CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

OTTAWA

IR 73-55 September 1973

LABORATORY SUPPORT FOR SPODUMENE PILOT PLANT TRIALS

by

K.D. Atkinson

Mineral Processing Division

MINES BRANCH

Note: This report relates essentially to the samples as received. The report and any correspondence connected therewith shall not be used in full or in part as publicity or advertising matter.

Copy No. September 1973

Mines Branch Investigation Report IR 73-65

LABORATORY SUPPORT FOR SPODUMENE PILOT PLANT TRIALS

by

K. D. Atkinson*

- - -

SUMMARY

The spodumene pilot plant of Tantalum Mining Corporation of Canada Limited at Bernic Lake, Manitoba, is based on a process developed at the Mines Branch. When expected results were not realized during start-up of this plant, and Mines Branch results were not duplicated in the mine's laboratory, Mr. K. D. Atkinson of the Mineral Processing Division, Mines Branch went to Bernic Lake for the period June 12-29, 1973, to assist with the problem.

The present report covers experiments performed in the mine laboratory in conjunction with the pilot plant operations, and also directly related experiments performed later in Ottawa.

The results of this work demonstrated that the process was workable and satisfactory operation has been obtained with the pilot plant. There remains, however, a demand for continued improvement in overall performance.

---

*Physical Scientist, Industrial Minerals Milling Section, Mineral Processing Division, Mines Branch, Department of Energy Mines & Resources, Ottawa, Canada.

CONTENTS

FIGURES

INTRODUCTION

Intermittently since 1968 the Industrial Minerals Milling Section has done beneficiation work on spodumene ores for Tantalum Mining Corporation of Canada Limited (TANCO). Several samples have been tested, the most recent being a "Spodumene Table Test Concentrate" (MPD 72/64 and MPD 73/12) prepared December 1, 1972. This represented feed for a pilot circuit at Bernic Lake which commenced operations in late April 1973.

Work on this sample at the Mines Branch outlined a simple but effective flotation process. It was found that stage additions of a single reagent (Armac L-10), at the natural pH of the ground ore in tap water, removed quartz, feldspar, and other minerals to leave a high-grade spodumene product; this is known as reverse flotation. The economic feasibility of this approach appears to be much better than that of flotation systems previously developed.

TANCO's laboratory and pilot plant operation conducted at Bernic Lake mill did not duplicate Mines Branch laboratory results. In response to a request for assistance on the problem, the author spent from 12 to 29 June 1973, at the mine.

In order to accomplish the most in the time available, it was agreed that the author would concentrate on laboratory experiments on pilot plant samples while Messrs. Clyde Lendrum, TANCO's consultant, and John Ambler, Mill Superintendent, would put laboratory findings into plant practice. This procedure would be followed until consistently good results were obtained in TANCO's laboratory after which work would be concentrated on the pilot plant. It was further agreed that Mr. Lendrum would report on the pilot

plant operation and the author on the laboratory work for the period covered.

This report also records tests related to the problem but subsequently performed at the Mines Branch.

TANCO'S PILOT PLANT OPERATION

Currently, TNACO'S mill operation is for the production of a tantalite table concentrate, and spodumene is recovered on a pilot plant scale (Figure 1). The spodumene pilot plant is housed in an extension of the tantalite plant.

Crushing, grinding, and tabling are done in the tantalite mill to fill a holding tank with deslimed material which is withdrawn for further grinding and classification. The material is then passed through a low-intensity magnetic separator and directed to one of three sets of flotation cells as desired. These three sets of flotation cells consist of four No. 15 cells, four No. 12 cells, and six No. 7 cells.

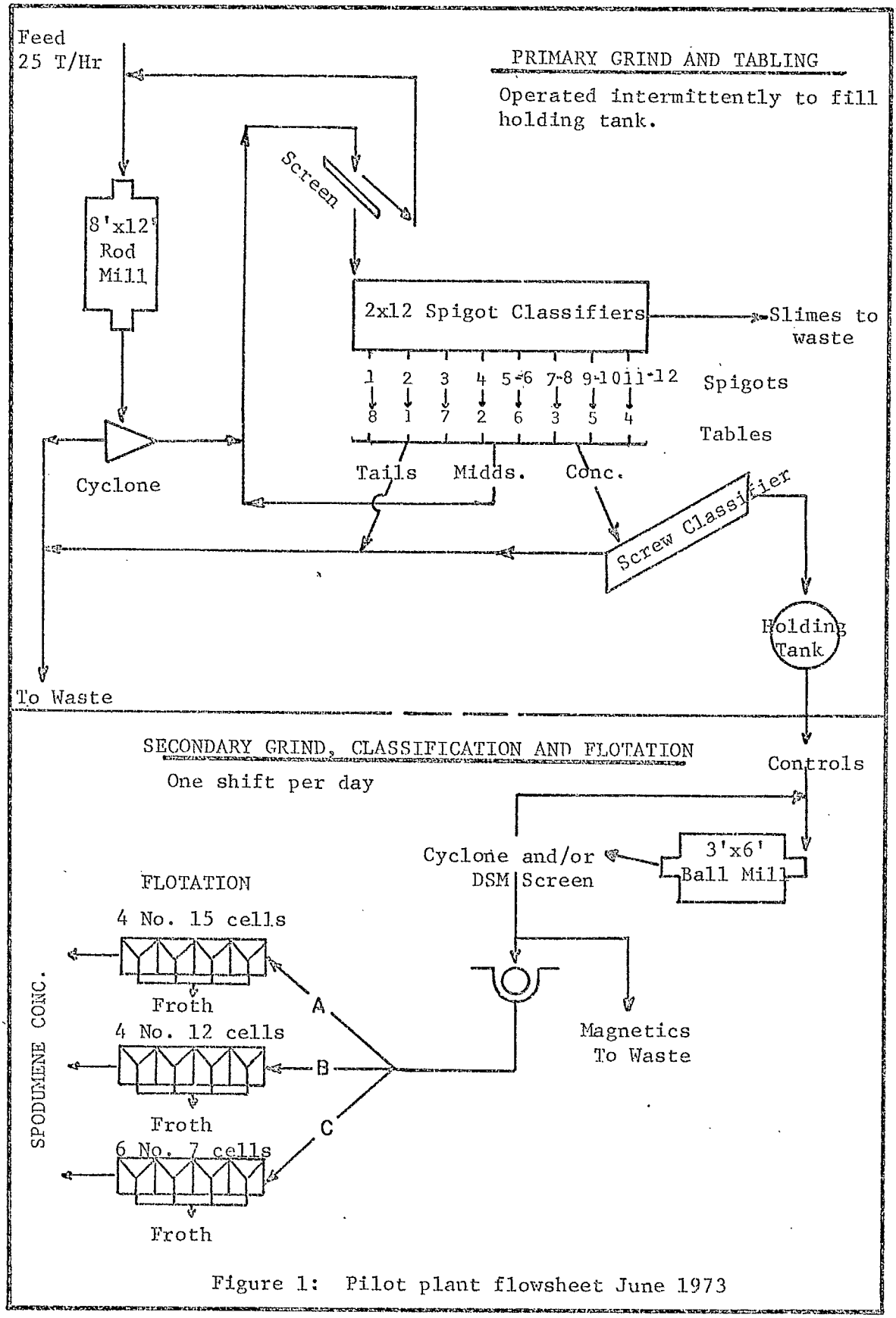


Figure 1: Pilot plant flowsheet June 1973

TANCO's assay laboratory is capable of handling Ta, Cd, Sn, Ti, Li_2O, K_2O, Na_2O, P, Fe_2O_3, Ga, Pb, Ce, Ca, Mg and SiO_2. Few mine laboratories can achieve this.

Test Conditions and Equipment

In all laboratory tests performed at Bernic Lake the following equiment and materials were used:

(1) a Fagergren flotation machine, 1700 rpm, 2500-ml glass bowl;

(2) untreated Bernic Lake water;

(3) a 1% solution Armac L-10

(a) mixed in Ottawa, March 28, 1973, used as is,
(b) mixed in Ottawa, June 12, 1973, used as is,
(c) mixed in Bernic Lake, diluted from 4% solution being used on the pilot plant;

(4) 0.2 to 0.3% magnetic iron present, unless otherwise stated;

(5) all screen analyses performed dry, on a ro-tap for 10 minutes;

(6) the pilot plant holding tank was filled intermittently as required; (this caused variations in the feed and rate of use).

EXPERIMENTAL

Experimental data on all laboratory tests made at the mine are given as Appendix A.

The first three tests were run on pilot plant cell feed which had been filtered and partly dried. At this time, no tabling was being done in the pilot plant, therefore the laboratory work was performed on untreated mill feed rather than table concentrate as at the Mines Branch. Everything floated in all three tests. However, Tests 2 and 3 indicated preferential flotation of the feldspars and silica in the sectioned floats.

The grind was very fine, but this was thought due to not tabling before secondary grinding. Therefore, it was decided to operate the pilot plant on tabled product in order to obtain feed similar to that used in the Ottawa tests.

Samples of pilot plant cell feed were taken in 2500-ml lots for Tests 4, 5, and 6. In Test 4 and 5, again everything floated. Less L-10 was used in Test 5.

It was found that the plant grind was finer than reported screen analyses indicated. In the "rush" for data some material had been lost by decantation of fines prior to screening. With this knowledge, it was decided to run the secondary grind in open circuit.

The grind for Test 6 was similar to that of the Mines Branch, and although less material floated, a concentrate grade of 5.47 Li_2O was obtained.

At this time, it was decided to move farther back in the pilot plant circuit and use the feed to the secondary grinding circuit (holding tank discharge) as feed for laboratory work. This material was oven dried at approximately 400°F and ground in a porcelain Abbé mill with cylpebs as media. Much better results were obtained in Test 7 (a), (b), and (c), the grade increasing with increased grinding time.

Test 8 (a), (b), (c), and (d) were run in parallel with Test 7 to see if a fresh grind and/or desliming had any effect on pilot plant cell feed. The fresh grind of only five minutes did not appear to have any effect, but the desliming appeared to be beneficial.

Test 7 did not appear to yield a complete picture, so it was decided to do three more tests. These were performed on a second sample taken from the second filling of the holding tank after our arrival. These two samples are quite similar on a size distribution basis (Figure 2).

Tests 7 and 9 were plotted with grind time versus assays of Li_2O, Na_2O, K_2O, and recovery of Li_2O (Figure 3). Between Test 7 (c) and 9 (a), the graphs show a distinct break for Na_2O4K_2O but not Li_2O. Grinding and float times were the only variables with float time being 7 minutes for Test 7 (c), and $5\frac{1}{2}$ minutes for Test 9 (a). Therefore, Test 10 was run identically to Test 9 (a) except that float time was increased to 8 minutes.

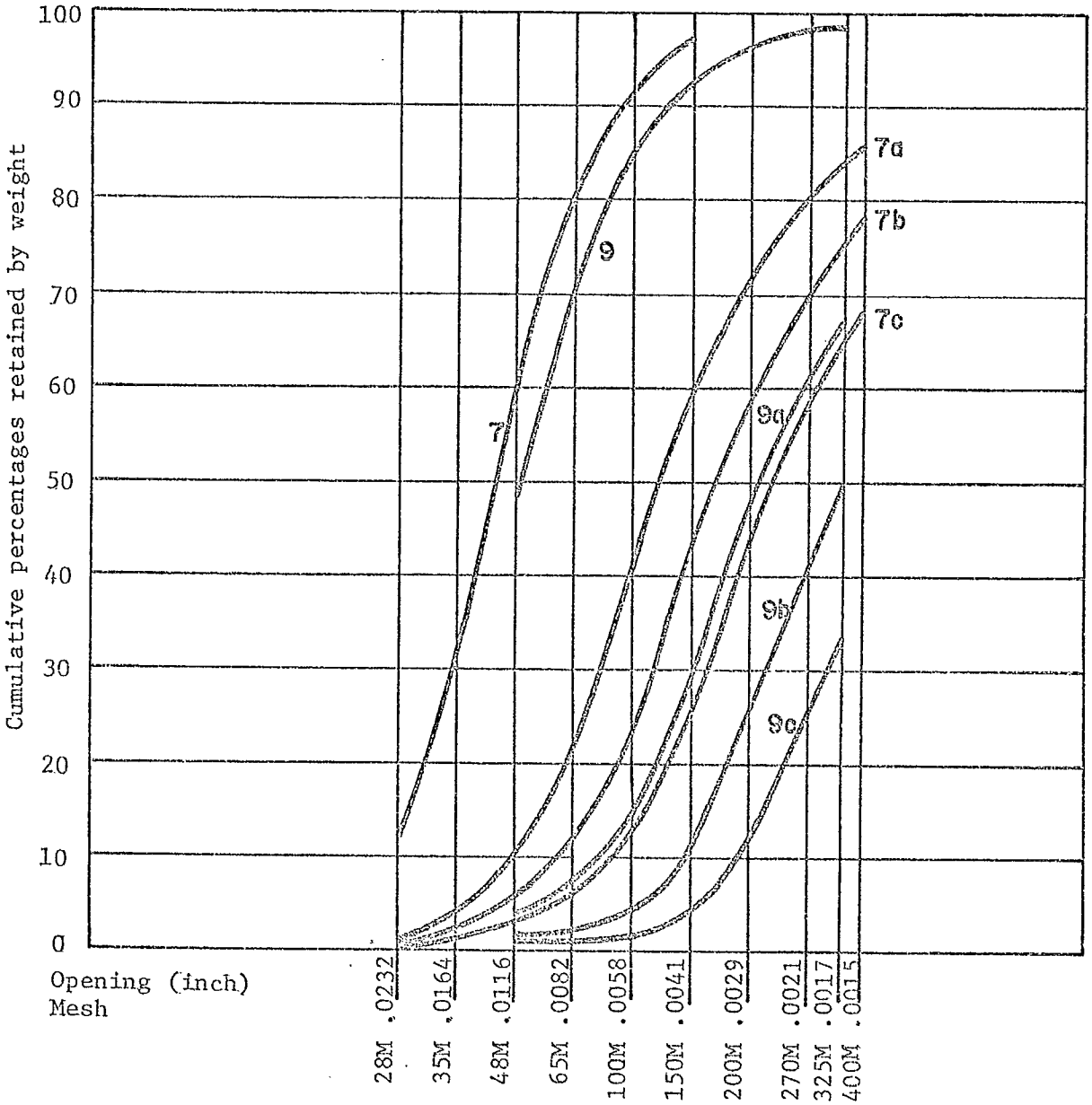
The results of Test 10 conform better to the continuous curves of Figure 3, confirming that too little float time was allowed for Test 9 (a).

A 60-minute laboratory grind yielded flotation results comparable to those desired so a grinding time of 60 minutes was used in subsequent work and the cumulative screen analysis of product between that for Test 7 (b) and that for Test 9 (b) was set as the pilot plant "target" grind.

Test 11 was an attempt to establish the threshold level and to determine the dependency of the float on time.

At this point, Mr. Henry Hartman of the Mines Branch joined the group and the effort was concentrated on the pilot plant with the laboratory being used only where necessary.

Test 12 (a) and (b) were performed to study the effect of No. 7 Denver cells in the pilot plant. Test 12(a) showed that additional material would float from the No. 7 cells concentrate with no additional reagent but also with little upgrading. Test 12(b) was a comparative test on pilot plant cell feed taken at the same time as No. 7 cells concentrate. There was very little difference between the results of these two laboratory tests and the pilot plant results.



LEGEND: 7 - Sample of first holding tank full.
9 - Sample of second holding tank full.
7a - 30-min.grind Test 7a.
7b - 45-min.grind Test 7b.
7c - 60-min.grind Test 7c.
9a - 60-min.grind Test 9a.
9b - 90-min.grind Test 9b.
9c - 120-min.grind Test 9c.

Figure 2: Cumulative Logarithmic Diagram of Screen Analyses.

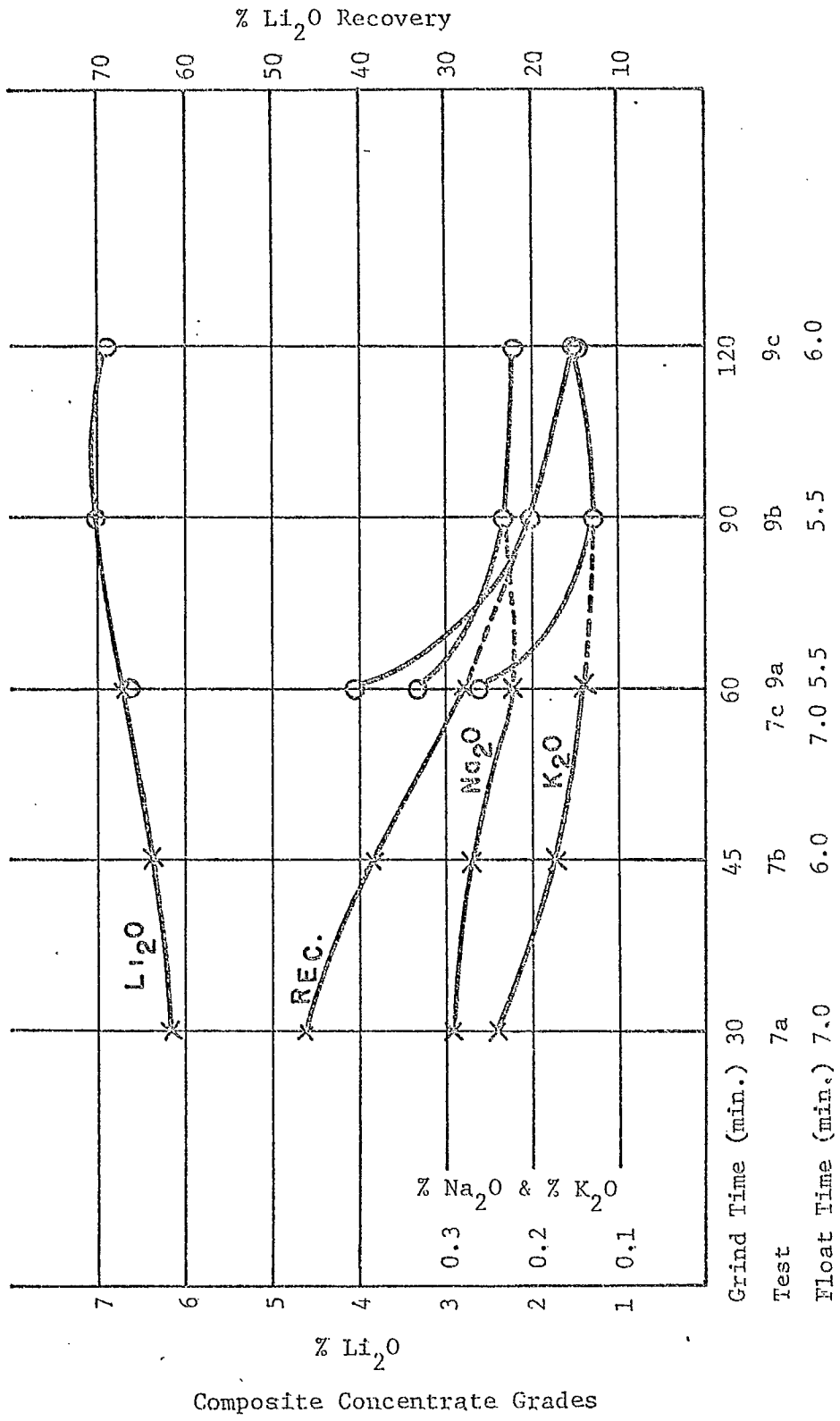


Figure 3: Concentrate Grades and Li_2O Recovery Versus Grind Time

Test 13 was an attempt to oxidize ferrous to ferric iron in the feed to the pilot plant cells by adding commercial Javex, containing 6% sodium hypochlorite. However, due to an excess addition of the Javex nothing floated.

Test 14 was performed in which an undetermined solution of ferrous sulphate was added. Its effect was similar to that in Test 13 in that very little material floated. Further work on the role of Fe++ and Fe+++ after the author's return to the Mines Branch is shown in Appendix B.

The author was soon to return to Ottawa and the laboratory work would be necessarily continued. Mr. Forrest Andrews, mill foreman, did some testing using the established procedure.

Good results had been obtained in the laboratory but not in the pilot plant up to this time. It was thought this may have been because the samples in the laboratory had been oven dried at a high temperature. It was, therefore, decided to try a pilot plant cell feed (Test 15) which was also oven dried. This showed negligible improvement.

It was then decided to try to oxidize ferrous iron by bubbling air overnight into a bucket of holding tank discharge without drying the sample. Good results were obtained by doing this in Test 16. It was next decided to repeat Test 16 and leave out the aeration step. This was done in Test 17, after the author's departure, by Mr. Forrest Andrews. Good results were obtained.

COMMENTS

Good results were obtained in TANCO's laboratory on holding tank discharge ground in an Abbé mill before flotation. However, very little beneficiation could be obtained in either the pilot plant or the mill laboratory after secondary grinding and classification in the pilot plant.

A considerable proportion of the original feed was discarded as waste in preparing flotation feed. However, as developing a workable flotation system for spodumene, rather than optimum throughput, was the objective, this was not taken into account.

Mr. Forrest Andrew has followed the author's test procedures and has continued the laboratory work necessary in de-bugging the mill circuit. This work has been reported in part by Mr. Clyde Lendrum elsewhere.

At the time of the author's return to Ottawa, soluble ferrous iron was considered to have a detrimental effect on the flotation process. Therefore, additional work was carried out at the Mines Branch and reported in Appendix B.

ACKNOWLEDGEMENTS

For information and discussions on work performed, a great deal of assistance has been received from: Messrs. F. Clyde Lendrum, Consultant; C. T. Williams, Manager, and John Ambler, Mill Superintendent, Tantalum Mining Corporation of Canada Limited; R. A. Wyman, Head, and F. H. Hartman, Research Scientist, Industrial Minerals Milling Section, Mineral Processing Division of the Mines Branch.

At Bernic Lake mill Mr. Forrest Andrews, General Mill Foreman, assisted in and performed laboratory work and supervised plant sampling, in addition to his many other duties.

In the Mineral Processing Division of the Mines Branch, G. A. Kent, Chemist, S. T. Lepage, and J. H. Colborne, Technicians, did chemical analyses and heavy liquid separations; P. R. Lachapelle, Technician, performed test work.

DKA:ec

Appendix A

Tests 1-3 inclusive

Sample of pilot plant cell feed was pressure filtered and partly dried in oven. Approximately 425 gm weighed for each test. (25 gm for moisture content).

Mesh	% Wt	Am % Wt
+ 28	-	-
+ 35	-	-
+ 48	0.1	0.1
+ 65	0.3	0.4
+ 100	1.4	1.8
+ 150	7.8	9.6
+ 200	5.7	15.3
+ 325	19.3	34.6
+ 400	6.9	41.5
- 400	58.5	-

Typical screen analysis of test feed 13 June, 1973. At this time rod mill product to holding tank i.e. no tabling and therefore no desliming prior to secondary grind.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 1	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 425 g. R. fl. feed	DATE: 13 June 1973
OBJECT OF TEST: float pilot plant cell feed as is	Grind: pilot plant only	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(Mine)								
ROUGHER Float 1	2.0	20			0.48									
2	2.0				0.48									
3	2.0				0.48									
Total	6.0				1.44									
CLEANING														

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float	99.3	-	-	-	-	-	-	-	-	-	-		
Rougher Conc.	0.7	-	-	-	-	-	-	-	-	-	-		

REMARKS: All material floated non-slectively, no assays

MINES BRANCH FLOTATION TEST REPORT

TEST NO 2	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 428 g R. fl. feed	DATE: 13 June 1973
OBJECT OF TEST: float pilot plant cell feed as is	Grind: pilot plant only	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(Ottawa Mar. 28/73)								
ROUGHER Float 1	2.0	15			0.48									
2	2.0				0.48									
3	2.0				0.48									
Total	6.0				1.44									
Float 1	0.5				–									
2	0.5				–									
3	0.5				–									
4	0.5				–									
CLEANING 5	0.5				–									
6	0.5				–									
Total	3.0													

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning float 1	50.5	2.47	36.91	0.66	52.19	1.62	57.99	–	–	–	–		
2	15.2	3.08	13.85	0.63	14.99	1.42	15.30	–	–	–	–		
3	8.9	3.98	10.46	0.58	8.07	1.20	7.56	–	–	–	–		
4	4.7	4.48	6.20	0.55	4.03	1.10	3.65	–	–	–	–		
5	3.5	4.84	5.02	0.65	3.57	1.20	2.98	–	–	–	–		
6	1.2	5.45	1.89	0.59	1.08	1.04	0.86	–	–	–	–		
Cleaning 1 conc.	15.2	5.46	24.56	0.65	15.47	1.05	11.31	–	–	–	–		
Rougher conc.	0.8	4.57	1.11	0.47	0.60	0.61	0.35	–	–	–	–		
Heads (Calc'd)	100.0	3.38	100.00	0.63	100.00	1.41	100.00						

REMARKS: Check on mine L-10 versus Ottawa L-10.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 3	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 417g R. fl. feed	DATE: 13 June 1973
OBJECT OF TEST: float pilot plant cell feed as is	Grind: pilot plant only	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton L-10	(mine)								
ROUGHER Float 1(a)	0.5	14			0.48									
(b)	0.5				–									
(c)	0.5				–									
(d)	0.5				–									
2 (a)	1.0				0.48									
2 (b)	1.0				–									
Total	4.0				0.96									
CLEANING None														

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float 1 (a)	50.8	2.28	34.72	0.60	50.52	1.35	56.21	–	–	–	–		
1 (b)	12.7	3.33	12.68	0.65	13.68	1.25	13.01	–	–	–	–		
1 (c)	8.4	4.04	10.16	0.60	8.34	1.16	7.97	–	–	–	–		
1 (d)	6.7	4.50	9.05	0.60	6.67	1.07	5.88	–	–	–	–		
2 (a)	17.0	5.16	26.32	0.60	16.92	1.02	14.22	–	–	–	–		
2 (b)	2.2	5.55	3.59	0.58	2.07	0.88	1.56	–	–	–	–		
Rougher conc	2.2	5.39	3.48	0.50	1.79	0.65	1.15	–	–	–	–		
Heads (calc'd)	100.0	3.33	100.00	0.60	100.00	1.22	100.00						

REMARKS: Breakdown of froth times per L-10 additions.

Tests 4-6 inclusive

Samples of pilot plant cell feed were taken as pulp, 2500 ml. for each lab test.

Typical screen analyses of laboratory test feed.

	14 June 1973 Tests 4 & 5		15 June 1973 Test 6	
Mesh	% Wt	Cum % Wt	% Wt	Cum % Wt
+ 28	-	-	-	
+ 35	-	-	0.5	0.5
+ 48	0.3	0.3	2.6	3.1
+ 65	0.9	1.2	6.8	9.9
+ 100	4.0	5.2	13.3	23.2
+ 150	8.8	14.0	16.4	39.6
+ 200	12.5	26.5	16.1	55.7
+ 270	8.3	34.8	8.5	64.2
+ 325	12.5	47.3	9.4	73.6
+ 400	6.0	53.3	3.6	77.2
- 400	46.9	-	22.8	-

On 14 June 1973 pilot plot holding tank discharged and refilled with table concentrate (1st tank full). Also an attempt to get coarser secondary grind.

On 15 June 1973 secondary grind run open circuit (cyclone removed).

MINES BRANCH FLOTATION TEST REPORT

TEST NO 4	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 536 g. R. fl. feed	DATE: 14 June 1973
OBJECT OF TEST: float pilot plant cell feed as is	Grind: pilot plant only	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(mine)								
ROUGHER Float 1 (a)	1.0	19			0.37									
1 (b)	1.0				–									
1 (c)	1.0				–									
1 (d)	1.0				–									
2 (a)	1.0				0.37									
2 (b)	1.0				–									
3 (a)	1.0				0.37									
3 (b)	1.0				–									
Total	8.0				1.11									
CLEANING None														

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float 1 (a)	24.3	2.29	14.19	0.80	31.92	1.47	39.02	–	–	–	–		
1 (b)	16.3	3.16	13.08	0.69	18.39	1.07	18.97	–	–	–	–		
1 (c)	10.5	4.10	10.93	0.58	9.96	0.83	9.48	–	–	–	–		
1 (d)	3.8	4.49	4.31	0.50	3.09	0.72	2.96	–	–	–	–		
2 (a)	17.2	4.61	20.24	0.45	12.72	0.64	12.04	–	–	–	–		
2 (b)	10.0	4.89	12.50	0.46	7.57	0.59	6.46	–	–	–	–		
3 (a)	6.3	5.27	8.46	0.50	5.17	0.57	3.92	–	–	–	–		
3 (b)	4.0	5.41	5.48	0.54	3.52	0.59	2.56	–	–	–	–		
Rougher conc	7.6	5.55	10.81	0.61	7.65	0.55	4.59	–	–	–	–		
Pilot Plant Cell Feed	–	4.05	–	0.58	–	0.86	–	–	–	–	–		
Heads (calc'd)	100.0	3.92	100.00	0.60	100.00	0.91	100.00	–	–	–	–		

REMARKS: New solution L-10 and table product instead of straight feed.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 5	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 462 g R. fl. feed	DATE: 14 June 1973
OBJECT OF TEST: float pilot plant all feed as is	Grind: pilot plant only	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(mine)								
ROUGHER Float 1 (a)	1.0	17			0.22									
1 (b)	1.0				–									
1 (c)	1.0				–									
1 (d)	1.0				–									
2 (a)	1.0				0.22									
2 (b)	1.0				–									
2 (c)	1.0				0.22									
	1.0				–									
Total	8.0				0.66									
CLEANING None														

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float 1 (a)	19.1	2.27	10.60	0.73	24.74	1.42	29.43	–	–	–	–		
1 (b)	11.7	3.11	8.94	0.67	13.99	1.10	14.04	–	–	–	–		
1 (c)	5.6	3.93	5.36	0.56	5.54	1.81	10.96	–	–	–	–		
1 (d)	4.5	4.26	4.70	0.56	4.49	0.75	3.67	–	–	–	–		
2 (a)	27.6	4.26	28.79	0.47	23.06	0.75	22.51	–	–	–	–		
2 (b)	11.3	4.98	13.74	0.47	9.41	0.60	7.35	–	–	–	–		
3 (a)	8.6	5.42	11.47	0.51	7.84	0.59	5.54	–	–	–	–		
3 (b)	3.7	5.73	5.20	0.51	3.36	0.59	2.38	–	–	–	–		
Rougher conc	7.9	5.80	11.20	0.54	7.57	0.48	4.12	–	–	–	–		
Pilot Plant Cell Feed	–	4.14	–	0.54	–	0.83	–	–	–	–	–		
Heads (calc'd)	100.0	4.08	100.00	0.56	100.00	0.91	100.00	–	–	–	–		

REMARKS: As test 4, effect of less L-10, threshold level suggested.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 6	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 639 g. R. fl. feed	DATE: 15 June 1973
OBJECT OF TEST: float pilot plant cell feed as is.	Grind: pilot plant only	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(mine)								
ROUGHER Float 1	2.5	22			0.31									
2	2.0				0.31									
3	1.25				0.31									
Total	5.75				0.93									
CLEANING Float 1	3.5				-									
2	3.0				-									
Total	6.5													

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	14.8	1.64	6.24	1.02	23.07	2.07	28.23	-	-	-	-		
Cleaning 2 conc.	10.4	2.16	5.79	0.73	11.60	1.41	13.55	-	-	-	-		
Cleaning 1 conc.	37.7	3.72	36.01	0.55	31.69	1.02	35.41	-	-	-	-		
+ 48 Rougher conc.	3.8	4.34	4.23	0.55	3.19	1.10	3.85	-	-	-	-		
- 48 Rougher conc.	33.2	5.60	47.74	0.60	30.44	.62	18.96	-	-	-	-		
Composite Rougher conc. (calc'd)	37.0	5.47	51.97	0.59	33.63	0.67	22.81	-	-	-	-		
Pilot Plant Cell Feed	-	4.03	-	-	-	1.05	-	-	-	-	-		
Heads (calc'd)	100.0	3.89	100.00	0.65	100.00	1.08	100.00						

REMARKS: Cyclone out of circuit, coarser grind; another new solution L-10.

Test 7 (a) - 7 (c) inclusive.

Sample of holding tank discharge (1st tank full) had been dried and saved.

Test samples of 500 gm each were ground in a medium Abbé mill with a 3000-gm charge of cylpebs (1200 gm of $\frac{1}{2}$ in. and 1800-gm of $\frac{13}{16}$) and 500 ml of mine water. Grind performed at 58 rpm for times indicated; samples then washed in the laboratory cell.

After each test a screen analysis was run by recombining proportional amounts of each product sample.

Test/grind time	7(a)/30 min.		7(b)/45 min.		7(c)/60 min.	
Mesh	% Wt	Cum % Wt	% Wt	Cum % Wt.	% Wt.	Cum % Wt
+ 28	0.6	0.6	0.5	0.5	0.3	0.3
+ 35	3.5	4.1	1.9	2.4	1.2	1.5
+ 48	6.7	10.8	3.3	5.7	1.5	3.0
+ 65	9.8	20.6	5.9	11.6	2.6	5.6
+ 100	19.1	39.7	12.1	23.7	7.0	12.6
+ 150	19.7	59.4	19.0	42.7	13.8	26.4
+ 200	12.5	71.9	15.9	58.6	17.5	43.9
+ 270	5.9	77.8	8.0	66.6	10.3	54.2
+ 325	6.2	84.0	8.9	75.5	11.0	65.2
+ 400	2.9	86.9	3.6	79.1	4.9	70.1
- 400	13.1	-	20.9	-	29.9	-

In test 7(a), (b), (c), after grinding, each pulp was allowed to stand for 30, 30, and 10 minutes, respectively, before partly decanting excess wash water.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 7 (a)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba)500 g. hold tank dis.	DATE: 16 June 1973
OBJECT OF TEST: float lab. ground holding tank discharge	Grind: Medium Abbé mill 30 min.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton: L-10	(Ottawa) June 12/73
ROUGHER Float 1	3.0	20			0.4	
2	2.0				0.4	
3	2.0				0.4	
Total	7.0				1.2	
CLEANING Float 1	3.0				-	
2	2.0				-	
Total	5.0					

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	17.9	1.42	6.50	0.79	25.51	1.23	31.65	-	-	-	-		
Cleaning 2 conc.	12.5	2.24	7.16	0.75	16.90	1.03	18.50	-	-	-	-		
Cleaning 1 conc.	40.2	3.92	40.23	0.58	41.99	0.69	39.82	-	-	-	-		
+ 48 Rougher conc.	9.4	6.18	14.90	0.22	3.74	0.20	2.71	-	-	-	-		
+150 Rougher conc.	18.7	6.23	29.78	0.32	10.79	0.24	6.45	-	-	-	-		
-150 Rougher conc.	1.2	4.51	1.43	0.48	1.07	0.49	0.87	-	-	-	-		
Composite Rougher conc. (calc,d)	29.4	6.14	46.11	0.29	15.60	0.24	10.03	-	-	-	-		
Decanted slimes (losses)	4.7												
Head (Calc,d)	100.0	3.91	100.00	0.55	100.00	0.69	100.00						

REMARKS: Sample taken 15 June 1973, holding tank discharge, oven dried (+400°F)

MINES BRANCH FLOTATION TEST REPORT

TEST NO 7 (b)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 500g. Hold Tank dis.	DATE: 16 June 1973
OBJECT OF TEST: float lab. ground holding tank discharge	Grind: medium Abbé mill 45 min.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(Ottawa June 12/73)								
ROUGHER Float 1	3.0	20			0.4									
2	2.0				0.4									
3	1.0				0.4									
Total	6.0				1.2									
CLEANING Float 1	3.0				–									
2	3.0				–									
Total	6.0													

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	19.3	1.89	9.09	0.90	31.28	1.49	40.59	–	–	–	–		
Cleaning 2 conc.	14.2	2.03	7.19	0.75	19.19	1.05	21.06	–	–	–	–		
Cleaning 1 conc.	42.1	4.34	45.47	0.50	37.86	0.55	32.64	–	–	–	–		
+48 Rougher conc.	4.9	6.30	7.66	0.23	2.02	0.21	1.45	–	–	–	–		
+150 Rougher conc.	16.2	6.51	26.30	0.25	7.30	0.12	2.75	–	–	–	–		
-150 Rougher conc.	3.2	5.43	4.29	0.41	2.34	0.34	1.52	–	–	–	–		
Composite rougher conc. (Calc,d)	24.3	6.33	38.25	0.27	11.66	0.17	5.72	–	–	–	–		
Decanted slimes (losses)	4.3												
Heads (Calc,d)	100.0	4.02	100.00	0.55	100.00	0.70	100.00	–	–	–	–		

REMARKS:
As 7 (a)

MINES BRANCH FLOTATION TEST REPORT

TEST NO 7 (c)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 500 g. Hold tank dis.	DATE: 16 June 1973
OBJECT OF TEST: float lab. ground holding tank discharge	Grind: Medium Abbé mill 60 min.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton L-10 (Ottawa June 12/73)
ROUGHER Float 1	3.5	20			0.4
2	2.0				0.4
3	1.5				0.4
Total	7.0				1.2
CLEANING Float 1	2.5				-
2	3.0				-
Total	5.5				

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	21.0	1.51	7.50	0.95	37.65	1.60	47.49	-	-	-	-		
Cleaning 2 conc.	14.2	2.05	6.64	0.69	18.50	0.94	18.88	-	-	-	-		
Cleaning 1 conc	47.2	5.19	57.98	0.41	36.59	0.45	30.08	-	-	-	-		
+ 48 Rougher conc.	3.2	5.76	4.36	0.30	1.84	0.36	1.65	-	-	-	-		
+ 150 Rougher conc	10.2	7.15	17.25	0.15	2.89	0.05	0.72	-	-	-	-		
- 150 Rougher conc.	4.2	6.32	6.27	0.32	2.53	0.20	1.18	-	-	-	-		
Composite Rougher conc. (Calc'd)	17.6	6.69	27.88	0.22	7.26	0.14	3.55	-	-	-	-		
Decanted slimes (losses)	6.8												
Heads (Calc'd)	100.0	4.23	100.00	0.52	100.00	0.70	100.00	-	-	-	-		

REMARKS: As 7 (a)

Tests 8(a)- 8(b) inclusive

Samples of pilot plant cell feed were taken as pulp, 2500 ml for each laboratory test.

Typical screen analysis of laboratory test feed.

Mesh	% Wt	Cum % Wt
+ 48	1.9	1.9
+ 65	4.1	6.0
+ 100	10.3	16.3
+ 150	11.7	28.0
+ 200	13.3	41.3
+ 325	18.1	59.4
- 325	40.7	-

Holding tanks refilled 18 June 1973 (2nd tank full) with table concentrate.

When the samples were taken there was caustic to 3' x 6' secondary ball mill (pH to 8.5). Open circuit grind.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 8 (a)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 463 g R. fl. feed	DATE: 18 June 1973
OBJECT OF TEST: float pilot plant cell feed as is	Grind: pilot plant only	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton
					L-10 (Ottawa June 12/73)
ROUGHER Float 1	3.5	17			0.4
2	2.0				0.4
3	1.0				0.4
Total	6.5				1.2
CLEANING Float 1	3.5				–
2	3.0				–
Total	6.5				

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	17.8	1.53	6.79	0.91	24.94	1.72	33.29	–	–	–	–		
Cleaning 2 conc.	14.6	2.51	9.15	0.76	17.11	1.16	18.44	–	–	–	–		
Cleaning 1 conc.	47.8	4.67	55.78	0.56	41.31	0.72	37.51	–	–	–	–		
+ 48 Rougher conc.	2.7	3.92	2.64	0.58	2.41	0.97	2.85	–	–	–	–		
+150 Rougher conc.	12.9	5.78	18.61	0.59	11.73	0.48	6.74	–	–	–	–		
-150 Rougher conc.	4.3	6.62	7.03	0.38	2.45	0.25	1.16	–	–	–	–		
Composite Rougher conc. (calc'd)	19.9	5.71	28.28	0.54	16.59	0.50	10.75	–	–	–	–		
Heads (calc'd)	100.0	4.00	100.00	0.64	100.00	0.91	100.00	–	–	–	–		

REMARKS: Samples taken 10:30 June 18/73; cyclone out of circuit, caustic added to mill pH 8.5

MINES BRANCH FLOTATION TEST REPORT

TEST NO 8 (b)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 498 g. R. fl. feed	DATE: 18 June 1973
OBJECT OF TEST: float pilot plant cell feed	Grind: pilot plant plus 5 min. medium Abbe mill	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton: L-10 (Ottawa June 12/73)
ROUGHER Float 1	4.0	18			0.4
2	2.0				0.4
3	1.25				0.4
Total	7.25				1.2
CLEANING Float 1	3.0				–
2	2.5				–
Total	5.5				

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	17.6	1.92	8.22	0.86	23.41	1.51	29.42	–	–	–	–		
Cleaning 2 conc.	16.3	2.70	10.69	0.77	19.38	1.20	21.62	–	–	–	–		
Cleaning 1 conc.	51.4	4.79	60.00	0.58	46.18	0.73	41.60	–	–	–	–		
+ 48 Rougher conc.	0.9	5.66	1.23	0.38	0.52	0.51	0.50	–	–	–	–		
+150 Rougher conc.	9.2	5.68	12.72	0.52	7.40	0.50	5.09	–	–	–	–		
-150 Rougher conc.	4.7	6.27	7.14	0.43	3.11	0.34	1.76	–	–	–	–		
Composite Rougher conc. (calc d)	14.8	5.85	21.09	0.48	11.03	0.45	7.35	–	–	–	–		
Heads (calc'd)	100.0	4.10	100.00	0.64	100.00	0.90	100.00	–	–	–	–		

REMARKS: As 8(a) + grind for fresh surfaces.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 8 (c)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 478 g. R. fl. feed	DATE: 18 June 1973
OBJECT OF TEST: float pilot plant cell feed	Grind: pilot plant plus 5 min. medium Abbé mill.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton
					L-10 (Ottawa June 12/73)
ROUGHER Float 1	2.0	17			0.4
2	1.5				0.4
3	2.0				0.4
Total	5.5				1.2
CLEANING Float 1	2.0				–
2	1.5				–
Total	3.5				

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	47.6	2.29	27.66	0.80	60.19	1.29	70.10	–	–	–	–		
Cleaning 2 conc.	23.1	4.49	26.27	0.58	21.14	0.72	18.95	–	–	–	–		
Cleaning 1 conc.	25.8	6.18	40.45	0.42	17.13	0.35	10.31	–	–	–	–		
Rougher conc.	3.5	6.34	5.62	0.28	1.55	0.16	0.64	–	–	–	–		
Heads (calc'd)	100.0	3.94	100.00	0.63	100.00	0.87	100.00	–	–	–	–		

REMARKS: As 8(a) + grind for fresh surfaces and desliming – washing steps.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 8 (d)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 395 g. R. fl. feed	DATE: 18 June 1973
OBJECT OF TEST: float pilot plant cell feed.	Grind: pilot plant plus 5 min medium Abbé mill	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(Ottawa June 12/73)								
ROUGHER Float 1	1.5				0.51									
CLEANING None														

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher 1 float	66.7	3.09	51.73	0.70	75.17	1.04	82.43	-	-	-	-		
+ 48 Rougher conc.	0.5	5.10	0.65	0.37	0.30	0.50	0.30	-	-	-	-		
+ 150 Rougher conc.	14.3	5.34	19.24	0.52	12.02	0.51	8.70	-	-	-	-		
- 150 Rougher conc.	18.5	6.11	28.38	0.42	12.51	0.39	8.58	-	-	-	-		
Composite Rougher conc. (calc'd)	33.3	5.76	48.27	0.46	24.83	0.44	17.58	-	-	-	-		
Heads (Calc'd)	100.0	3.98	100.00	0.62	100.00	0.84	100.00	-	-	-	-		

REMARKS: As 8 (a) and 8 (c) effect single addition.

Tests 9 (a) - 11 inclusive

Sample of holding tank discharge (2nd tank full) was taken on 18 June 1973 at approximately the same time as sample taken for tests 8 (a) to (d). This sample was then dried and saved.

Test samples of 500 gm each were ground in a medium Abbé mill using same conditions as Test 7. Times as indicated.

Screen analyses similar to Test 7 were run on a recombined basis for Test 9 (a), (b) and (c).

Test/grind time	9 (a)/60 min.		9 (b)/90 min.		9 (c)/120 min.	
mesh	% Wt	Cum % Wt.	% Wt	Cum % Wt.	% Wt	Cum % Wt.
+ 48	3.5	3.5	1.6	1.6	1.0	1.0
+ 65	2.9	6.4	0.4	2.0	0.1	1.1
+ 100	7.7	14.1	2.0	4.0	0.3	1.4
+ 150	15.7	29.8	6.7	10.7	2.0	3.4
+ 200	18.4	48.2	15.3	26.0	8.8	12.2
+ 325	18.8	67.0	23.1	49.9	21.5	33.7
- 325	33.0	-	50.1	-	66.3	-

Cu

The magnetic iron was removed with a hard magnet for Test 11 only. (0.27% wt. mag. Fe).

Size distributions for Tests 10 and 11 should be similar to Test 9 (a).

MINES BRANCH FLOTATION TEST REPORT

TEST NO 9(a)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 500g. hold tank dis.	DATE: 19 June 1973
OBJECT OF TEST: float lab. ground holding tank discharge.	Grind: medium Abbé mill 60 min.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton L-10 (Ottawa June 12/73)
ROUGHER Float 1	3.0	20			0.4
2	1.5				0.4
3	1.0				0.4
Total	5.5				1.2
CLEANING Float 1	2.5				–
2	3.0				–
Total	5.5				

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	15.6	2.07	8.11	1.00	24.62	1.75	31.76	–	–	–	–		
Cleaning 2 conc.	12.2	2.04	6.25	0.88	16.94	1.27	18.03	–	–	–	–		
Cleaning 1 conc.	48.2	3.74	45.37	0.60	45.75	0.76	42.73	–	–	–	–		
+ 48 Rougher conc.	3.4	6.39	5.45	0.31	1.66	0.35	1.38	–	–	–	–		
+ 150 Rougher conc.	13.5	6.91	23.52	0.27	5.78	0.20	3.15	–	–	–	–		
- 150 Rougher conc.	7.2	6.22	11.30	0.46	5.25	0.35	2.95	–	–	0.05	–		
Composite Rougher conc. (Calc'd)	24.1	6.63	40.27	0.33	12.69	0.26	7.48	–	–	–	–		
Decanted slimes (losses)	3.8												
Heads (calc'd)	100.0	3.97	100.00	0.63	100.00	0.85	100.00	–	–	–	–		

REMARKS: Sample taken at 10:30 June 18/73, holding tank discharge (2nd tank); oven dried (+400 F)

MINES BRANCH FLOTATION TEST REPORT

TEST NO 9 (b)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 500g. hold tank dis.	DATE: 19 June 1973
OBJECT OF TEST: float lab. grind holding tank dis.	Grind: medium Abbé mill 90 min.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton: L-10 (Ottawa June 12/73)
ROUGHER Float 1	3.0	20			0.4
2	1.5				0.4
3	1.0				0.4
Total	5.5				1.2
CLEANING Float 1	3.0				–
2	2.5				–
Total	5.5				

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	23.4	1.78	9.77	0.94	36.84	1.64	46.96	–	–	–	–		
Cleaning 2 conc.	17.0	2.38	9.50	0.80	22.80	1.12	23.32	–	–	–	–		
Cleaning 1 conc.	47.3	5.44	60.43	0.45	35.71	0.48	27.81	–	–	–	–		
+ 48 Rougher conc.	1.5	6.08	2.10	0.30	0.74	0.34	0.61	–	–	–	–		
+ 150 Rougher conc.	4.1	7.27	7.08	0.19	1.32	0.09	0.46	–	–	–	–		
- 150 Rougher conc.	6.7	7.08	11.13	0.23	2.58	0.10	0.32	–	–	<0.01	–		
Composite Rougher conc (calc'd)	12.3	7.02	20.31	0.23	4.64	0.13	1.89	–	–	–	–		
Decanted slimes (Losses)	7.4												
Heads (calc'd)	100.0	4.25	100.00	0.59	100.00	0.81	100.00	–	–	–	–		

REMARKS: As 9 (a)

MINES BRANCH FLOTATION TEST REPORT

TEST NO 9 (c)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 500 g hold tank dis.	DATE: 19 June 1973
OBJECT OF TEST: float lab. ground holding tank dis.	Grind: medium Abbé mill 120 min.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(Ottawa June 12/73)								
ROUGHER Float 1	3.5	20			0.4									
2	1.5				0.4									
3	1.0				0.4									
Total	6.0				1.2									
CLEANING Float 1	3.5				–									
2	3.0				–									
Total	6.5													

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	26.6	1.78	10.76	0.91	41.10	1.58	51.54	–	–	–	–		
Cleaning 2 conc.	16.6	3.34	12.63	0.68	19.20	0.93	18.97	–	–	–	–		
Cleaning 1 conc.	47.0	5.72	61.26	0.45	35.99	0.48	27.73	–	–	–	–		
+ 48 Rougher conc.	0.9	5.99	1.24	0.30	0.46	0.33	0.37	–	–	–	–		
+ 150 Rougher conc.	1.5	6.48	2.29	0.19	0.50	0.12	0.23	–	–	–	–		
- 150 Rougher conc.	7.3	7.08	11.82	0.22	2.74	0.13	1.17	–	–	–	–		
Composite Rougher conc. (calc'd)	9.7	6.89	15.35	0.22	3.70	0.15	1.77	–	–	–	–		
Decant slimes (losses)	12.2												
Heads (calc'd)	100.0	4.39	100.00	0.58	100.00	0.81	100.00	–	–	–	–		

REMARKS: As 9 (a)

MINES BRANCH FLOTATION TEST REPORT

TEST NO 10	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 500g hold tank dis.	DATE: 21 June 1973
OBJECT OF TEST: Repeat 7 (c) + 9 (a) and check for time factor.	Grind" medium Abbé mill 60 min.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton								
					L-10	(Ottawa June 12/73)							
ROUGHER Float 1	4.0	20			0.4								
2	2.0				0.4								
3	2.0				0.4								
Total	8.0				1.2								
CLEANING													

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float 1 (a)	21.2	1.48	8.42	0.96	30.68	1.61	39.54	–	–	0.15	9.73		
1 (b)	10.4	2.01	5.56	0.90	14.03	1.22	14.62	–	–	0.30	9.49		
1 (c)	4.9	2.55	3.38	0.77	5.73	1.46	8.34	–	–	0.39	5.88		
1 (d)	2.7	2.49	1.81	0.96	3.93	1.14	3.59	–	–	0.30	2.49		
2 (a)	18.8	3.47	17.47	0.69	19.48	0.78	16.92	–	–	0.46	26.36		
2 (b)	9.4	4.35	10.91	0.64	9.02	0.72	7.80	–	–	0.52	14.86		
3 (a)	10.7	5.76	16.50	0.49	7.88	0.43	5.32	–	–	0.52	16.97		
3 (b)	6.9	6.16	11.44	0.36	3.76	0.26	2.08	–	–	0.28	5.93		
+ 48 Rougher conc,	3.4	6.41	5.81	0.23	1.17	0.11	0.43	0.08	–	0.06	0.62		
+ 150 Rougher conc.	9.2	5.96	14.75	0.23	3.20	0.10	1.07	0.14	–	0.01	0.28		
- 150 Rougher conc.	2.3	6.52	3.95	0.33	1.12	0.11	0.29	1.53	–	1.07	7.39		
Composite Rougher conc. (calc'd)	14.9	6.15	24.51	0.25	5.49	0.10	1.79	0.35	–	0.19	8.29		
Decanted slimes (losses	3.8												
Heads (calc'd)	100.0	3.73	100.00	0.66	100.00	0.86	100.00	–	–	0.32	100.00		

REMARKS: As 9 (a) + light (one min.) float samples.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 11	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 500g hold tank dis.	DATE: 22 June 1973
OBJECT OF TEST: time dependency and threshold level	Grind medium Abbé mill 60 min.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION		Time min	% Solids	pH	Unit used	Reagents, lb per ton								
						L-10	Ottawa June 12/73							
ROUGHER		CUM	20				CUM							
Float 1	4.0	4.0				0.14	0.14							
2	2.0	6.0				0.08	0.20							
3	2.0	8.0				0.08	0.30							
4	2.0	10.0				0.12	0.42							
5	1.0	11.0				0.04	0.46							
6	1.0	12.0				0.12	0.58							
7	1.0	13.0				0.08	0.66							
8	1.0	14.0				0.16	0.82							
CLEANING None 9	1.0	15.0				0.20	1.02							
–		–				0.40	1.42	No additional material recovered.						

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float 1	5.2	1.91	2.56	1.01	8.12	0.76	5.48	–	–	–	–		
2	8.7	1.53	3.45	1.12	15.13	0.53	6.41	–	–	–	–		
3	11.2	1.86	5.39	0.97	16.85	1.41	21.94	–	–	–	–		
4	13.1	2.51	8.46	0.75	15.16	1.12	20.29	–	–	–	–		
5	9.1	3.28	7.68	0.62	8.71	0.89	11.20	–	–	–	–		
6	9.8	3.60	9.08	0.58	8.78	0.74	10.03	–	–	–	–		
7	7.9	4.39	9.00	0.52	6.40	0.68	7.49	–	–	–	–		
8	9.6	5.25	12.97	0.47	6.96	0.52	6.90	–	–	–	–		
9	7.5	5.88	11.34	0.45	5.21	0.47	4.87	–	–	–	–		
+ 48 Rougher conc.	3.1	6.67	5.41	0.16	0.78	0.04	0.17	0.04	–	–	–		
+ 150 Rougher conc.	11.7	6.62	20.03	0.28	5.08	0.22	3.58	0.04	–	–	–		
- 150 Rougher conc.	3.1	5.90	4.63	0.60	2.82	0.39	1.64	0.26	–	–	–		
Composite Rougher conc. (calc'd)	17.9	6.50	30.07	0.31	8.68	0.22	5.39	0.08	–	–	–		
Heads (calc'd)	100.0	3.87	100.00	0.64	100.00	0.72	100.00	–	–	–	–		

REMARKS:
L-10 added in 0.04 #/T increments (0.5% Solution); iron removed prior to float.

Tests 12(a) - 13 inclusive

For each test 2500 ml of pulp was taken; concentrate for 6 Denver No. 7 cells was used for test 12(a) and pilot plant cell feed for 12(b) and 13.

On 25 June 1973 a composite sample of pilot plant cell feed was taken, a screen analysis performed and assays obtained on the fractions. This data should be similar to conditions for tests 12(a) to 13 samples.

Mesh	% Wt.	Cum % Wt.	Li_2O	Na_2O	K_2O
+ 48	2.6	2.6	3.17	0.65	1.11
+ 65	10.4	13.0	3.72	0.65	0.95
+ 100	10.8	23.8	3.94	0.66	0.99
+ 150	18.9	42.7	4.14	0.63	0.80
+ 200	17.9	60.6	4.12	0.66	0.84
+ 270	8.2	68.8	4.16	0.67	0.90
+ 325	9.4	78.2	4.16	0.67	0.89
+ 400	2.5	80.7	3.92	0.72	0.95
- 400	19.4	-	3.88	0.74	0.99

Cyclone and D.S.M. screen closed circuit with 3' x 6' pebble mill.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 12(a)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 339g Plant conc.	DATE: 27 June 1973
OBJECT OF TEST: To see if additional material would float.	Grind: pilot plant only	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton
ROUGHER Float 1		12			None
2					
3					
CLEANING None					

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float 1	55.6	4.34	52.51	0.63	50.23	0.77	52.45	-	-	-	-		
2	11.9	4.58	11.86	0.70	11.95	0.88	12.83	-	-	-	-		
3	4.2	4.58	4.11	0.84	5.04	0.97	4.97	-	-	-	-		
Rougher conc.	28.3	5.12	31.45	0.81	32.79	0.86	29.74	-	-	-	-		
Heads (Calc'd)	100.0	4.59	100.00	0.69	100.00	0.81	100.00	-	-	-	-		

REMARKS: pilot plant conc. (#6 cell); reagent added to mill circuit.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 12(b)	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 440g. R. fl. feed	DATE: 27 June 1973
OBJECT OF TEST: to compare with 12(a)	Grind: pilot plant only.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton L-10 (Ottawa June 12/73)
ROUGHER Float 1	3.5	16			0.45
2	3.0				0.45
3	2.5				0.45
Total	9.0				1.35
CLEANING None					

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float 1	22.4	3.19	16.94	0.85	27.03	1.45	34.20	-	-	-	-		
2	40.3	4.20	40.06	0.61	34.84	0.81	34.31	-	-	-	-		
3	27.8	4.79	31.52	0.66	26.00	0.77	22.50	-	-	-	-		
Rougher conc.	9.5	5.10	11.48	0.90	12.13	0.90	8.99	-	-	-	-		
Heads (calc'd)	100.0	4.22	100.00	0.70	100.00	0.95	100.00	-	-	-	-		

REMARKS:

MINES BRANCH FLOTATION TEST REPORT

TEST NO 13	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) R. fl. feed	DATE: 27 June 1973
OBJECT OF TEST: convert ferrous iron if present to ferric iron	Grind: pilot plant grind only	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	Ottawa	June	12/73)	Javex	(6% sodium hypochlorite)				
ROUGHER Float 1	–	≈15			0.4				20 ml					
2	–				0.4									
3	–				0.4									
4	–				Conc.									
CLEANING None														

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
None													

REMARKS: Nothing floated - killed everything with excess sodium hypochlorite.

Test 14

A 500 gm sample of holding tank discharge (2nd tank full) was ground for 60 min in medium Abbé mill as per Test 9(a) conditions.

No screen analysis performed.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 14	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 500g hold tank dis.	DATE: 27 June 1973
OBJECT OF TEST: effect of ferrous sulphite	Grind: medium Abbé mill 60 min.	CHARGE: 6813
		TESTED BY: K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(Ottawa June 12/73)			ferrous sulphate solution					
ROUGHER Float 1	2.5	20			0.4				unknown					
2	2.0				0.4				(prepared by John Ambler)					
3	1.5				0.4									
Total	6.0				1.2									
CLEANING														

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float 1	2.7	–	–	–	–	–	–	–	–	–	–		
2	1.5	–	–	–	–	–	–	–	–	–	–		
3	0.7	–	–	–	–	–	–	–	–	–	–		
Rougher conc.	95.0	–	–	–	–	–	–	–	–	–	–		
Decanted slimes (losses)	17.3	–											

REMARKS: very little floated, no assays, probably excess ferrous iron present.

Test 15

A 500 gm sample of dried pilot plant cell feed from 26 June 1973 was used with no additional grinding.

Screen analysis was not performed but size distribution should be similar to Test 12(a) to 13.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 15	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 500g. Dried R.fl. feed	DATE: 28 June 1973
OBJECT OF TEST: to float dried pilot plant feed.	Grind: pilot plant only.	CHARGE: 6813
		TESTED BY: F.A. & K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton L-10	(Ottawa June 12/73								
ROUGHER Float 1	3.0	20			0.4									
2	2.0				0.4									
Total	5.0				0.8									
CLEANING														

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float 1	–	2.78	–	–	–	–	–	–	–	–	–		
2	–	4.79	–	–	–	–	–	–	–	–	–		
Rougher conc.	–	5.29	–	0.51	–	0.36	–	–	–	–	–		

REMARKS: feed – R. fl. feed. 3:00 P.M. June 26/73 assays Li_2O – 3.84, Na_2O 0.71, K_2O 1.11

Tests 16 - 17 inclusive

For test 16 a bucket of holding tank discharge was collected and bubbled with compressed air overnight. The liquid was decanted in the morning and a 600-gm sample was weighed for flotation feed.

A similar 600-gm sample was used for test 17, but with no aeration.

No screen analysis performed.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 16	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 600-g wet hold tank dis.	DATE: 28 June 1973
OBJECT OF TEST: float aerated wet holding tank discharge	Grind: medium Abbé mill 60 min.	CHARGE: 6813
		TESTED BY: F.A. & K.D.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton: L-10 (Ottawa June 12/73)
ROUGHER Float 1	3.0	≈ 20			0.4
2	2.0				0.4
3	1.5				0.4
Total	6.5				1.2
CLEANING Float 1	4.25				–
2	3.0				–
Total	7.25				

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	13.3	1.51	4.54	1.08	25.18	2.00	35.07	–	–	–	–		
Cleaning 2 conc.	12.2	2.36	6.53	0.87	18.67	1.24	20.02	–	–	–	–		
Cleaning 1 conc.	48.3	4.48	49.07	0.51	43.34	0.63	40.27	–	–	–	–		
+ 48 Rougher conc.	4.4	6.68	6.60	0.20	1.53	0.09	0.52	–	–	–	–		
+ 150 Rougher conc.	18.7	6.77	28.68	0.28	9.20	0.14	3.46	–	–	–	–		
- 150 Rougher conc.	3.1	6.48	4.59	0.38	2.09	0.16	0.66	–	–	–	–		
Composite Rougher conc. (calc'd)	26.2	6.72	39.87	0.28	12.82	0.13	4.64	–	–	–	–		
Heads (calc'd)	100.0	4.41	100.00	0.56	100.00	0.75	100.00	–	–	–	–		

REMARKS: Holding tank discharge bubbled with air (wet) overnight, decanted liquid and cut 600-gm sample.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 17 | SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) 600-g. wet hold tank dis. | DATE: 29 June 1973

OBJECT OF TEST: float wet holding tank discharge | Grind: medium Abbé mill 60 min. | CHARGE: 6813 | TESTED BY: F.A.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton L-10 (Ottawa June 12/73)
ROUGHER Float 1	3.0	≈ 20			0.4
2	1.5				0.4
3	1.5				0.4
Total	6.0				1.2
CLEANING None					

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Rougher float 1	41.7	1.81	19.06	0.76	50.7	1.06	60.87	–	–	–	–		
2	27.8	4.39	30.81	0.63	28.0	0.64	24.50	–	–	–	–		
3	20.0	6.39	32.27	0.57	18.2	0.51	14.05	–	–	–	–		
Rougher conc.	10.5	6.74	17.87	0.18	3.0	0.04	0.58	–	–	–	–		
Heads (Calc'd)	100.00	3.96	100.00	0.62	100.0	0.72	100.00	–	–	–	–		

REMARKS:

Appendix B

Tests 115-2 to 115-5 and 115-9 to 115-10 inclusive.

These tests show that as the amount of soluble ferrous sulphate is increased, the Li_2O grade decreases (Figure 4). Therefore the presence of minor amounts of soluble iron is probably detrimental to the grade.

It is also interesting to note that the ratio of plus 150-mesh material to minus 150-mesh material in the concentrates is higher in the better-grade concentrates.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 115-2	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) MPD 73/12	DATE: 11 June 1973
OBJECT OF TEST: Reverse flotation of spodumene	Grind: medium Abbé mill 30 min.	CHARGE: 6813
		TESTED BY: P.R.L.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton
					L-10 (Ottawa March 28/73)
ROUGHER Float 1	3.0	20			0.4
2	3.0				0.4
3	2.0				0.4
Total	8.0				1.2
CLEANING Float 1	5.5				–
2	4.5				–
Total	10.0				

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	13.6	2.26	5.81	1.48	26.38	1.39	52.33	–	–	–	–		
Cleaning 2 conc.	21.4	3.75	15.17	1.13	31.69	0.36	21.33	–	–	–	–		
Cleaning 1 conc.	43.1	6.12	49.87	0.60	33.89	0.17	20.28	–	–	–	–		
Rougher conc.	21.9	7.04	29.15	0.28	8.04	0.10	6.06	–	–	–	–		
Heads (calc'd)	100.0	5.28	100.00	0.76	100.00	0.36	100.00	–	–	–	–		

REMARKS: Fagergren all speed 1930 rpm.

MINES BRANCH FLOTATION TEST REPORT

TEST NO 115-3	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) MPD 73/12	DATE: 16 July 1973
OBJECT OF TEST: Effect of soluble ferrous sulphate	Grind: AS 115-2	CHARGE: 6813
		TESTED BY: P.R.L.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(Ottawa June 12/73			ferrous sulphate					
ROUGHER Float 1	3.0	20			0.4				0.1					
2	4.0				0.4									
3	3.0				0.4									
Total	10.0				1.2									
CLEANING Float 1	5.5				–									
2	4.0				–									
Total	9.5													

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	6.6	2.01	2.87	1.24	12.22	3.76	46.76	0.40	17.53	–	–		
Cleaning 2 conc.	12.1	2.42	6.34	1.37	24.75	1.15	26.22	0.13	10.44	–	–		
Cleaning 1 conc.	54.1	4.24	49.64	0.68	54.92	0.24	24.46	0.11	39.52	–	–		
+150 Rougher conc.	–	6.78	–	0.18	–	0.06	–	0.06	–	–	–		
-150 Rougher conc.	–	6.57	–	0.56	–	0.08	–	0.42	–	–	–		
Rougher conc.	27.2	6.99	41.15	0.20	8.12	0.05	2.56	0.18	32.51	–	–		
Heads (calc'd)	100.0	4.62	100.00	0.66	100.00	0.53	100.00	0.15	100.00	–	–		

REMARKS:

MINES BRANCH FLOTATION TEST REPORT

TEST NO 115-4	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) MPD 73/12	DATE: 16 July 1973
OBJECT OF TEST: AS 115-3	AS 115-2	CHARGE: 6813
		TESTED BY: P.R.L.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	Ottawa June 12/73)					furrous sulphate			
ROUGHER Float 1	4.0	20			0.4						1.0			
2	4.0				0.4									
3	5.0				0.4									
Total	13.0				1.2									
CLEANING Float 1	5.0				-									
2	4.0				-									
Total	9.0													

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	8.8	2.03	4.03	1.49	19.13	3.82	60.65	0.51	26.43	-	-		
Cleaning 2 conc.	8.6	1.83	3.55	1.86	23.33	1.08	16.76	0.16	8.10	-	-		
Cleaning 1 conc.	21.2	2.40	11.48	1.02	31.55	0.33	12.62	0.09	11.24	-	-		
+150 Rougher conc.	-	5.18	-	0.23	-	0.06	-	0.09	-	-	-		
-150 Rougher conc.	-	6.12	-	0.50	-	0.11	-	0.16	-	-	-		
Rougher conc.	61.4	5.84	80.93	0.29	25.98	0.09	9.97	0.15	54.23	-	-		
Heads (calc'd)	100.0	4.43	100.00	0.68	100.00	0.55	100.00	0.16	100.00	-	-		

REMARKS:

MINES BRANCH FLOTATION TEST REPORT

TEST NO 115-5	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) MPD 73/12	DATE: 17 July 1973
OBJECT OF TEST: AS 115-3	AS 115-2	CHARGE: 6813
		TESTED BY: P.R.L.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(Ottawa June 12/73)					ferrous sulphate			
ROUGHER Float 1	4.0	20			0.4						0.5			
2	3.0				0.4									
3	4.0				0.4									
Total	11.0				1.2									
CLEANING Float 1	5.0													
2	4.0													
Total	9.0													

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	11.6	2.05	5.25	1.48	24.69	3.09	66.33	0.37	18.81	-	-		
Cleaning 2 conc	15.8	2.01	7.01	1.43	32.49	0.60	17.54	0.09	6.23	-	-		
Cleaning 1 conc.	36.3	4.15	33.23	0.62	32.36	0.19	12.76	0.08	12.73	-	-		
+150 Rougher conc.	-	6.85	-	0.16	-	0.03	-	0.08	-	-	-		
-150 Rougher conc.	-	6.87	-	0.42	-	0.07	-	0.25	-	-	-		
Rougher conc.	36.4	6.79	54.52	0.20	10.47	0.05	3.37	0.39	62.22	-	-		
Heads (calc'd)	100.00	4.52	100.00	0.69	100.00	0.53	100.00	0.22	100.00	-	-		

REMARKS:

MINES BRANCH FLOTATION TEST REPORT

TEST NO 115-9	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) MPD 73/12	DATE: 23 July 1973
OBJECT OF TEST: AS 115-3	AS 115-2	CHARGE: 6813
		TESTED BY: P.R.L.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(Ottawa June 12/73)					ferrous sulphate			
ROUGHER Float 1	4.0	20			0.4						1.5			
2	4.0				0.4									
3	3.0				0.4									
4	2.0													
Total	13.0				1.2									
CLEANING Float 1	4.0				–									
2	3.5				–									
Total	7.5													

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	13.3	2.35	6.66	1.38	33.95	2.39	72.02	0.33	37.84	–	–		
Cleaning 2 conc.	7.6	2.26	3.66	1.28	17.99	0.47	8.09	0.11	7.21	–	–		
Cleaning 1 conc.	11.3	2.37	5.71	0.91	19.02	0.33	8.45	0.08	7.79	–	–		
Rougher Float 4	1.5	2.77	0.89	0.74	2.05	0.27	0.92	0.11	1.42	–	–		
+150 Rougher conc.	–	6.09	–	0.13	–	0.07	–	0.04	–	–	–		
-150 Rougher conc.	–	5.93	–	0.38	–	0.09	–	0.10	–	–	–		
Rougher conc.	66.3	5.88	83.09	0.22	26.98	0.07	10.52	0.08	45.73	–	–		
Heads (Calc'd)	100.0	4.69	100.00	0.54	100.00	0.44	100.00	0.11	100.00	–	–		

REMARKS:

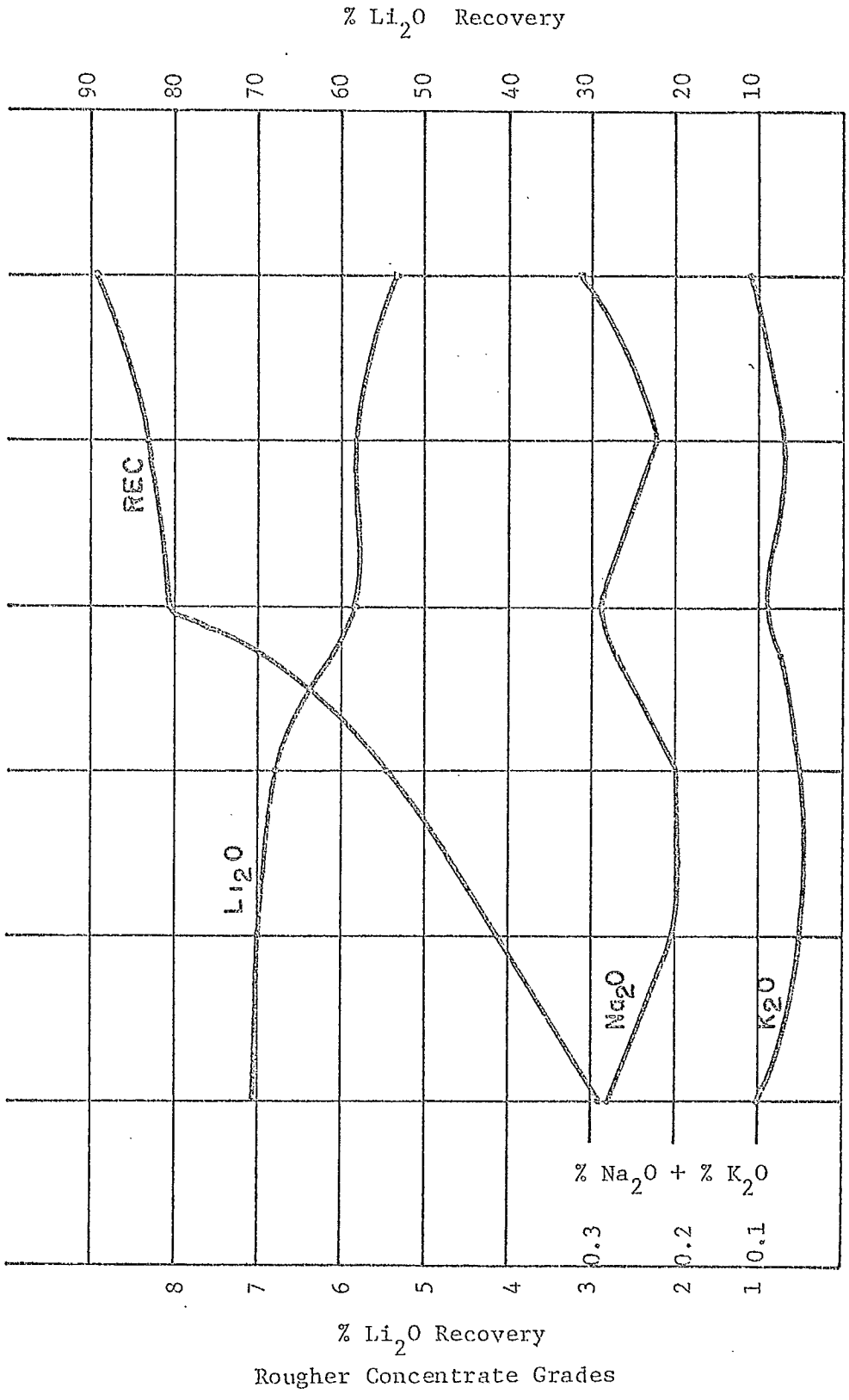
MINES BRANCH FLOTATION TEST REPORT

TEST NO 115-10	SAMPLE: SPODUMENE (Tanco, Bernic Lake, Manitoba) MPD 73/12	DATE: 24 July 1973
OBJECT OF TEST: AS 115-3	AS 115-2	CHARGE: 6813
		TESTED BY: P.R.L.

OPERATION	Time min	% Solids	pH	Unit used	Reagents, lb per ton									
					L-10	(Ottawa June 12/73)					ferrous sulphate			
ROUGHER Float 1	4.0	20			0.4						2.0			
2	4.0				0.4									
3	3.0				0.4									
4	2.0				–									
Total	13.0				1.2									
CLEANING Float 1	4.0				–									
2	3.5				–									
Total	7.5													

PRODUCT	WT %	% Li_2O		% Na_2O		% K_2O		% Fe_2O_3		% P_2O_5		%	
		Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.	Assay	Dist.
Cleaning 2 float	10.0	2.53	5.30	1.32	23.72	2.84	64.35	0.43	31.49	–	–		
Cleaning 2 conc.	3.9	2.56	2.09	1.79	12.54	0.78	6.89	0.23	6.57	–	–		
Cleaning 1 conc.	5.4	2.58	2.92	1.69	16.40	0.62	7.59	0.21	8.31	–	–		
Rougher float 4	1.2	2.05	0.51	1.42	3.06	0.50	1.36	0.14	1.23	–	–		
+150 Rougher conc.	–	5.53	–	0.18	–	0.09	–	0.03	–	–	–		
-150 Rougher conc.	–	4.79	–	0.49	–	0.14	–	0.08	–	–	–		
Rougher conc.	79.5	5.35	89.17	0.31	44.28	0.11	19.81	0.09	52.40	–	–		
Heads (Calc'd)	100.0	4.77	100.00	0.55	100.00	0.44	100.00	0.13	100.00				

REMARKS:



#/T Ferrous Sulphate	0.0	0.1	0.5	1.0	1.5	2.0
ppm Fe	0.0	2.4	12.0	24.0	36.0	48.0
Test	115-2	115-3	115-5	115-4	115-9	115-10
Time (Min.)	8	10	11	13	13	13
RRougher Concentrate	92	90	82	54	59	54
ratio of +150/-150 mesh.	8	10	18	46	41	46

Figure 4: Concentrate Grades and Li_2O Recovery Versus Amount of Ferrous Sulphate.