



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

The following file is part of the Anderson Mine Collection

ACCESS STATEMENT

These digitized collections are accessible for purposes of education and research. We have indicated what we know about copyright and rights of privacy, publicity, or trademark. Due to the nature of archival collections, we are not always able to identify this information. We are eager to hear from any rights owners, so that we may obtain accurate information. Upon request, we will remove material from public view while we address a rights issue.

CONSTRAINTS STATEMENT

The Arizona Geological Survey does not claim to control all rights for all materials in its collection. These rights include, but are not limited to: copyright, privacy rights, and cultural protection rights. The User hereby assumes all responsibility for obtaining any rights to use the material in excess of "fair use."

The Survey makes no intellectual property claims to the products created by individual authors in the manuscript collections, except when the author deeded those rights to the Survey or when those authors were employed by the State of Arizona and created intellectual products as a function of their official duties. The Survey does maintain property rights to the physical and digital representations of the works.

QUALITY STATEMENT

The Arizona Geological Survey is not responsible for the accuracy of the records, information, or opinions that may be contained in the files. The Survey collects, catalogs, and archives data on mineral properties regardless of its views of the veracity or accuracy of those data.

HAZEN RESEARCH, INC.



7511 SO. HOUGHTON RD.
POST OFFICE BOX 17928
TUCSON, ARIZONA 85731
TELEPHONE (602) 886-5545

HRI Project No. 2233 T
Copy No. 6

ACID AGITATION LEACHING AND
THICKENING STUDIES ON
DATE CREEK URANIUM ORES

Phase 2, Part 1

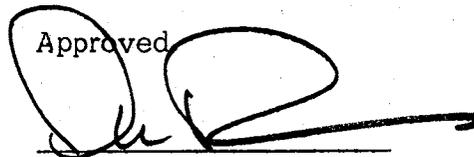
for

Urangesellschaft U.S.A., Inc.
6000 East Evans Avenue
Denver, Colorado 80222

February 1979



T. A. Applegate
Senior Project Engineer

Approved


P. N. Thomas
Vice President

HAZEN RESEARCH, INC.



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

February 15, 1979

Mr. John Abramo
Minerals Exploration Company
1708 West Grant Road
P.O. Box 50324
Tucson, AZ 85703

J. ABRAMO

APR 11 1979

Mgr. Met. Opr.

Re: HRI Project 2233-T

Dear Mr. Abramo:

Enclosed please find one (1) copy of the report entitled, "Acid Agitation Leaching and Thickening Studies on Date Creek Uranium Ores," dated February, 1979.

If you have any questions regarding this report, please contact me.

Very truly yours,

P. N. Thomas
Vice President

PNT/skb
Encl.

TABLE OF CONTENTS

	<u>Page</u>
List of Tables	iii
Introduction	1
Summary	2
Sample Preparation and Head Analyses	2
Leaching and Thickening	2
Sample Preparation and Head Analyses	4
Sample Preparation	4
Head Analyses	4
Leaching and Thickening	9
Test Procedure	9
Leaching Results	10
Thickening Results	13
Appendix	15

LIST OF TABLES

<u>Table</u>		<u>Page</u>
1	Composite Makeup	5
2	Head Analyses of Hole Composites	7
3	Emission Spectrochemical Analyses	8
4	Leaching/Thickening Summary	11

INTRODUCTION

In November 1978, Hazen Research, Inc. was authorized by Urangesellschaft U.S.A., Inc. to conduct Phase 2, Part 1 of an amenability study for uranium recovery from Date Creek, Arizona, uranium ore. Individual Date Creek core interval samples were prepared and analyzed by the Hazen Research, Golden, Colorado, laboratory under Project No. 4603 G. A single composite for each hole was formed by combining portions from each ore grade interval. These composites were sent to the Hazen Research, Tucson, Arizona, laboratory for use in the present testing program.

Sulfuric acid agitation leaching and thickening tests were run on each of the hole composites using conditions previously established by Hazen Research for Minerals Exploration Company's Anderson Mine property which is located adjacent to the Urangesellschaft Date Creek property. Authorization was given by Mr. John Abramo of Minerals Exploration Company for use of such data.

Hazen Research previously conducted preliminary tests on five composites prepared from earlier Date Creek drill holes. Those results, given in our report of November 1978 entitled "Acid and Alkaline Leaching and Thickening Studies on Date Creek Uranium Ores, Phase 1", showed the Date Creek ores to be generally amenable to the Minerals Exploration acid leaching conditions. Therefore, the intent of the present program was to determine the metallurgical amenability of the new core composites to the acid leaching/thickening conditions.

SUMMARY

The following summarizes Phase 2, Part 1 of a laboratory testing program for uranium recovery performed by Hazen Research on hole composite samples from Urangesellschaft's Date Creek, Arizona, uranium property.

SAMPLE PREPARATION AND HEAD ANALYSES

Composite samples from 13 Date Creek drill holes were prepared for the present testing program. Uranium analyses of the 13 composites ranged from 0.037 to 0.081% U_3O_8 and averaged approximately 0.063% U_3O_8 . Of major importance was the high calcite content of the composites as shown by the average carbonate content of 11.7% CO_3 . The composites also contained an average of 2.66% organic carbon.

LEACHING AND THICKENING

Sulfuric acid agitation leach and Kynch method thickening tests were run on each of the hole composites. Test conditions were similar to those established for the Anderson Mine ores belonging to Minerals Exploration Company.

The six-hour leaches of the nominally 98% minus 28-mesh composites resulted in an average final leach residue of approximately 0.008% U_3O_8 which represented an average final uranium dissolution of approximately 87%. Sulfuric acid consumptions were quite high and averaged approximately 579 pounds H_2SO_4 per ton of ore. It was noted that some leach residues dropped in uranium content following the thickening tests, thus indicating insufficient leaching time. However, additional uranium dissolution during thickening averaged only 0.7 percentage point.

Thickening tests resulted in settling rates with flocculant that were generally adequate with unit area requirements, without safety factors, averaging 4.5 ft^2 per ton of ore per day. However, thickened

pulp densities which averaged only 30.8% solids may preclude the use of conventional countercurrent decantation as a method of liquid/solid separation of the Date Creek ores. Further in-depth testing is recommended in this area.

SAMPLE PREPARATION AND HEAD ANALYSES

SAMPLE PREPARATION

During the period of October through December 1978, Urangesellschaft U.S.A., Inc. sent drill core from 13 holes at the Date Creek, Arizona, uranium property to the Hazen Research laboratory in Golden for sample preparation and head analyses of individual one-foot intervals. Core intervals from each hole were selected for inclusion into individual hole composites based upon uranium content. In order to form each hole composite, an amount of ore was split from each one-foot interval selected for the composite such that each composite would weigh approximately 1500 to 1600 grams. Core intervals included in each hole composite are shown in Table 1. These 13 composites, with particle sizes of all passing one-quarter inch, were sent to the Hazen Research laboratory in Tucson for further preparation and metallurgical testing.

Upon receipt in Tucson, each composite was individually blended and approximately 800 grams were split out and stage crushed to nominally 98% passing 28-mesh. This portion was further blended and two 300-gram test charges were prepared. The remaining approximately 200 grams of crushed ore was oven dried for three hours at 40^o C to determine moisture content. Duplicate head samples, designated Head A and Head B, were prepared from the dried material.

HEAD ANALYSES

The Head A pulps were analyzed for U₃O₈ by fluorimetric techniques at Skyline Labs, Inc. in Tucson. Head B pulps were analyzed at the Hazen Research analytical laboratory in Golden for U₃O₈ (fluorimetric), CO₃, total C, Mo, V₂O₅, PO₄, and Li. The Head B's were also sent out for qualitative-semiquantitative spectrochemical analyses. The amount of organic carbon present in each hole composite was determined by subtracting the carbon present as CO₃ from the total carbon analysis.

Table 1

Composite Makeup

Hole Composite	Footage Intervals Included in Composite					
	From - To	From - To	From - To	From - To	From - To	From - To
145-C	495-496 589-590	502-505	509-511	537-540	557-558	571-572
146-C	635-639	906-912	914-915	921-923		
155-C	515-516	527-528	529-530	542-544	556-557	580-581
158-C	383-384 488-489	390-391 491-496	402-403	448-449	460-461	474-475
161-C	529-530 606-608	534-535 636-637	538-539 638-639	573-575 641-642	598-600 646-647	603-605
165-C	576-580	620-621	926-928			
126-C	668-673	677-680	683-684	691-692	695-697	706-708
Tonto 8-C	540-541	551-552	553-555	587-590	612-613	
171-C	687-690	692-696	699-701	711-712	717-718	735-736
177-C	542-543	576-578	588-589	606-607	635-636	
169-C	615-616	630-631	639-642	721-723		
175-C	559-560	580-581	582-583	603-606		
176-C	557-558	569-572	584-585	594-597	609-610	

Head analyses results are shown in Table 2 and spectrochemical analyses are shown in Table 3. Uranium analyses, based upon the individual interval analyses and calculated from subsequent metallurgical tests, are shown for comparison.

Table 2
Head Analyses of Hole Composites

Hole Composite	Estimated	U ₃ O ₈ , %		Calculated From Leach Data	Head Analyses 1/ %							% Moisture
		Direct Fluorimetric at HRL 1/	at Skyline 2/		Mo	CO ₃	C _{org}	V ₂ O ₅	PO ₄	Li		
145-C	0.068	0.068	0.072	0.075	0.010	18.3	3.37	0.06	0.166	0.024	0.2	
146-C	0.078	0.073	0.066	0.082	0.008	11.2	3.57	0.18	0.166	0.017	0.4	
155-C	0.039	0.039	0.035	0.036	0.013	3.77	6.76	0.93	0.209	0.009	0.5	
158-C	0.072	0.070	0.068	0.068	0.005	8.81	1.92	0.90	0.248	0.015	0.4	
161-C	0.066	0.069	0.066	0.072	0.012	5.80	4.67	0.01	0.25	0.008	0.1	
165-C	0.063	0.064	0.055	0.059	0.003	3.08	0.60	0.10	0.24	0.013	1.4	
126-C	0.074	0.081	0.081	0.076	<0.001	11.2	0.24	0.02	0.23	0.017	1.0	
Tonto 8-C	0.059	0.061	0.057	0.057	0.010	24.1	1.84	0.16	0.21	0.011	0.5	
171-C	0.068	0.066	0.066	0.068	0.002	17.2	1.67	0.05	0.20	0.032	1.0	
177-C	0.054	0.052	0.050	0.049	0.005	6.84	2.14	0.05	0.26	0.012	0.1	
169-C	0.041	0.040	0.042	0.046	<0.001	28.9	0.44	0.03	0.16	0.026	0.3	
175-C	0.056	0.056	0.059	0.058	0.003	8.12	2.12	0.04	0.28	0.010	0.7	
176-C	0.080	0.077	0.080	0.076	0.007	4.99	5.22	0.06	0.28	0.013	1.1	
Average	0.063	0.063	0.061	0.063	0.006	11.7	2.66	0.20	0.22	0.016	0.6	

1/ Hazen Research lab, Golden
2/ Skyline Labs, Tucson

Table 3

Emission Spectrochemical Analyses

Element Found	145-C		146-C		155-C		158-C		161-C		165-C		126-C		Tonto 8-C		171-C		177-C		169-C		175-C		176-C		
	Major	2/	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major	Major
Silicon																											
Aluminum	2		2	1	2	8	8	8	8	8	8	8	8	8	8	8	8	3	3	5	10	10	10	10	10	10	10
Iron	1		2	3	4	2	2	2	2	2	2	2	2	1	2	2	2	2	4	4	4	4	4	4	4	4	4
Calcium	4		2	1	3	2	1	2	2	2	1	2	2	2	3	3	3	3	4	4	4	8	8	2	2	2	2
Magnesium	1		1	0.5	0.8	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1	1	1	1	1	1	1	0.5	0.5	0.7	0.7
Sodium	4		4	4	6	4	4	4	4	4	4	4	3	3	3	3	2	2	4	4	4	4	4	4	4	5	5
Titanium	0.2		0.2	0.3	0.5	0.3	0.4	0.4	0.3	0.3	0.4	0.4	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.5	0.5	0.5	0.5
Manganese	0.1		0.07	0.01	0.01	0.07	0.07	0.07	0.07	0.07	0.07	0.07	0.1	0.1	0.1	0.1	0.1	0.1	0.01	0.01	0.01	0.05	0.05	0.02	0.02	0.02	0.02
Molybdenum	0.03		0.02	0.05	0.05	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-	-	-	0.01	-	-	0.005	0.005	0.005	-	-	0.01	0.01	0.03	0.03
Strontium	0.01		0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.05	0.05	0.01	0.01	0.02	0.02
Chromium	0.005		0.008	0.005	0.01	0.01	0.005	0.01	0.01	0.01	0.005	0.005	0.003	0.003	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.007	0.007
Barium	0.005		0.005	-	-	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.003	0.003	0.002	0.002	0.002	0.005	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Zirconium	0.005		-	0.03	0.05	0.07	0.1	0.1	0.07	0.07	0.1	0.1	0.05	0.05	0.1	0.1	0.01	0.01	0.005	0.005	0.005	0.5	0.5	0.01	0.01	0.01	0.01
Lead	0.002		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.001	0.001	0.001	-	-	-	-	-	-
Copper	0.0005		0.001	0.0005	0.0005	0.001	0.002	0.002	0.001	0.001	0.002	0.0005	0.0005	0.0005	0.001	0.001	0.0005	0.0005	0.01	0.01	0.01	0.0005	0.0005	0.001	0.001	0.003	0.003
Vanadium	-		-	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.001	0.001	0.001	0.001	0.01	0.01	0.01	0.01	0.01	0.01	0.005	0.005	0.007	0.007	0.01	0.01
Nickel	-		-	0.007	0.005	-	-	-	-	-	-	-	-	-	-	-	-	0.005	0.005	0.005	0.005	0.002	0.002	0.005	0.005	0.005	0.005
Boron	-		-	0.001	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.0005	0.0005	0.001	0.001	0.001	0.001	0.002	0.002

1/ Values shown are estimates expressed as weight percentages

2/ >10%

LEACHING AND THICKENING

TEST PROCEDURE

Combined sulfuric acid agitation leaching and Kynch method thickening tests were run on test charges from each of the hole composites. Leaching conditions, which conformed to those previously established by Hazen Research for the Anderson Mine Property of Minerals Exploration Company, were:

Ore feed:	300 grams
Ore size:	≈98% passing 28-mesh
Initial pulp density:	45% solids
Agitation:	Mechanical
Target acid level:	≈25 grams H ₂ SO ₄ /liter
Oxidant:	6 pounds NaClO ₃ /ton of ore (in two additions)
Temperature:	75° C
Time:	6 hours

The ore charges were pulped in deionized water at 45% solids, agitated and heated to 75° C. Concentrated sulfuric acid was slowly added to the pulps until a stable pH of ≈0.95 was attained. When the pH had stabilized, one-half of the sodium chlorate was added and the final one-half was added after two hours.

Fifty milliliter pulp samples were taken one-half, four, and six hours after the pH had stabilized. Each pulp sample was filtered and washed with two 50 milliliter displacements of pH 2 solution followed by one 50 milliliter displacement of deionized water. The dried leach residues and the combined pregnant plus wash liquors were analyzed for U₃O₈. Free acid titrations were run on the undiluted pregnant solutions and acid consumptions were determined. Remaining portions of the leach pulps were allowed to stand overnight before starting the thickening tests.

Leach pulps were transferred to one liter graduated cylinders for Kynch method thickening tests. The pulps were diluted incrementally with pH 2 solution containing flocculant. After adequate

flocculation was visually observed, the pulps were diluted to approximately 19% solids with pH 2 solution containing no flocculant. A variety of synthetic polymer flocculants were tested.

Following completion of all thickening test measurements, the thickening test pulps were filtered and washed. The dried residue and liquor samples were analyzed for U_3O_8 in order to calculate an overall metallurgical balance for the leach/thickening tests.

Leaching and thickening results from all hole composites are summarized in Table 4. Individual thickening test data sheets are included in Appendix Tables A-1 through A-14.

LEACHING RESULTS

The leaching data showed the 13 hole composites to be generally amenable to the Minerals Exploration leaching conditions. Average leaching results for the 13 composites were:

	<u>Leach Residue,</u> <u>% U_3O_8</u>	<u>% U_3O_8</u> <u>Dissolution</u>
Half hour	0.0140	79.3
Four hour	0.0090	85.9
Six hour	0.0084	86.8
After thickening	0.0077	87.5
Average calculated head	0.0630	

These data indicated that, on the average, the six-hour leaching periods were adequate for effective solubilization of the uranium values. However, the data from Composites 145-C, 146-C, and 155-C, showed that significant leaching occurred during the thickening operations. Thus, uranium dissolution percentages increased approximately 4 to 11 percentage points indicating insufficient leaching times for those three composites.

Sulfuric acid consumptions during leaching were quite high, ranging from 286 to 1155 pounds H_2SO_4 per ton of ore. Average consumption was 579 pounds H_2SO_4 per ton of ore. This acid consumption was somewhat higher than would be expected based upon the average carbonate assay of 11.7% CO_3 , thus indicating the presence of

Table 4

Leaching/Thickening Summary

Hole Composite	145-C	146-C	155-C	158-C	161-C	165-C	Tonto 8-C	126-C
<u>0.5 Hour</u>								
Residue assay, % U ₃ O ₈	0.026	0.021	0.010	0.013	0.017	0.012	0.0095	0.019
U ₃ O ₈ dissolution, %	67.0	76.4	75.5	82.9	74.0	79.1	80.5	76.4
<u>4.0 Hour</u>								
Residue assay, % U ₃ O ₈	0.019	0.014	0.009	0.0075	0.0085	0.0050	0.0070	0.0013
U ₃ O ₈ dissolution, %	68.4	83.7	77.0	91.0	88.4	91.9	86.9	84.1
<u>6.0 Hour</u>								
Residue assay, % U ₃ O ₈	0.017	0.013	0.011	0.0075	0.0090	0.0050	0.0065	0.010
U ₃ O ₈ dissolution, %	79.8	85.2	68.2	90.7	88.2	93.0	88.5	88.8
Avg g H ₂ SO ₄ /1	29	35	27	28	43	58	36	42
Acid consump, lb/t ore	813	475	248	393	296	286	896	573
Leach calc head, % U ₃ O ₈	0.076	0.081	0.036	0.077	0.071	0.059	0.062	0.084
<u>Thickening Test</u>								
Residue assay, % U ₃ O ₈	0.0095	0.0095	0.0080	0.0085	0.0085	0.0065	0.0090	0.010
U ₃ O ₈ dissolution, %	87.1	89.4	79.0	87.3	88.4	89.6	81.0	86.4
Total calc head, % U ₃ O ₈	0.075	0.082	0.036	0.068	0.072	0.059	0.057	0.076
Flocculant, lb/t ore	0.981/	0.451/	0.602/	0.832/	0.203/	0.454/	0.705/	0.472/
<u>Pulp Density, wt % Solids</u>								
Feed	18.9	17.5	18.1	18.1	18.9	17.5	22.7	17.1
Thickened	28.1	33.0	34.8	30.0	38.4	31.2	33.6	30.1
Decant clarity	Clear	Clear						
Unit area, ft ² /ton/day	5.0	4.3	2.1	2.6	5.1	5.8	5.0	4.2

Table 4
(continued)

Leaching/Thickening Summary

Hole Composite	171-C	177-C	169-C	175-C	Repeat 175-C	176-C	Avg
<u>0.5 Hour</u>							
Residue assay, % U ₃ O ₈	0.010	0.0060	0.010	0.0035	0.0050	0.019	0.014
U ₃ O ₈ dissolution, %	86.2	86.7	81.5	94.4	91.4	73.1	79.3
<u>4.0 Hour</u>							
Residue assay, % U ₃ O ₈	0.0080	0.0045	0.0045	0.0025	0.0050	0.012	0.0096
U ₃ O ₈ dissolution, %	87.3	91.9	91.3	95.6	91.4	83.9	85.9
<u>6.0 Hour</u>							
Residue assay, % U ₃ O ₈	0.0075	0.0050	0.0050	0.0055	0.0035	0.0095	0.0084
U ₃ O ₈ dissolution, %	87.9	88.5	87.2	90.3	94.1	87.9	86.8
Avg g H ₂ SO ₄ /l	49	35	39	99	33	33	37
Acid consump, lb/t ore	940	674	1155	456	450	334	579
Leach calc head, % U ₃ O ₈	0.066	0.048	0.044	0.057	0.057	0.072	0.064
<u>Thickening Test</u>							
Residue assay, % U ₃ O ₈	0.0080	0.0065	0.0045	0.0030	0.0035	0.0085	0.0077
U ₃ O ₈ dissolution, %	88.5	87.0	90.5	95.0	94.2	89.4	87.5
Total calc head, % U ₃ O ₈	0.068	0.049	0.046	0.058	0.058	0.076	0.063
Flocculant, lb/t ore	1.013/	0.592/	0.333/	0.353/	0.372/	0.352/	0.55
<u>Pulp Density, wt % Solids</u>							
Feed	18.6	19.5	18.9	17.9	18.0	18.1	18.6
Thickened	23.6	27.6	26.3	29.4	32.9	32.5	30.8
Decant clarity	Clear	Clear	f/	Clear	Clear	Clear	Clear
Unit area, ft ² /ton/day	3.6	4.8	4.9	4.3	6.5	5.3	4.54

1/ Dow Chemical Separan MG-200
 2/ American Cyanamid Superfloc 127
 3/ Stein Hall Polyhall 1080
 4/ 60% Separan AP 273 and 40% Polyhall 1080
 5/ 44% Separan AP 30 and 56% Polyhall 1080
 6/ Slightly cloudy

acid consuming minerals other than limestone. The average free acid concentration during the leaches was typically higher than the target level of 25 grams H_2SO_4 per liter due to buffering effects encountered during pH monitoring. Final oxidation potentials during the leaches ranged from approximately minus 370 to minus 535 millivolts.

The following weight changes occurred during the leaching and thickening tests.

<u>Composite</u>	<u>% Weight Loss(Gain)</u>	<u>Composite</u>	<u>% Weight Loss(Gain)</u>
145-C	(1.9)	126-C	1.3
146-C	7.5	171-C	1.8
155-C	4.4	177-C	0.4
158-C	3.9	169-C	0.1
161-C	0.1	175-C	2.1
165-C	6.4	176-C	3.3
Tonto 8-C	(17.5)		

THICKENING RESULTS

The thickening results summarized in Table 4 show that liquid/solid separation by conventional thickening techniques may present major problems. The following thickening data illustrate this point.

	<u>Range</u>	<u>Average</u>
Feed pulp density, % solids	17.1-22.7	18.6
Thickened pulp density, % solids	23.6-38.4	30.8
Unit area, ft^2 /ton of ore/day	2.1- 6.5	4.5

Flocculant dosages ranged from 0.2 to 1.0 pound per ton of ore. Non-ionic, high molecular weight polyacrylamide-type flocculants (Superfloc 127 and Polyhall 1080) appeared to give the best results of the flocculants tested. Optimum dosages would likely be in the range of 0.3 to 0.4 pound per ton of ore.

All overflow liquors were clear with the exception of one test. The thickener area requirements averaging 4.5 square feet per ton of ore per day were comparable to previous thickening data developed

for Minerals Exploration Company. The major problems with the thickening results, however, were the poor thickened pulp densities which averaged only 30.8% solids. The suspected cause of the low terminal densities was the relatively large amount of fine-grained gypsum produced by acid leaching the high calcite-bearing ores. Terminal densities were typically lower as the acid consumption during leaching increased.

It is possible that thickening results could be improved with further testing. A representative composite sample would be best for such testing. This should include the study of various flocculant types and dosages. It is doubted, however, that acceptable high thickened pulp densities will be obtained even with optimization. Therefore, vacuum belt filtration may have to be considered as a possible alternative to thickening for liquid/solid separation of the Date Creek acid leach pulps.

APPENDIX

Appendix Table A-1

KYNCH PROCEDURE

THICKENING TEST DATA

Pulp Acid agitation leach of 145-C, diluted with Project 2233 T
 pH 2 solution containing 0.98 pound MG-200 per Test AL-TH-1
 ton of ore. Date 11/10/78
 By CB

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1015	639.0	376.0
950	4.5	Gross wet wt, g	1890.1	-	
900	8	Tare, g	686.2	-	
850	16	Net wet wt, g	1203.9	811.0	392.9
838	18	Gross dry wt, g	-	-	
830	20	Tare, g	-	-	
819	22	Net dry wt, g	227.9	227.9	
814	24	Density, g/l	1186.1	1269.2	1045
806	26	Solids, %	18.9	28.1	
800	28	Thickener rake rotation = - min/rev			
793	30	<u>Terminal Density Calculation</u>			
785	32	Clear liquor volume at 19 hr: 376 ml			
777	34	Clear liquor weight at 19 hr: 376 ml x 1045 g/l = 392.9 g			
770	36	Thickened slurry wt: (1203.9) g - (392.9) g = 811 g			
768	38	Dry solids weight: 227.9 g			
762	40	Thickened pulp density: 28.9 Solids, %			
758	42	<u>Thickener Unit Area Requirement</u>			
755	44	Initial height, H ₀ : 1.156 ft			
748	46	Initial pulp density, C ₀ = (31.3 x 10 ⁻⁶) (feed solids content, g solids/liter slurry) = ton/ft ³			
745	48	C ₀ = (31.3 x 10 ⁻⁶) x 224.5 = 0.0070 ton/ft ³			
741	50	Critical time, t _x = 0.0403 days			
738	52	Unit area, A = $\frac{t_x}{C_0 H_0} = \frac{(0.0403)}{(0.0070)(1.156)}$			
735	54	A = 5.0 ft ² /ton/day			
732	56				
728	58				
726	60				
705	80				
650	200				
639					
Terminal Level					
19 hours					

Remarks _____

Clarity of Decant Liquor: Very clear

Appendix Table A-2
KYNCH PROCEDURE
THICKENING TEST DATA

Pulp Acid agitation leach of 146-C, diluted with Project 2233 T
 pH 2 solution containing 0.45 pound MG-200 Test AL-TH-2
 per ton of ore. Date 11/10/78
By BP

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1015	487	528
950	2.3	Gross wet wt, g	1820.5	-	-
900	4	Tare, g	642.5	-	-
850	5.4	Net wet wt, g	1178.0	625.7	552.3
800	7.2	Gross dry wt, g	-	-	-
750	8.8	Tare, g	-	-	-
700	11	Net dry wt, g	206.6	206.6	-
676	13	Density, g/l	1160.6	1284.8	1046
655	15	Solids, %	17.5	33.0	-
638	17	Thickener rake rotation = <u> - </u> min/rev <u>Terminal Density Calculation</u> Clear liquor volume at <u>19</u> hr: <u>528</u> ml Clear liquor weight at <u>19</u> hr: <u>528 ml x 1046 g/l = 552.3 g</u> Thickened slurry wt: (<u>1178</u>) g - (<u>552.3</u>) g = <u>625.7 g</u> Dry solids weight: <u>206.6</u> g Thickened pulp density: <u>33.0</u> Solids, % <u>Thickener Unit Area Requirement</u> Initial height, H_0 : <u>1.208</u> ft Initial pulp density, $C_0 = (31.3 \times 10^{-6})$ (feed solids content, g solids/liter slurry) = ton/ft^3 $C_0 = (31.3 \times 10^{-6}) \times 203.5 = 0.0064 \text{ ton/ft}^3$ Critical time, $t_x = 0.0330$ days Unit area, $A = \frac{t_x}{C_0 H_0} = \frac{(0.0330)}{(0.0064)(1.208)}$ $A = 4.3 \text{ ft}^2/\text{ton/day}$			
621	19				
612	21				
600	23				
593	25				
588	27				
580	29				
573	31				
568	33				
563	35				
560	37				
553	39				
552	41				
542	43				
545	45				
539	51				
520	81				
505	132				
487					
Terminal Level <u>19</u> hours					

Remarks _____

 Clarity of Decant Liquor: Very clear

Appendix Table A-3
KYNCH PROCEDURE
THICKENING TEST DATA

Pulp Acid agitation leach of 155-C, diluted with Project 2233 T
pH 2 solution containing 0.60 pound Superfloc Test AL-TH-3
per ton of ore Date 12/7/78
 By BP

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1020	475	545
950	0.3	Gross wet wt, g	1789.6	-	-
900	0.7	Tare, g	622.6	-	-
850	1.1	Net wet wt, g	1167.0	607.8	559.2
800	1.5	Gross dry wt, g	-	-	-
750	2	Tare, g	-	-	-
700	2.3	Net dry wt, g	211.6	211.6	-
650	3	Density, g/l	1144.1	1279.6	1026
615	4	Solids, %	18.1	34.8	-
575	6	Thickener rake rotation = _____ min/rev <u>Terminal Density Calculation</u> Clear liquor volume at <u>22</u> hr: <u>545</u> ml Clear liquor weight at <u>22</u> hr: <u>545</u> ml x <u>1026</u> g/l = <u>559.2</u> g Thickened slurry wt: <u>(1167.0)</u> g - <u>(559.2)</u> g = <u>607.8</u> g Dry solids weight: <u>211.6</u> g Thickened pulp density: <u>34.8</u> Solids, % <u>Thickener Unit Area Requirement</u> Initial height, H_0 : <u>1.172</u> ft Initial pulp density, $C_0 = (31.3 \times 10^{-6})$ (feed solids content, g solids/liter slurry) = ton/ft ³ $C_0 = (31.3 \times 10^{-6}) \times 207.45 = .0065$ ton/ft ³ Critical time, $t_x = .0160$ days Unit area, $A = \frac{t_x}{C_0 H_0} = \frac{(.0160)}{(.0065)(1.172)}$ $A = 2.1$ ft ² /ton/day			
555	8				
540	10				
530	12				
525	14				
520	16				
516	18				
511	20				
510	22				
508	24				
504	29				
501	34				
500	39				
495	49				
491	69				
490	89				
485	129				
484	169				
482	200				
475					
Terminal Level					
<u>22</u> hours					

Remarks _____

Clarity of Decant Liquor: Very clear

Appendix Table A-5
KYNCH PROCEDURE
THICKENING TEST DATA

Pulp Acid agitation leach of 161-C diluted with Project 2233 T
pH 2 solution containing 0.20 pound Polyhall Test AL-TH-5
1080 per ton of ore Date 12/20/78
 By CB

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1020	445	575
950	3.3	Gross wet wt, g	1803.0	-	-
900	5.4	Tare, g	642.3	-	-
850	7.8	Net wet wt, g	1160.7	571.9	588.8
800	10.1	Gross dry wt, g	-	-	-
750	12.4	Tare, g	-	-	-
700	14.6	Net dry wt, g	219.7	219.7	-
670	17	Density, g/l	1137.9	1285.2	1024
645	20	Solids, %	18.9	38.4	-
630	22	Thickener rake rotation = _____ min/rev			
620	24	<u>Terminal Density Calculation</u>			
610	26	Clear liquor volume at 19.5hr: <u>575</u> ml			
600	28	Clear liquor weight at 19.5hr: <u>575</u> ml x <u>1024</u> g/l = <u>588.8</u> g			
592	30	Thickened slurry wt: (<u>1160.7</u>) g - (<u>588.8</u>) g = <u>571.9</u> g			
585	32	Dry solids weight: <u>219.7</u> g			
578	34	Thickened pulp density: <u>38.4</u> Solids, %			
570	36	<u>Thickener Unit Area Requirement</u>			
565	38	Initial height, H ₀ : <u>1.208</u> ft			
560	40	Initial pulp density, C ₀ = (31.3 x 10 ⁻⁶) (feed solids content, g solids/liter slurry) = ton/ft ³			
555	42	C ₀ = (31.3 x 10 ⁻⁶) x <u>215.4</u> = <u>0.0067</u> ton/ft ³			
550	44	Critical time, t _x = <u>0.0413</u> days			
546	46	Unit area, A = $\frac{t_x}{C_0 H_0}$ = $\frac{(0.0413)}{(0.0067)(1.208)}$			
542	48	A = <u>5.1</u> ft ² /ton/day			
540	50				
530	55				
522	60				
517	65				
512	70				
502	80				
495	90				
445					
Terminal Level <u>19.5</u> hours					

Remarks _____

Clarity of Decant Liquor: Very clear

Appendix Table A-6
KYNCH PROCEDURE
THICKENING TEST DATA

Pulp Acid agitation leach of 165-C, diluted with Project 2233 T
 pH 2 solution containing 0.27 pound AP 273 Test AL-TH-6
 and 0.18 pound Polyhall 1080 per ton of ore Date 12/20/78
 By CB

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1020	519	501
950	2.8	Gross wet wt, g	1804.2	-	-
900	5.4	Tare, g	632.8	-	-
850	7.3	Net wet wt, g	1171.4	656.9	514.5
800	10	Gross dry wt, g	-	-	-
775	12	Tare, g	-	-	-
760	14	Net dry wt, g	205.2	205.2	-
745	16	Density, g/l	1148.4	1265.7	1027
733	18	Solids, %	17.5	31.2	-
720	20	Thickener rake rotation = _____ min/rev <u>Terminal Density Calculation</u> Clear liquor volume at 19 hr: _____ 501 _____ ml Clear liquor weight at 19 hr: 501 ml x 1027 g/l = 514.5 g Thickened slurry wt: (1171.4) g - (514.5) g = 656.9 g Dry solids weight: _____ 205.2 _____ g Thickened pulp density: _____ 31.2 _____ Solids, % <u>Thickener Unit Area Requirement</u> Initial height, H ₀ : _____ 1.146 _____ ft Initial pulp density, C ₀ = (31.3 x 10 ⁻⁶) (feed solids content, g solids/liter slurry) = ton/ft ³ C ₀ = (31.3 x 10 ⁻⁶) x 201.2 = 0.0063 ton/ft ³ Critical time, t _x = _____ 0.0417 _____ days Unit area, A = $\frac{t_x}{C_0 H_0} = \frac{(0.0417)}{(0.0063)(1.146)}$ A = _____ 5.8 _____ ft ² /ton/day			
710	22				
702	24				
695	26				
686	28				
680	30				
672	32				
668	34				
662	36				
652	40				
642	45				
633	50				
626	55				
620	60				
615	65				
608	70				
600	80				
585	100				
570	130				
560	170				
552	200				
519					
Terminal Level					
19 hours					

Remarks _____

Clarity of Decant Liquor: Very clear

Appendix Table A-7
KYNCH PROCEDURE
THICKENING TEST DATA

Pulp Acid agitation leach of Tonto 8-C diluted with Project 2233 T
 pH 2 solution containing 0.31 pound AP-30 and Test AL-TH-7
 0.39 pound Polyhall 1080 per ton of ore. Date 12/20/78
 By CB

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1020	640	380
950	12.1	Gross wet wt, g	1833.2	-	-
900	28	Tare, g	625.2	-	-
865	45	Net wet wt, g	1208.0	816.6	391.4
845	60	Gross dry wt, g	-	-	-
805	80	Tare, g	-	-	-
755	120	Net dry wt, g	274.2	274.2	-
722	170	Density, g/l	1184.3	1275.9	1030
		Solids, %	22.7	33.6	0
		Thickener rake rotation = _____ min/rev			
		<u>Terminal Density Calculation</u>			
		Clear liquor volume at 19 hr: 380 ml			
		Clear liquor weight at 19 hr: 380 ml x 1030 g/l = 391.4 g			
		Thickened slurry wt: (1208.0) g - (391.4) g = 816.6 g			
		Dry solids weight: 274.2 g			
		Thickened pulp density: 33.6 Solids, %			
		<u>Thickener Unit Area Requirement</u>			
		Initial height, H ₀ : 1.172 ft			
		Initial pulp density, C ₀ = (31.3 x 10 ⁻⁶) (feed solids content, g solids/liter slurry) = ton/ft ³			
		$C_0 = (31.3 \times 10^{-6}) \times 268.8 = (0.0084) \text{ ton/ft}^3$			
		Critical time, t _x = 0.0493 days			
		Unit area, A = $\frac{t_x}{C_0 H_0} = \frac{(0.0493)}{(0.0084)(1.172)}$			
640		A = 5.0 ft ² /ton/day			
Terminal Level					
19 hours					

Remarks _____

Clarity of Decant Liquor: Very clear

Appendix Table A-9
KYNCH PROCEDURE
THICKENING TEST DATA

Pulp Acid agitation leach of 171-C, diluted with Project 2233 T
 pH solution containing 1.01 pounds Polyhall 1080 Test AL-TH-9
 per ton of ore Date 1/9/79
 By CB

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1030	780	250
985	2	Gross wet wt, g	1937.4	-	-
975	4	Tare, g	686.2	-	-
960	6	Net wet wt, g	1251.2	984.4	266.8
950	8	Gross dry wt, g	-	-	-
940	10	Tare, g	-	-	-
930	12	Net dry wt, g	232.7	232.7	-
922	14	Density, g/l	1214.7	1262.1	1067
915	16	Solids, %	18.6	23.6	-
909	18	Thickener rake rotation = _____ min/rev <u>Terminal Density Calculation</u> Clear liquor volume at 21.5 hr: 250 ml Clear liquor weight at 21.5 hr: 250 ml x 1067 g/l = 266.8g Thickened slurry wt: (1251.2) g - (266.8) g = 984.4 g Dry solids weight: 232.7 g Thickened pulp density: 23.6 Solids, % <u>Thickener Unit Area Requirement</u> Initial height, H ₀ : 1.146 ft Initial pulp density, C ₀ = (31.3 x 10 ⁻⁶) (feed solids content, g solids/liter slurry) = ton/ft ³ C ₀ = (31.3 x 10 ⁻⁶) x 225.9 = 0.0071 ton/ft ³ Critical time, t _x = 0.0292 days Unit area, A = $\frac{t_x}{C_0 H_0} = \frac{0.0292}{(0.0071)(1.146)}$ A = 3.6 ft ² /ton/day			
900	20				
895	22				
890	24				
885	26				
880	28				
875	30				
862	35				
856	40				
850	45				
839	55				
830	70				
820	90				
805	150				
800	200				
780					
Terminal Level 21.5 hours					

Remarks Beaker settle 475 ml

Clarity of Decant Liquor: Very clear

Appendix Table A-10

KYNCH PROCEDURE

THICKENING TEST DATA

Pulp Acid agitation leach of 177-C, diluted with Project 2233 T
pH 2 solution containing 0.59 pound Superfloc Test AL-TH-10
127 per ton of ore. Date 1/9/79
 By CB

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1005	670	335
985	2	Gross wet wt, g	1845.9	-	-
964	4	Tare, g	642.5	-	-
944	6	Net wet wt, g	1203.4	852.7	350.7
932	8	Gross dry wt, g	-	-	-
920	10	Tare, g	-	-	-
910	12	Net dry wt, g	235.2	235.2	-
902	14	Density, g/l	1197.4	1272.7	1047
896	16	Solids, %	19.5	27.6	-
890	18	Thickener rake rotation = <u>-</u> min/rev			
885	20				
880	22	<u>Terminal Density Calculation</u>			
872	24	Clear liquor volume at <u>22</u> hr: <u>335</u> ml			
868	26	Clear liquor weight at <u>22</u> hr: <u>335</u> ml x <u>1047</u> g/l = <u>350.7</u> g			
864	28	Thickened slurry wt: <u>(1203.4)</u> g - <u>(350.7)</u> g = <u>852.7</u> g			
860	30	Dry solids weight: <u>235.2</u> g			
849	35	Thickened pulp density: <u>27.6</u> Solids, %			
839	40	<u>Thickener Unit Area Requirement</u>			
829	45	Initial height, H_0 : <u>1.203</u> ft			
820	50	Initial pulp density, $C_0 = (31.3 \times 10^{-6})$ (feed solids content, g solids/liter slurry) = ton/ft^3			
805	60	$C_0 = (31.3 \times 10^{-6}) \times 234.0 = 0.0073 \text{ ton/ft}^3$			
790	70	Critical time, $t_x = 0.0417$ days			
737	130	Unit area, $A = \frac{t_x}{C_0 H_0} = \frac{(0.0417)}{(0.0073)(1.203)}$			
719	170	$A = 4.8 \text{ ft}^2/\text{ton/day}$			
710	200				
670					
Terminal Level 22 hours					

Remarks Beaker settle 675 ml

Clarity of Decant Liquor: Very clear

Appendix Table A-12

KYNCH PROCEDURE

THICKENING TEST DATA

Pulp Acid agitation leach of 175-C, diluted with Project 2233 T
pH 2 solution containing 0.35 pound Polyhall Test AL-TH-12
1080 per ton of ore. Date 1/11/79
 By BP

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1015	570	445
950	2	Gross wet wt, g	1892.2	-	-
900	3.2	Tare, g	686.2	-	-
850	4.4	Net wet wt, g	1206.0	733.9	472.1
800	7	Gross dry wt, g	-	-	-
773	9	Tare, g	-	-	-
754	11	Net dry wt, g	216.0	216.0	-
740	13	Density, g/l	1188.2	1287.5	1061
730	15	Solids, %	17.9	29.4	-
720	17	Thickener rake rotation = <u>-</u> min/rev			
709	19	<u>Terminal Density Calculation</u>			
700	21	Clear liquor volume at <u>19</u> hr: <u>445</u> ml			
692	23	Clear liquor weight at <u>19</u> hr: <u>445</u> ml x <u>1061</u> g/l = <u>472.1</u> g			
689	25	Thickened slurry wt: (<u>1206.0</u>) g - (<u>472.1</u>) g = <u>733.9</u> g			
680	27	Dry solids weight: <u>216.0</u> g			
675	29	Thickened pulp density: <u>29.4</u> Solids, %			
670	31	<u>Thickener Unit Area Requirement</u>			
665	33	Initial height, H_0 : <u>1.146</u> ft			
660	35	Initial pulp density, $C_0 = (31.3 \times 10^{-6})$ (feed solids content, g solids/liter slurry) = ton/ft^3			
655	37	$C_0 = (31.3 \times 10^{-6}) \times \underline{212.8} = \underline{0.0067} \text{ ton/ft}^3$			
653	39	Critical time, $t_x = \underline{0.0326}$ days			
648	43	Unit area, $A = \frac{t_x}{C_0 H_0} = \frac{(0.0326)}{(0.0067)(1.146)}$			
641	47	$A = \underline{4.3} \text{ ft}^2/\text{ton/day}$			
638	51	Terminal Level			
629	61	<u>19</u> hours			
620	71				
610	91				
600	121				
596	141				
570					

Remarks _____

Clarity of Decant Liquor: Clear

Appendix Table A-13
KYNCH PROCEDURE
THICKENING TEST DATA

Pulp Repair acid agitation leach of 175-C, diluted Project 2233 T
 with pH 2 solution containing 0.35 pound Super- Test AL-TH-12R
 floc 127 per ton of ore. Date 1/17/79
 By BP

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1005	491	514
988	2	Gross wet wt, g	1797.7	-	-
965	4	Tare, g	632.9	-	-
935	6	Net wet wt, g	1164.8	636.9	527.9
880	8	Gross dry wt, g	-	-	-
840	10	Tare, g	-	-	-
815	12	Net dry wt, g	209.7	209.7	-
796	14	Density, g/l	1159.0	1297.1	1027
780	16	Solids, %	18.0	32.9	-
764	18	Thickener rake rotation = _____ min/rev <u>Terminal Density Calculation</u> Clear liquor volume at 19 hr: 514 ml Clear liquor weight at 19 hr: 514 ml x 1027 g/l = 527.9 g Thickened slurry wt: (1164.8) g - (527.9) g = 636.9 g Dry solids weight: 209.7 g Thickened pulp density: 32.9 Solids, % <u>Thickener Unit Area Requirement</u> Initial height, H ₀ : 1.146 ft Initial pulp density, C ₀ = (31.3 x 10 ⁻⁶) (feed solids content, g solids/liter slurry) = ton/ft ³ C ₀ = (31.3 x 10 ⁻⁶) x 208.7 = 0.0065 ton/ft ³ Critical time, t _x = 0.0487 days Unit area, A = $\frac{t_x}{C_0 H_0} = \frac{(0.0487)}{(0.0065)(1.146)}$ A = 6.5 ft ² /ton/day			
750	20				
738	22				
730	24				
715	26				
705	28				
699	30				
689	32				
680	34				
672	36				
665	38				
659	40				
651	42				
625	52				
605	62				
590	72				
557	102				
539	132				
522	172				
491					
Terminal Level					
19 hours					

Remarks Initially cloudy

Clarity of Decant Liquor: Clear

Appendix Table A-14
KYNCH PROCEDURE
THICKENING TEST DATA

Pulp Acid agitation leach of 176-C, diluted with Project 2233 T
pH 2 solution containing 0.35 pound Superfloc Test AL-TH-13
127 per ton of ore. Date 1/17/79
 By BP

Settling Rate			Pulp Density Measurements		
Level ml	Time min		Feed pulp	Thickened Solids	Decant Liquor
1000	0	Volume, ml	1015	506	509
964	2	Gross wet wt, g	1832.1	-	-
886	4	Tare, g	655.6	-	-
822	6	Net wet wt, g	1176.5	654.3	522.2
790	8	Gross dry wt, g	-	-	-
767	10	Tare, g	-	-	-
748	12	Net dry wt, g	212.7	212.7	-
731	14	Density, g/l	1159.1	1293.1	1026
719	16	Solids, %	18.1	32.5	-
705	18	Thickener rake rotation = <u> - </u> min/rev			
695	20	<u>Terminal Density Calculation</u>			
685	22	Clear liquor volume at <u>19</u> hr: <u>509</u> ml			
679	24	Clear liquor weight at <u>19</u> hr: <u>509</u> ml x <u>1026</u> g/l = <u>522.2</u> g			
670	26	Thickened slurry wt: <u>(1176.5)</u> g - <u>(522.2)</u> g = <u>654.3</u> g			
661	28	Dry solids weight: <u>212.7</u> g			
655	30	Thickened pulp density: <u>32.5</u> Solids, %			
650	32	<u>Thickener Unit Area Requirement</u>			
645	34	Initial height, H ₀ : <u>1.146</u> ft			
640	36	Initial pulp density, C ₀ = (31.3 x 10 ⁻⁶) (feed solids content, g solids/liter slurry) = ton/ft ³			
635	38	C ₀ = (31.3 x 10 ⁻⁶) x <u>209.6</u> = <u>0.0066</u> ton/ft ³			
630	40	Critical time, t _x = <u>0.0403</u> days			
620	44	Unit area, A = $\frac{t_x}{C_0 H_0} = \frac{(0.0403)}{(0.0066)(1.146)}$			
618	46	A = <u>5.3</u> ft ² /ton/day			
612	48				
599	58				
585	68				
575	78				
567	88				
540	138				
506					
Terminal Level					
<u>19</u> hours					

Remarks _____

Clarity of Decant Liquor: Clear