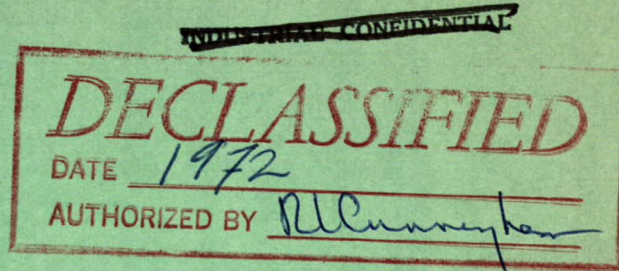


This document was produced
by scanning the original publication.

Ce document est le produit d'une
numérisation par balayage
de la publication originale.



CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

OTTAWA



Mines Branch

Declassified
Déclassifié

Industrial Confidential

CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

OTTAWA

IR 71-2

December 15, 1970

PILOT PLANT CONCENTRATION OF
TALC FROM DELORO TOWNSHIP, ONTARIO
(PROJECT MP-IM-7005)

by

R. A. Wyman

Mineral Processing Division

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.

Declassified
Déclassifié

~~Industrial Confidential~~

Mines Branch Investigation Report IR 71-2
PILOT PLANT CONCENTRATION OF TALC FROM
DELORO TOWNSHIP, ONTARIO (PROJECT MP-IM-7005)

by

R. A. Wyman*

- - -

SUMMARY OF RESULTS

On request from Canadian Magnesite Mines Limited, a process development project for the concentration of the talc content of magnesite ore from Deloro Township, Ontario, was undertaken.

The talc content of this ore is approximately 23%. Pilot-plant flotation operations in a simple circuit produced products containing up to 94% acid insoluble material, mostly talc; a hematite content in these products of approximately 1% was reduced to less than 0.5% by magnetic separation. The best non-magnetic product contained 0.26% Fe_2O_3 and 97% insoluble. The brightness of this product was 85% that of magnesium carbonate; other products were as high as 91% in brightness. The flotation results clearly indicated that further cleaning stages would produce improved products.

*Head, Industrial Minerals Milling Section, Mineral Processing Division, Mines Branch, Department of Energy, Mines and Resources, Ottawa, Canada.

BACKGROUND

During the period 1962 to 1964, the Mineral Processing Division of the Mines Branch carried out laboratory studies (1,2,3) toward the development of a flotation process for the concentration of magnesite from the orebody in Deloro Township, Ontario, controlled by Canadian Magnesite Mines Limited. The process involved flotation of talc as a preliminary step but, at that time, there was no interest in talc as a commercial commodity.

In May, 1970, a request was received to re-open the investigation with a view to recovering the talc as a usable material. It was agreed that talc concentration on a pilot plant scale should be examined and that products should be turned over to the Ceramic Section for assessment as ceramic material.

EXPERIMENTAL STUDIES

Sample

A bulk lot of some 600 pounds of ore from the mine was provided by Canadian Magnesite Mines Limited for this work. The sample consisted of minus 8-inch lumps and represented material to be mined.

The mineral composition of the ore from this deposit as determined during the original investigation⁽¹⁾ is shown below. It is assumed that the present sample conformed substantially to this composition.

| | |
|--|-----------|
| Magnesite, MgCO_3 | 57% |
| Talc, $\text{H}_2\text{O} \cdot 3\text{MgO} \cdot 4\text{SiO}_2$ | 23% |
| Quartz, SiO_2 | 15% |
| Oxides, Sulphides, Chlorite, Calcite | <u>5%</u> |
| | 100% |

Comminution

The whole sample was crushed by a Blake-type jaw crusher set to discharge at about 3/4 inch. The crushed material was screened on a 28-mesh screen, the oversize being further reduced by cone crusher. The screening and cone crushing was continued until the remaining plus 28-mesh fraction did not appear to contain any talc.

Approximately half of the minus 28-mesh was set aside as flotation feed, and the remainder was screened on 50 mesh. The oversize was ground in a porcelain mill with Burundum cylpebs and rescreened. The plus 50-mesh fraction appeared to contain little or no talc. The minus 50-mesh fraction was set aside as flotation feed.

The preparation of feed is summarized in Table 1.

TABLE 1

Preparation of Flotation Feed

| Fraction | Wt % | Description | Feed No. |
|----------|-------------|-------------|----------|
| +28 m | 6.5 | non-talcose | 1 |
| -28 m | <u>93.5</u> | talcose | |
| | 100.0 | | |
| ----- | | | |
| -28+50 m | 18.9 | non-talcose | 2 |
| -50 m | <u>74.6</u> | talcose | |
| | 93.5 | | |

Flotation Circuit

Flotation feed was supplied to the circuit by a Vibra-screw feeder which provides accurate feeding at small inputs. A flowrator was used to meter water to the circuit. Pine oil, the only reagent employed, was supplied by a manually controlled dropper to assure accuracy. The ore, water, and reagent were simultaneously fed into a Denyer conditioner which discharged into the rougher flotation cells. The rougher froth product provided feed for the first cleaner; and cleaner 1 froth provided feed for the second cleaner. The second cleaner froth was collected as talc concentrate. The rougher, first cleaner, and second cleaner tails were collected separately.

Because of the small quantity of cleaner tails produced, they were not recirculated; perhaps in a larger system, recirculation could be incorporated. To produce a higher grade of concentrate, additional cleaning could also be carried out.

The flowsheet for the system is shown in Figure 1.

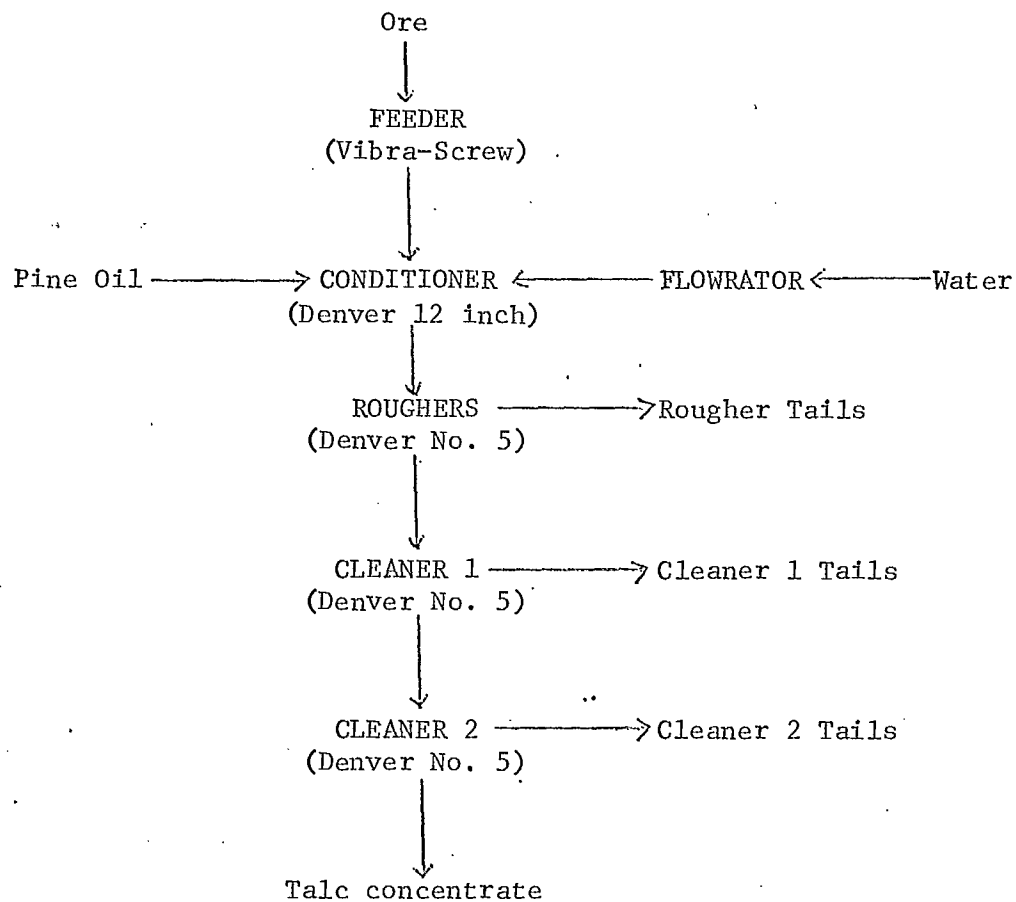


Figure 1: Talc Flotation Flow Diagram

Run No. 1

This operation, with details shown in Table 2, served chiefly to test the system and make observations.

TABLE 2

Run No. 1

| | |
|---|-----------------------|
| Feed Size: | -28 mesh (Feed No. 1) |
| " Rate: | 90 lb/hr |
| Water Input: | 360 lb/hr |
| % Solids: | 20 |
| Pine Oil Input: | 0.16 lb/ton |
| Duration of Run: | 45 minutes |
| <u>Observations:</u> (1) No. 5 cells have no sand relief valves and tended to sand up on this feed. | |
| (2) Thick, heavy, sand-bearing froth from roughers. | |
| (3) No sanding in cleaners. Thick froths. | |

| Results | | | | |
|-----------------|-------|-------------|----------------|------------------------------------|
| Fraction | Wt % | Wt % of Ore | Acid Insol (%) | Fe ₂ O ₃ (%) |
| Rougher tails | 64.2 | 60.0 | 25.72 | 2.50 |
| Cleaner 1 tails | 7.4 | 6.9 | 39.82 | 2.66 |
| Cleaner 2 tails | 3.5 | 3.3 | 74.93 | 1.64 |
| Concentrate | 24.9 | 23.3 | 84.96 | 1.42 |
| Combined | 100.0 | 93.5 | 42.80 | 2.20 |
| Recovery (%)* | | | 81.2 | |

*Assuming 23% talc in original ore, and 5% non-talc in insoluble.

Run No. 2

Run No. 1 demonstrated that the circuit would produce a talc concentrate. However, the tendency for roughers to sand up or become blocked with coarse material, which could not be moved easily from one cell to the next, required correcting. Also, too much coarse magnesite and quartz were carried over in the rougher froth in Run No. 1.

In Run No. 2, the feed rate was reduced in an effort to reduce sanding and the pine oil input was lowered slightly in order to reduce carry-over of sand with the froth.

Particulars pertaining to Run No. 2 are given in Table 3. The flotation concentrate was later treated by high-intensity wet-magnetic separation. The equipment used, a Jones separator, produces a middling as well as the magnetic and non-magnetic fractions. Although the amount of concentrate was too small to allow recirculation of middlings, the middlings were retreated to simulate recirculation and produce a higher yield of non-magnetic product. High-intensity or maximum-extraction plates were used at maximum field strength. The pulp fed to the separator was approximately 25% solids.

TABLE 3

Run No. 2

| | |
|----------------------|-----------------------|
| Feed Size: | -28 mesh (Feed No. 1) |
| " Rate: | 60 lb/hr |
| Water Input: | 240 lb/hr |
| % Solids: | 20 |
| Pine Oil Input: | 0.15 lb/ton |
| Duration of Run: | 60 minutes |
| Magnetic Separation: | 25 amps |

Observations: (1) Tendency for roughers to sand.
(2) Carry-over of sand in rougher froth.
(3) No sanding in cleaners. Dark mineral in froths.

| <u>Results</u> | | | | |
|-----------------|-------|----------------|-------------------|---------------------------------------|
| Fraction | Wt % | Wt % of Ore | Acid Insol (%) | Fe ₂ O ₃ (%) |
| Rougher tails | 73.8 | 69.0 | 25.85 | 2.74 |
| Cleaner 1 tails | 5.0 | 4.7 | 57.97 | 2.15 |
| Cleaner 2 tails | 4.8 | 4.5 | 88.55 | 1.26 |
| Concentrate | 16.4 | 15.3 | 94.27 | 0.81 |
| Combined | 100.0 | 93.5 | 41.41 | 2.33 |
| Magnetics | 0.8 | 0.8 | 53.40 | 7.25 |
| Non-magnetics | 15.6 | 14.5 | 96.23 | 0.48 |
| Combined | 16.4 | 15.3 | 94.27 | 0.81 |
| Recovery (%)* | | | 60.6 | |

* Assuming 23% talc in ore, and 0.2% non-talc in insoluble.

Run No. 3

Run No. 2 produced a much improved concentrate, but with a sharp drop in recovery. In addition to magnesite, the concentrate was found to have a few particles of quartz. A third cleaning stage would improve the quality, and recirculation of cleaner tails would improve the yield.

The 25% insoluble for rougher tails in both Run No. 1 and Run No. 2 suggests unliberated talc because the ore is estimated to contain 15% quartz and 1 or 2% other insolubles. Although talc in rougher tails was not apparent to the eye, the possibility of losses at this point together with the tendency for roughers to sand indicated that a reduction in feed size was necessary. For Run No. 3, therefore, Feed No. 2 (minus 50-mesh) was employed. Feed rate and pulp density (% solids) were maintained at the same levels as in Run No. 2, but reagent input was reduced to see if grade would improve. Magnetic separation with simulated recirculation of middlings was applied to the flotation concentrate.

The particulars for Run No. 3 are given in Table 4.

TABLE 4

Run No. 3

| | |
|---------------------|-----------------------|
| Feed Size | -50 mesh (Feed No. 2) |
| " Rate | 60 lb/hr |
| Water Input | 240 lb/hr |
| % Solids | 20 |
| Pine Oil Input | 0.123 lb/ton |
| Duration of Run | 60 minutes |
| Magnetic Separation | 25 amps |

Observations: (1) No sanding of roughers.
(2) Froth less dense and easily moved to next stage.
(3) Dark mineral and sand observable in concentrate.

| Results | | | | |
|-----------------|-------|-------------|----------------|------------------------------------|
| Fraction | Wt % | Wt % of Ore | Acid Insol (%) | Fe ₂ O ₃ (%) |
| Rougher tails | 66.3 | 49.5 | 16.49 | 2.87 |
| Cleaner 1 tails | 4.4 | 3.3 | 53.72 | 2.60 |
| Cleaner 2 tails | 4.1 | 3.1 | 83.17 | 1.51 |
| Concentrate | 25.2 | 18.8 | 85.90 | 1.03 |
| Combined | 100.0 | 74.6 | 39.18 | 2.33 |
| Magnetics | 1.6 | 1.2 | 48.28 | 8.64 |
| Midds** | 3.7 | 2.7 | 72.08 | 0.96 |
| Non-magnetics | 19.9 | 14.9 | 95.42 | 0.51 |
| Combined | 25.2 | 18.8 | 85.90 | 1.03 |
| Recovery (%)* | | | 61.8 | |

* Assuming 23% talc in ore, and 0.3% non-talc in insoluble.

** Not further treated by magnetic separation.

Run No. 4

Run No. 3 displayed a considerable improvement in physical performance, and produced a slight recovery increase without a grade improvement. The final froth, Cleaner 3, was dense enough to support some non-talc material. While an additional cleaning stage would improve the product quality, it was decided to see if reducing reagent input still further and reducing pulp density in the flotation cells would be beneficial. Accordingly, these variations were incorporated in Run No. 4. A longer running time was used to obtain a larger bulk of product. The product was cleaned by magnetic separation as in Runs No. 2 and 3.

Particulars are given in Table 5.

TABLE 5

Run No. 4

| | |
|---------------------|-----------------------|
| Feed Size | -50 mesh (Feed No. 2) |
| " Rate | 60 lb/hr |
| Water Input | 300 lb/hr |
| % Solids | 16.5 |
| Pine Oil Input | 0.10 lb/ton |
| Duration of Run | 120 minutes |
| Magnetic Separation | 25 amps |

Observations: (1) Good balance. Smooth and regular performance.
(2) No sanding.
(3) Froths thinner; less non-talc included.

| <u>Results</u> | | | | |
|-----------------|-------|----------------|-------------------|---------------------------------------|
| Fraction | Wt % | Wt % of Ore | Acid Insol (%) | Fe ₂ O ₃ (%) |
| Rougher tails | 68.7 | 51.3 | 14.73 | 2.70 |
| Cleaner 1 tails | 4.9 | 3.6 | 56.23 | 2.09 |
| Cleaner 2 tails | 1.6 | 1.2 | 84.33 | 1.39 |
| Concentrate | 24.8 | 18.5 | 93.79 | 0.55 |
| Combined | 100.0 | 74.6 | 37.47 | 2.07 |
| Magnetics | 1.3 | 0.9 | 55.30 | 5.53 |
| Midds** | 2.3 | 1.7 | 85.60 | 0.53 |
| Non-magnetics | 21.2 | 15.9 | 96.90 | 0.26 |
| Combined | 24.8 | 18.5 | 93.79 | 0.55 |
| Recovery (%)* | | | 66.8 | |

* Assuming 23% talc in ore, and 0.2% non-talc in insoluble.

** Not further treated by magnetic separation.

DISCUSSION

Upgrading from one flotation stage to the next is clearly demonstrated in each of the runs performed. Run No. 4 perhaps exemplifies this best; the lower pulp density and reagent input resulted in better recovery and grade than was realized in Runs No. 2 and 3.

The increased insoluble content of product after magnetic separation suggests that some magnesite has been removed. This is possible because magnesite contains a little iron, and the grains are also sometimes coated with iron oxide.

The experimental work indicates the feed should be at least minus 28 mesh with flotation taking place at a comparatively low pulp density, around 15% solids, and that reagent input should not be above 0.1 pound per ton. It would probably be advantageous to include one or even two more cleaning steps to improve grade. The low volume of tailings from each cleaner suggests combining and thickening with recirculation back to the rougher cells.

This is a rather simple and easily manageable flotation system and it is sufficiently effective for a low-cost operation. Considering that the runs were of short duration and included both starting and stopping periods, the efficiency displayed was excellent. However, recovery figures must be accepted as estimates only since no assessment of free-silica distribution was attempted.

Densicron brightness readings were made to measure the whiteness of products from Runs 2, 3, and 4, ground to pass a 325-mesh screen (Table 6). The material from Run No. 4, with highest insoluble and lowest iron, gave the lowest brightness readings, while that from Run No. 3, with lowest insoluble and highest iron content, gave the highest brightness readings. This unusual behaviour could not be explained but it should not detract from the effectiveness of the concentration method.

TABLE 6

Talc Concentrates

| Run No. | 1 | 2 | 3 | 4 |
|----------------------------------|------|------|------|------|
| Flotation Concentrate | | | | |
| Weight % | 24.9 | 16.4 | 25.2 | 24.8 |
| " % of ore | 23.3 | 15.3 | 18.8 | 18.5 |
| % Insoluble | 85.0 | 94.3 | 85.9 | 93.8 |
| % Fe ₂ O ₃ | 1.42 | 0.81 | 1.03 | 0.55 |
| % Recovery* | 81 | 63 | 70 | 75 |
| Non-Magnetic Concentrate | | | | |
| Weight % | - | 15.6 | 19.9 | 21.2 |
| " % of ore | - | 14.5 | 14.9 | 15.9 |
| % Insoluble | - | 96.2 | 95.4 | 96.9 |
| % Fe ₂ O ₃ | - | 0.48 | 0.51 | 0.26 |
| % Brightness | - | 87 | 91 | 85 |
| % Recovery* | - | 61 | 62 | 67 |

* Approximate

CONCLUSIONS

1. A simple flotation circuit involving a conditioner, rougher cells, and two or more cleaning stages would serve in concentrating talc from the ore treated. Pulp dilution should be approximately 15% solids, and reagent input (pine oil only) should not exceed 0.1 pound per ton.
2. Grinding feed to minus 50 mesh may enhance recovery and liberate iron.
3. Magnetic separation is effective in removing both iron oxide and some magnesite from the talc flotation concentrates.

REFERENCES

- (1) F. H. Hartman, "Concentration of Magnesite from Deloro Township, Ontario, Progress Report No. 1", Mines Branch, Mineral Processing Division, Internal Report MPI 63-61, Dept. of Energy, Mines and Resources, Ottawa (1963).
- (2) F. H. Hartman and R.A. Wyman, "Concentration of Magnesite from Deloro Township, Ontario, Progress Report No. 2: Pilot Plant Operations", Mines Branch Investigation Report IR 64-90, Dept. of Energy, Mines and Resources, Ottawa (1964).
- (3) F. H. Hartman, "Concentration of Magnesite from Deloro Township, Ontario, Progress Report No. 3", Mines Branch Investigation Report IR 64-104, Dept. of Energy, Mines and Resources, Ottawa (1964).