070-138

Strip solution — Composite of strip solutions from SX runs 2/2, 2/3, 2/6, and 2/7, 21.8 g/l U_3O_8

pH — 7.4-7.6, with 7.15 N NH_4OH

Temperature — 40-42°C

Time — 1 hour at pH

Method

1. To 250 ml 150 g/l $(NH_4)_2SO_4$ in 2-liter beaker was added simultaneously 1400 ml strip solution at 22 ml/min and 44.4 ml 7.15 N NH_4OH at 0.68 ml/min to control pH at 7.4-7.6. Temperature was maintained at 40-42°C, and stirring was sufficient to avoid localized high pH.

2. After all the strip solution was added, the slurry was stirred at 40°C and pH 7.5 for 1 hour.

3. The precipitate was allowed to stand for 3 hours (settling rate was noted), 1495 ml slightly cloudy supernate was removed, and thickened slurry was filtered. The cake was washed with 2 x 250 ml portions of 10 g/l $(NH_4)_2SO_4$ pH 7.5, then 3 x 150 ml portions of pH 8.0 NH_4OH, and dried at 90°C for 18 hours.

Settling data

	Slurry	
Time, min	Vol, cc	Depth, cm
1	1400	11.2
3	1000	8.1
5	520	4.4
7	190	1.8
10	150	1.3
15	≈120	1.0
60	≈110	0.9
180	≈110	0.9

Filter data

Filter: 12.5 cm Buchner funnel, Whatman No. 1 filter paper, 15-20" Hg vacuum

		Vol, ml	Filter Time min:sec
Prime filtrate		85	0:25
10 g/l $(NH_4)_2SO_4$, Wash	1	250	2:05
	2	254	2:55
pH 8 NH_4OH	3	147	2:05
	4	150	2:35

Cake size	4 mm thick x 12 cm diam
wt	77.9 g moist
	34.7 g dry (at 90°C)
% solids	44.5

Assays

Product		Vol, ml	Assay, g/l U_3O_8	SO_4	Mo	V_2O_5	PO_4	g U_3O_8
Strip solution		1400	21.8	106	0.013	<0.002	<0.005	30.5
Supernate		1495						
PF		85	<0.001	109	<0.002	<0.002		
10 g/l $(NH_4)_2SO_4$	W1	250	<0.001	31.7				
	2	254	<0.001	7.48				<0.001
pH 8 NH_4OH	W3	147	<0.001	3.42				
	4	150	0.0052	<0.1				<0.001
	5	151	0.011	<0.1				0.002
Yellow cake		34.7 g	87.2	0.82	0.049%	<0.01%		30.3
								30.3

NH_3 consumption

NH_3 used	44.4 ml at 121.6 g/l NH_3 = 5.40 g NH_3
U_3O_8 precipitated	= 30.3 g U_3O_8
NH_3 consumed	= 0.178 NH_3/g U_3O_8

Yellow cake analysis

1. Chemical

	%
U_3O_8	87.2
Mo	0.049
SO_4	0.82
V_2O_5	<0.01
Na	<0.01
K	<0.01
Ca	<0.01
Mg	<0.01
Fe	<0.01
PO_4	<0.01
As	<0.01
Cl	<0.03
F	<0.02
Zr	<0.1 1/
Th	<0.1 1/
CO_3	<0.1
HNO_3 insol U_3O_8	<0.05

2. Spectrographic (emission, qual-semiquantitative) 1/

	%		%
U	Major	Th	<0.1
Fe	0.007	As	<0.1
Si	0.005	Zr	<0.05
Ca	0.001	Ti	<0.01
Mg	0.0005	Na	<1
		K	<1
		B	<0.005

1/ By X-ray Fluorescence, HRI.
2/ By Spectran Lab, Denver, Colorado.

Neutralization of SX Raffinate

Book 1070-129

Raffinate	3.00 liter/test, from SX run 2/6/78
$Ca(OH)_2$	Reagent grade
pH	To 8.0 and 9.2
Temperature	Ambient, 23°C
Time	At pH 8.0 and 9.2 for 1 hour
Procedure	$Ca(OH)_2$ powder was gradually added to raffinate while stirring vigorously over 4-5 hr period until test pH was reached. The slurry was stirred for 1 hour at test pH, then filtered. The precipitates were not washed.

$Ca(OH)_2$ consumption

	$Ca(OH)_2$ Added		
pH	g	lb/gal Raffinate	lb/lb U_3O_8 1/
5.2	54.6	0.095	107
6.7	59.9	0.105	117
7.0	61.0	0.106	120
8.0	63.2	0.110	124
9.2	79.0	0.138	155

	pH 8.0 Test	pH 9.2 Test
Filtrate vol, L	2.62	2.44
Cake wt, g moist	458	681
g dry 2/	177	247
% solids	38.6	36.3

1/ Liquor to SX assayed 0.17 g/l U_3O_8.
2/ Dried at 90°C for 18 hours.

Assays:

	Assay, g/l or %						
		Filtrate		Precipitate		% Precipitated	
	Raffinate	pH 8.0	pH 9.2	pH 8.0	pH 9.2	pH 8.0	pH 9.2
H_2SO_4	14						
Cations	0.76 eq/L	0.22 eq/L	0.074 eq/L				
Fe	1.93	<0.002	<0.002	3.33	2.55	>99.9	>99.9
Al	1.31	<0.005	<0.005	1.85	1.39	>99.6	>99.6
Mg	2.10	1.83	0.051	0.91	2.75	13	97.6
V_2O_5	0.14	<0.002	<0.002	0.23	0.17	>98	>98
Ca	0.32	0.42	0.45	17.1	16.4		
Si	0.082	<0.01	<0.01			>88	>88
SO_4	36.1	10.3	2.91	47.9	45.4		
Cl	0.33	0.33	0.30			<5	<10
PO_4	0.33	0.001	0.002			>99	>99
TDS1/	45.8	15.1	4.9				

Spectrographic2/:

	Emission	XRF	Emission	XRF	Emission	XRF	Emission	XRF	Emission	XRF
Si	0.05		<0.0001		<0.0001		0.5		0.4	
Al	1						5		3	
Fe	2	1		0.004		0.005	7	2	5	2
Ca	0.3		0.2		0.2		8		6	
Mg	1		2		0.05		0.5		3	
Na	3		2		>0.5		0.5		3	
K			0.2		0.2					
Ti	0.02						0.07		0.05	
Mn	0.2	0.04	0.05	0.007		0.0001	0.3	0.07	0.3	0.05
Cr	0.005						0.01		0.01	
Mo		0.002		0.0003	0.0005	0.0002				
V	0.05	0.03					0.1		0.1	
B			0.0002		0.00005					
Sr	0.0005	0.02		0.0003	0.0001	0.002	0.002	0.04	0.002	0.03
Cu		0.002		0.0006		0.0001		0.01		0.009
Zn		0.01		0.0007		0.00005		0.03		0.02
Pb		0.003								
As		0.003		0.0003				0.02		0.01
Ni		0.004				0.0002		0.007		0.007
Rb		0.0005		0.002		0.002				
Ba		0.007		0.003				0.02		
Zr		0.003		0.0007		0.0004				
Y		0.004		0.0005		0.006		0.006		0.003
Th				<0.001						
U				0.0005						
Se		0.003						0.008		

1/ TDS = total dissolved solids.

2/ Qual/semi-quantitative.

Emission - By Spectran Labs, Denver, Colorado

XRF - By Fluo-X-Spec, Denver, Colorado