O T T A W A December 10th, 1940.

INTERIM REPORT

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ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 936.

Investigation on the Concentration of Magnesitic Rock from the Canadian Refractories Limited, Kilmar, Quebec.

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Shipment:

A car-lot of magnesitic crude rock was received on October 21st, 1940. The shipment was submitted by N. P. Pitt, Managing Director, Canadian Refractories Limited, Canada Cement Building, Phillips Square, Montreal, Quebec.

The shipment consisted of 15 tons of "Magnifrit" crude rock and 15 tons of "Basifrit" crude rock. These rocks were taken from respective rock piles at Kilmar, Quebec.

Characteristics of the Crude Rock:

The rock consisted of magnesite, dolomite, serpentine, and other silicate minerals. Magnesite is the most abundant.

Sampling and Analysis:

Sampling and analyses of the above rocks were carried out by the Canadian Refractories laboratory. The samples are 'grabs' from the bags as loaded and may not be strictly representative. The analyses were as follows:

	Magnifrit	Basifrit
Insoluble, per cent	- 4.1	4.9
R_2O_3, "	- 0.6	0.9
CaO, "	- 10.7	11.6
Ignition loss, per cent	- 45.9	45.3

Results of Investigations:

The results of the investigations showed that the magnesite can be recovered by flotation after desliming the flotation feed.

The mill discharge pulp showed appreciable flocculation of the fines. This may account for the poor flotation separation in Mill Run No. 1, in which run the flotation feed was not deslimed. In Mill Run No. 2, the cone classifier did not deslime the pulp sufficiently.

After desliming the flotation feed by means of a rake classifier, a flotation separation could be made. The slimes discharged to waste were around 20 per cent of the feed.

Returning the tailings from the cleaner circuits to the head of the rougher circuit had no adverse effect on flotation. (Mill Runs Nos. 6, 7, 8, 9, and 10).

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(Results of Investigations, cont'd) -

Concentrates obtained were 29.3 and 46.1 per cent of the flotation feed (23.2 and 36.0 per cent of the ball mill feed) and analysed 1.69 and 2.28 per cent CaO, respectively. (Mill Runs Nos. 8 and 10).

Desliming the rock, crushed to ¼ inch, prior to grinding, resulted in poor differential separation in the rougher circuit. This may be due to the slimes; also, the flotation feed was slightly flocculated. (Mill Runs Nos. 11, 12, and 13).

Warm water in the flotation circuits resulted in marked improvement in the recovery.

Investigative Work:

Mill Run No. 1.

The Magnifrit rock crushed to ½ inch was fed to the ball mill at the rate of 490 pounds per hour. The ball mill discharge passed over a 40-mesh "Hummer" screen in closed circuit with the ball mill. The undersize passed to the conditioning tank and then to the rougher flotation circuit. The rougher concentrate was cleaned in the "first" cleaner circuit; the concentrates from the latter circuit were cleaned in the "second" cleaner circuit. The concentrates from the "second" cleaner circuit were cleaned in the "third" cleaner circuit, which gave a final concentrate. The tailings from the cleaner circuits were discharged to waste in this run.

Soda ash and quebracho were added to the ball mill. Frother B-25 and oleic acid were added to the rougher circuit. Quebracho and oleic acid were added to

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(Mill Run No. 1, cont'd) -

the cleaner circuits.

The results of this run were not satisfactory. The ball mill discharge pulp was flocculated. This may account for poor separation.

Mill Run No. 2.

This run was similar to Mill Run No. 1 with the exception that the screen undersize passed to a cone classifier. The cone classifier overflow went to waste and the underflow passed to the conditioning tank, thence to flotation circuits. Sodium silicate was used in place of soda ash.

The results were not satisfactory.

Mill Run No. 3.

The flow-sheet of this run was similar to that of Mill Run No. 2 except that the cone classifier was replaced by a rake classifier. Soda ash was used in place of sodium silicate. The temperature of the pulp in the rougher circuit was around 55° F.

The results of this run were encouraging; a concentrate was obtained which assayed 2.60 per cent CaO and 0.48 per cent insoluble.

Mill Runs Nos. 4 and 5.

The Magnifrit rock was fed to the ball mill at a rate of 480 pounds per hour. The ball load in the mill was around 600 pounds. The ball mill discharge passed over a 50-mesh Hummer screen in closed circuit with the ball mill. The screen undersize was pumped to the rake classifier. The overflow from the classifier went to waste. The sands passed to the conditioning tank and thence to the flotation circuits. The tailings from all the circuits went to waste.

Warm water was used in the flotation circuit; the temperature of the pulp in the rougher circuit was around 70° F. and in the cleaner circuits was around 80° F.

The pulp density of the ball mill discharge was around 68 per cent solids and the flotation feed about 33 per cent solids. The flotation feed pulp appeared to be dispersed.

Reagents		Lb./ton of flot. feed	
		Mill Run No. 4.	Mill Run No. 5.
To conditioning tank:			
Soda ash	-	3.0	3.1
Quebracho	-	3.3	3.3
To rougher circuit:			
Frother B-25 (added to Cell 1)	-	0.154	0.154
Oleic (added to Cells 1,2,3, and 5)	-	1.10	1.06
To 1st cleaner circuit:			
Quebracho	-	0.14	0.21
Oleic (to Cell 3)	-	0.044	0.044
To 2nd cleaner circuit:			
Quebracho	-	0.17	0.21
Oleic (to Cell 1)	-	0.044	0.022
To 3rd cleaner circuit:			
Quebracho	-	0.05	0.06

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(Mill Runs Nos. 4 and 5, cont'd) -

Results:

Mill Run No.	Products	Weight, per cent	CaO analysis, per cent	Distribution of CaO, per cent	Insoluble, per cent
4.	Ball mill feed	100.0	10.79	100.0	
	Class. slime	19.8	11.92	21.9	
	Class. sand (flot. feed)	80.2	10.51	78.1	
	Flot. conc.	32.5	2.93	8.8	0.42
	Rougher tailing	26.7	18.02	44.6	8.84
	Cleaner tailings	21.0	12.60	24.7	
5.	Ball mill feed	100.0	11.16	100.0	
	Class. slime	19.8	12.25	21.7	
	Class. sand (flot. feed)	80.2	10.89	78.3	
	Flot. conc.	34.5	3.14	9.7	
	Rougher tailing	23.3	17.99	37.3	
	Cleaner tailings	22.4	15.45	31.3	

The rougher concentrates analysed 6.72 per cent CaO in Mill Run No. 4 and 18.02 per cent CaO in Mill Run No. 5.

	Mill Run No. 4.	Mill Run No. 5.
Ratio of concentration (based on flotation feed) -	2.47:1.	2.33:1.
Concentrates, per cent of flotation feed -	40.5	43.0

Screen tests on the flotation feed were as follows:

Mesh	Mill Run No. 4 (Weight, per cent)	Mill Run No. 5 (Weight, per cent)
+65	10.0	12.9
-65 +100	20.3	22.2
-100 +150	20.7	19.7
-150 +200	13.2	12.1
-200	35.8	33.1
Total	100.0	100.0

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(Mill Runs Nos. 4 and 5, cont'd) -

The pH determinations of the pulps in the flotation circuits of Mill Run No. 4 were as follows:

Rougher circuit	10.2
1st cleaner circuit	10.1
2nd " "	9.9
3rd " "	9.3

Mill Runs Nos. 6, 7, 8, 9, and 10.

The flow-sheets of these runs were similar to that of Mill Run No. 4, with the exception that the tailings from the cleaner circuits were pumped to a cone classifier, the overflow went to waste, and the discharge was returned to a conditioning tank at the head of the rougher circuit.

The flotation feed pulp showed no flocculation.

Reagents: (Lb./ton of Flotation Feed)

	Mill Run No.				
	6	7	8	9	10
To conditioning tank:					
Soda ash	3.1	3.1	2.0	2.0	2.0
Quebracho	3.3	3.3	3.3	2.56	2.95
To rougher circuit:					
Frother B-25 (added to 1st cell)	0.176	0.156	0.156	0.156	0.156
Oleic (added to Cells 1, 2, 3, and 5)	1.15	1.14	1.16	1.23	1.23
To 1st cleaner circuit:					
Quebracho	0.22	0.27	0.28	0.27	0.27
Oleic (to Cell 3)	0.044			0.022	0.022
To 2nd cleaner circuit:					
Quebracho	0.21	0.28	0.26	0.26	0.27
Oleic			0.022	0.022	0.022
To 3rd cleaner circuit:					
Quebracho	0.06	0.13	0.14	0.14	0.14

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(Mill Runs Nos. 6, 7, 8, 9, and 10, cont'd) -

Results:

Mill Run No.	Products	Weight, per cent	CaO analysis, per cent	Distribution of CaO, per cent	Insoluble, per cent
6.	Ball mill feed	100.0	10.82	100.0	
	Class. slime	19.8	12.25	22.4	
	Class. sands (flot. feed)	80.2	10.46	77.6	
	Flot. conc.	36.0	3.31	11.0	0.30
	Rougher tailing	40.2	16.59	61.7	6.06
	Cone overflow	4.0	13.28	4.9	
7.	Ball mill feed	100.0	11.29	100.0	
	Class. slime	20.8	12.22	22.4	
	Class. sands (flot. feed)	79.2	11.06	77.6	
	Flot. conc.	20.7	1.49	2.7	0.36
	Rougher tailing	57.7	14.55	74.3	4.86
	Cone overflow	0.8	8.35	0.6	
8.	Ball mill feed	100.0	11.03	100.0	
	Class. slime	20.8	12.17	22.9	
	Class. sands (flot. feed)	79.2	10.73	77.1	
	Flot. conc.	23.2	1.68	3.5	0.50
	Rougher tailing	55.2	14.58	73.1	4.52
	Cone overflow	0.8	7.10	0.5	
9.	Ball mill feed	100.0	11.28	100.0	
	Class. slime	20.8	12.09	22.3	
	Class. sands (flot. feed)	79.2	11.06	77.7	
	Flot. conc.	46.0	5.96	24.3	0.94
	Rougher tailing	31.6	18.21	51.1	9.08
	Cone overflow	1.6	16.26	2.3	
10.	Ball mill feed	100.0	10.20	100.0	
	Class. slime	21.9	12.14	26.1	
	Class. sands (flot. feed)	78.1	9.65	73.9	
	Flot. conc.	36.0	2.28	8.1	0.36
	Rougher tailing	40.5	16.12	64.0	5.54
	Cone overflow	1.6	11.17	1.8	

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(Mill Runs Nos. 6, 7, 8, 9, and 10, cont'd) -

	Ratio of Concentration (Based on flot. feed)	Concentrate (Per cent of flot. feed)
Mill Run No. 6	2.23:1.	44.9
" No. 7	3.82:1.	26.2
" No. 8	3.42:1.	29.3
" No. 9	1.72:1.	58.1
" No. 10	2.17:1.	46.1

pH Determinations:

	Rougher Circuit	1st Cleaner	2nd Cleaner	3rd Cleaner
Mill Run No. 7	9.85	9.50	9.45	9.20
" No. 8	9.95	9.65	9.30	9.10
" No. 10	10.00	9.75	9.35	9.35

Mill Runs Nos. 11, 12, and 13.

In the preceding mill runs the classifier overflow, which was discharged to waste, was around 20 per cent of the feed. To decrease the solids in the classifier overflow, the Basifrit rock crushed to minus ¼ inch was fed to the rake classifier. The classifier overflow went to waste, and the discharge was then fed to the ball mill in closed circuit with a 40-mesh Hummer screen. The flotation circuit was the same as in Mill Run No. 6.

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(Mill Runs Nos. 11, 12, and 13, cont'd)

Reagents: (Lb./ton of Flotation Feed)	Mill Run No. 11	Mill Run No. 12	Mill Run No. 13
To conditioning tank:			
Soda ash	1.87	1.70	2.10
Quebracho	3.00	2.90	3.35
To rougher circuit:			
Frother B-25	Nil	Nil	Nil
Oleic	0.88	0.94	1.05
To 1st cleaner circuit:			
Quebracho	0.24	0.23	0.23
Oleic	0.02	Nil	0.02
To 2nd cleaner circuit:			
Quebracho	0.24	0.23	0.24
Oleic	0.02	0.02	0.04
To 3rd cleaner circuit:			
Quebracho	0.13	0.13	0.12

Results:

Mill Run No.	Products	Weight, per cent	CaO analysis, per cent	Distribution of CaO, per cent	Insoluble, per cent
11.	Classifier feed	100.0	12.72	100.0	
	Classifier slime	11.5	13.06	11.8	
	Flot. feed	88.5	12.68	88.2	
	Flot. conc.	14.4	3.14	3.6	0.48
	Rougher tailing	62.6	14.15	69.6	4.32
	Cone overflow	11.5	16.64	15.0	

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(Mill Runs Nos. 11, 12, and 13, cont'd) -

Results, cont'd -

Mill Run No.	Products	Weight, per cent	CaO analysis, per cent	Distribution of CaO, per cent	Insoluble, per cent
12.	Classifier feed	100.0	12.74	100.0	
	Classifier slime	8.3	13.12	8.5	
	Flot. feed	92.7	12.57	91.5	
	Flot. conc.	15.6	2.93	3.6	0.68
	Rougher tailing	63.8	14.20	71.1	5.20
	Cone overflow	13.3	16.10	16.8	4.04
13.	Classifier feed	100.0	13.07	100.0	
	Classifier slime	10.8	13.60	11.2	
	Flot. feed	89.2	13.01	88.8	
	Flot. conc.	15.7	3.77	4.5	
	Rougher tailing	62.7	14.47	69.4	
	Cone overflow	10.8	17.99	14.9	
11.	Rougher conc.		11.27		
12.	Rougher conc.		11.22		
13.	Rougher conc.		11.22		

	Ratio of Concentration (based on flot. feed)	Concentrate. (Per cent of flot. feed)
Mill Run No. 11 -	6.14:1.	16.3
Mill Run No. 12 -	5.94:1.	16.8
Mill Run No. 13 -	5.68:1.	17.6

pH Determinations:

	Rougher Circuit	1st Cleaner	2nd Cleaner	3rd Cleaner
Mill Run No. 12 -	10.1	10.0	9.7	9.4
Mill Run No. 13 -	10.2	10.0	9.7	9.2

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(Mill Runs Nos. 11, 12, and 13, cont'd) -

Screen Test on Flotation Feed,
Mill Run No. 12.

Mesh	Weight, per cent
+ 65 -	11.2
- 65 +100 -	17.2
-100 +150 -	15.0
-150 +200 -	11.3
-200 -	45.3
	100.0

The pulp to the rougher circuit showed some flocculation. The rougher circuit showed very little differential separation.

Conclusions:

The results of the investigations show that the magnesite can be recovered by flotation after desliming the flotation feed.

The rock on which the above mill runs were conducted was taken from the rock piles and had been exposed to surface weathering. Further investigations will be conducted on the rock taken from underground.

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