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Ottawa, Ont.

REPORT
of the
ORE DRESSING AND METALLURGICAL LABORATORIES

The re-concentration of low grade graphite concentrates from Buckingham, Quebec.

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Shipments: The Crucible Graphite Co. Ltd., Buckingham, Que. sent in two shipments, the first was received March 19, 1926 and consisted of 10 bags, shipping weight 1000 lbs. Five of these bags were marked PX and five P12. The second shipment was received May 6, 1926 and consisted of 20 bags of PX, shipping weight 2000 lbs.

Purpose of tests: The purpose of the test work was to determine an economical method of raising the grade of the concentrates so that they could be marketed more profitably.

Characteristics of the low grade concentrates: The concentrates were produced in the mill of the Crucible Graphite Co. PX is the fines obtained when the dried flotation concentrate is screened on 150 mesh, and P12 the fines produced in bringing up the grade of the No. 2 flake by means of burr mill and screen. Both lots appeared to carry a lot of gangue and were very gritty when tested out by smoothing them under a spatula. A grab sample of PX was 85.6% -200 mesh, and of P12 was 86.8% -200 mesh

Sampling & Analysis: A sample was not taken of either of the full lots, but grab samples and samples of the feed to different tests were taken with the following results:

Lot PX	Grab sample	29.02%	carbon
	One bag, feed to tests 1, 2, & 4	29.60%	"
	1200 lbs. feed to test 5	19.83%	"
Lot P12	Grab sample	45.86%	"
	One bag, feed to test 5	29.52%	"

It will be seen from the above that the graphite content of these

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concentrates varies from bag to bag.

Tests with Gayco Air Separator: These tests were made to see what effect a Gayco separator would have in bringing up the grade of the concentrates and in removing grit and sand. A 30" machine was used in all tests

Lot P12, Test 1 About 100 lbs. were put through the Gayco, the speed of the machine being 687 rpm -

Fines obtained	54 lbs.	40.98% C	92.6%	-200 mesh
Oversize "	43 "	55.30% C	67.8%	-200 mesh

Lot P12, Test 4 Another test similar to test 1 was made, the speed of the Gayco being 624 rpm. The fines were re-run twice. Feed 90 lbs.

Fines obtained	49½ lbs.	39.28% C	96.0%	-200 mesh
Oversize "	37½ "	37.90% C	81.8%	"
Fines 1st. re-run	15½ "	36.30% C	93.2%	"
O'size "	21 "	35.00% C	81.2%	"
Fines 2nd "	6 "	36.00% C	85.8%	"
O'size "	14½ "	38.30% C	61.2%	"
Clean up	2 "			

Lot PX, Test 1 A test using the 30" Gayco was made on lot PX, the speed of the separator being 624 rpm, and the fines re-run twice

Feed	88½ lbs.	29.60% C	83.6%	-200 mesh
Fines obtained	39 "	35.20% C	94.6%	"
Oversize "	46 "	22.74% C	73.2%	"
Fines 1st. re-run	13 "	30.36% C	88.8%	"
O'size "	32 "	22.82% C	68.8%	"
Fines 2nd.	6 "	26.48% C	89.2%	"
O'size "	25 "	19.30% C	66.6%	"
Clean up	1½ "			

Summary of Gayco Tests: The three tests made demonstrates that the Gayco separator raises the grade a slight amount, and produces a finer product. When the Gayco products are tested by smoothing under a spatula, it is found that the fines of the first pass contain very little grit, the fines of the re-runs a fair amount, and the oversize products a good deal. The appearances of the products are all about the same. The fines are not very black in colour, and hence appear to carry a good deal of impurities.

Conclusions from Gayco Tests: The Gayco, or any similar separator, would be an unsuitable machine to raise the grade of these concentrates.

Small Scale Flotation Tests

Lot P12, Test 3 A lot of 100 grams of P12 was ground for 15 minutes with steel balls in a small porcelain jar with 0.25 cc coal oil and 0.1 cc pine oil. The ground charge was then floated in a small Ruth machine, the concentrates being cleaned. Results -

<u>Product</u>	<u>Weight gms</u>	<u>% carbon</u>	<u>Gms carbon</u>	<u>% of values</u>
Concentrate	42.0	85.64	35.97	95.14
Middling	6.0	17.21	1.03	2.72
Tailing	51.4	1.57	0.81	2.14
Feed	99.4	38.04	37.81	100

Lot P12, Test 6: A lot of 100 grams of P12 was ground for 1 minute with pebbles in a small porcelain jar mill with 0.25 cc coal oil and 0.1 cc pine oil. The ground charge was floated in a small Ruth machine, the concentrates being cleaned. Results -

<u>Product</u>	<u>Weight gms</u>	<u>% carbon</u>	<u>Gms carbon</u>	<u>% of values</u>
Concentrate	40.9	80.37	32.87	83.79
Middling	10.0	31.95	3.19	8.13
Tailing	48.0	6.60	3.17	8.08
Feed	98.9	39.67	39.23	100

Lot PX, test 2 A lot of 100 grams of PX was ground for 15 minutes with steel balls in a small porcelain jar with 0.25 cc coal oil and 0.1 cc pine oil. The ground charge was floated in a small Ruth machine, the concentrates being cleaned. Results -

<u>Product</u>	<u>Weight gms</u>	<u>% carbon</u>	<u>Gms carbon</u>	<u>% of values</u>
Concentrate	28.9	86.02	24.86	85.26
Middling	7.4	49.86	3.69	12.65
Tailing	64.4	0.95	0.61	2.09
Feed	100.7	28.96	29.16	100

A screen test on the concentrate shows it to be 95.42% -200 mesh

Lot PX, Test 4 A lot of 100 grams of PX was ground for 1 minute with pebbles in a small porcelain jar mill with 0.25 cc coal oil and 0.1 cc pine oil. The ground charge was floated in a small Ruth machine, the concentrates being cleaned. Results -

<u>Product</u>	<u>Weight gms</u>	<u>% carbon</u>	<u>Gms carbon</u>	<u>% of values</u>
Concentrate	32.4	68.18	22.09	80.68
Middling	11.2	11.81	1.32	4.82
Tailing	54.3	7.32	3.97	14.50
Feed	97.9	27.97	27.38	100

Summary of small scale Flotation tests Tests tests show that excellent results can be obtained by flotation, and that the longer the charge is ground before flotation the higher the grade of concentrate and the greater the recovery.

Medium Scale Flotation Tests

Lot P12, test 5 This test was made on a small continuous unit consisting of feeder, ball mill, rougher and cleaner cells. This unit was manufactured by the General Engineering Company and as supplied to us had a feeder, ballmill, classifier and rougher cell. For thks test work the classifier was not used, and an extra cell for cleaning added.

Both cells are of the Callow type. This test was divided into two parts; the feed in the first part being 16 lbs/hour, and in the second part $7\frac{1}{2}$ lbs/hour. Small amounts of coal oil and pine oil were fed during both parts of the test, the coal oil to the ball mill and the pine oil to the rougher cell. Results of first part -

<u>Product</u>	<u>Weight lbs.</u>	<u>% Carbon</u>	<u>Lbs. carbon</u>	<u>% of values</u>
Concentrate	4.5	59.70	2.69	86.77
Tailing	4.5	9.05	0.41	15.23
Feed	9.0	34.44	3.10	100

Results of the second part -

Concentrate	45.0	47.28	21.28	94.91
Tailing	31.5	3.61	1.14	5.09
Feed	76.5	29.31	22.42	100

Lot PX, Test 3 This test was conducted in a similar manner to the second part of test 5 on P12. The rate of feed was 16 lbs/hour. Results-

<u>Product</u>	<u>Weight lbs.</u>	<u>% carbon</u>	<u>lbs. carbon</u>	<u>% of values</u>
Concentrate	37.5	56.80	21.30	97.35
Tailing	43.0	1.36	0.58	2.65
Feed	80.5	27.18	21.88	100

Summary of medium scale tests: These two medium scale tests give lower grade concentrates than any of the small scale tests. This was due to the small size of the mill. The feed passed through the mill without being ground at all and judging by the appearance of the mill discharge, without being thoroughly mixed. For this reason these tests are not to be considered as giving accurate results, however, they do show that without grinding and with poor mixing, a fair concentrate and recovery can be made by flotation on both P12 and PX. These medium scale tests indicate that the pneumatic type of flotation machine can be used for this material as well as the mechanical type.

Large Scale Tests

Lot PX, test 5 In this test 150 pounds per hour of PX was fed to a $4\frac{1}{2}' \times 16''$ Hardinge mill along with 450 pounds of water per hour and a small amount of coal oil. This gives a ratio of three of water to one of solids. The mill carried a ball load of 4,500 pounds. The ground mill discharge was pumped to an 8-cell Greenawalt flotation unit, each cell being $12'' \times 12''$. Extra water was added at the pump at the rate of 1085 pounds per hour, giving a dilution in the first flotation cell of 10.25 to 1. A little pine oil was added to the feed of the first cell. The froth from the last six cells was returned to the feed of the first cell. The concentrate was re-run twice through the Greenawalt to clean it.

A little pine oil was used during each run to give a froth. Results -

<u>Product</u>	<u>Weight lbs.</u>	<u>% carbon</u>	<u>Lbs.carbon</u>	<u>% values</u>
Concentrate	208.0	81.14	168.77	88.77
1st. tailing	752.5	0.85	6.40	3.37
2nd. tailing	29.0	20.43	5.92	3.11
3rd. tailing	20.0	45.20	9.04	4.75
<u>Feed</u>	<u>1009.5</u>	<u>18.82</u>	<u>190.13</u>	<u>100</u>

The following table shows the recovery and grade of concentrate obtained in the above test after each pass through the Greenawalt.

<u>Product</u>	<u>% carbon</u>	<u>% of values</u>
1st. conc. obtained	71.49	96.63
2nd. " "	77.99	93.52
3rd. " "	81.14	88.77

Screen tests show the third concentrate to be 85.6% -200 mesh, and the first tailing 99.60% -200 mesh

Lot PX, test 6 A lot of 400 pounds of PX was ground for 2 hours in a 4 $\frac{1}{2}$ ' x 16" Hardinge mill with 285 pounds of water and 4000 pounds balls. The ground charge was flushed from the mill with 960 pounds water per hour to a pump where 1125 pounds of water per hour was added. The pump elevated the diluted mill discharge to the Greenawalt machine. The pulp was in the Greenawalt, a small amount of pine oil being added to the feed. The froth from the last six cells was returned to the feed of the first cell. The running time was three hours. This gives a calculated dilution of 15.5 to 1 in the feed to the first cell. The concentrate obtained was re-run twice through the same flotation machine to clean it, a little pine oil being used during each run. Results -

<u>Product</u>	<u>Weight lbs.</u>	<u>% carbon</u>	<u>Lbs.carbon</u>	<u>% values</u>
Concentrate	59.0	80.80	47.67	77.60
1st. tailing	309.5	2.51	7.77	12.64
2nd. tailing	17.5	9.95	1.74	2.83
3rd. tailing	14.0	30.42	4.26	6.93
<u>Feed</u>	<u>400.0</u>	<u>15.36</u>	<u>61.44</u>	<u>100</u>

The following table shows the recovery and grade of concentrate after each pass through the Greenawalt -

<u>Product</u>	<u>% carbon</u>	<u>% of values</u>
1st. conc. obtained	80.80	77.60
2nd. " "	71.14	84.53
3rd. " "	59.30	87.36

Screen test shows the third concentrate to be 93.1% -200 mesh and the first tailing to be 98.9% -200 mesh

Summary of Large Scale Tests: Both these tests show excellent results and prove that lot PX can be treated in a large scale by flotation. Continuous grinding gave the best results, but this may have been due

to the fact that no coal oil was used in the charge grinding. In theory, charge grinding should give as good, or better, results than continuous grinding on this kind of material, other conditions being the same. The more the ground graphite is floated the higher the grade of the resulting concentrate and the lower the recovery.

Recommendations: It is advised that the Crucible Graphite Co. install a fine wet screen, 80, 100, or 150 mesh, to treat their flotation concentrates, the plus going to the dryer and then to the refinery, and the minus to a thickener and then to a continuous ball mill. The discharge of the mill would be floated, the tailing going to the dump and the concentrate to a dryer. The P12 from the refinery would be fed to the ball mill and thus ground and floated with the fines from the screen.

No recommendation is made as to the fineness of grinding, or the amount of floating to be done, as this would depend on what grade of concentrate could be readily sold.