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DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 64-104

CONCENTRATION OF MAGNESITE FROM DELORO TOWNSHIP, ONTARIO, PROGRESS REPORT NO. 3 (PROJECT MP-IM-6222)

by

F. H. HARTMAN

MINERAL PROCESSING DIVISION

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COPY NO. 6

NOVEMBER 26, 1964

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SUMMARY OF RESULTS

A number of flotation reagents to float talc, silica and iron-bearing minerals from magnesite were compared. None showed marked improvement over those previously used i. e., pine oil to float talc, and Armac T plus Aerofroth 73 to remove silica and iron (See Progress Reports No. 1 and No. 2).

The collector aid Ethomeen 18/60 produced significant results when used with Duomac T. It is also reported to be specific with Armac C, but as this reagent is more expensive it was not tested.

The use of starch as a depressant does not appear to be particularly beneficial. Ultraflotation, as tried, shows no promise of improving grade or recovery.

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INTRODUCTION

Previous work, described in Progress Reports No. 1 and No. 2, had produced a magnesite concentrate, low in silica and containing a minimal amount of iron. Most of the tests had been done with one combination of reagents that, after preliminary work, appeared to give good results.

The suitability of a number of other reagents for this problem was checked. The possibility of ultraflotation was also investigated. The results obtained are herein reported.

DESCRIPTION OF SAMPLE

The material tested was essentially the same as that described in Progress Reports No. 1 and No. 2.

ANALYSIS

Analyses carried out were similar to those described in the two previous progress reports.

TEST WORK

Bench scale tests were carried out in a 500 g Denver Flotation Cell. The results for alternative reagents were compared with those from the standard system: pine oil to float talc, and Armac T plus Aerofroth 73 to float the silica-iron minerals. In previous work this reagent combination had given the best results.

The tests were run at 20% solids. For each test the talc was floated with pine oil, then silica was floated in a series of steps with the particular reagent under study. Trials were made with three types of feed: (a) the ground ore, (b) middlings from the pilot plant operation, and (c) the same middlings reground. Talc flotation was not required for the middlings. Most of the test work sought alternative silica collectors; one or two tests checked an alcohol frother as a substitute for pine oil in the talc flotation.

Three tests were run to see if ultraflotation would show any promise as a means of beneficiation. In the first two the silica was floated; in the third the magnesite.

In ultraflotation a coarse carrier mineral, coated with the flotation reagent, is used to "lift" or remove particles of mineral slime. It extends the useful working range of conventional froth flotation to materials of extremely fine particle size.

The two main advantages of using a carrier are (1) When treated with suitable reagents, the particles of the carrier mineral have a large surface for attachment of the slime particles. (2) The loaded carrier particles have a high probability of attachment to an air bubble.

The tests tried consisted of the regular talc float with pine oil, dry grinding the magnesite-silica-iron product to approximately 73% -200 mesh, followed by screening on 200 mesh. The plus 200 mesh was used as the carrier. It was mixed vigorously with the flotation reagents in a 500 g Denver Flotation Cell. To this pulp, the minus 200 mesh fraction of the sample was added and, after conditioning, a regular flotation test was carried out.

The pertinent data for individual tests is given in the Appendices, as follows:

A: Silica Collectors
B: Talc Collectors
C: Starch as Depressant
D: Ultraflotation

COMPARISON OF RESULTS

a) Talc Flotation

Most of the tests were performed with pine oil as the talc collector. With one or two exceptions, the results, using the same procedure, are quite consistent. The average weight floated as talc is 29.3% and the average acid soluble is 23.9%. Aerofroth 70 did not show as strong an ability to float the talc as pine oil. Table 1 makes a comparison.

TABLE 1

Talc Flotation

Test No.	Reagent	lb/ton	Weight % Floated	Acid Soluble %
*	Pine oil	0.10	29.3	23.9
111	Aerofroth 70	0.10	24.1	18.0
112	"	0.40	30.7	24.8

* Average of 10 tests.

The above indicates that approximately four times as much Aerofroth 70 as pine oil is required to float talc to the same degree as this material.

b) Silica Flotation

In order to develop a direct comparison between the silica collectors tried, Table 2 presents the product data for all the silica tests. The first five tests shown are on the pine oil-Armac T system, to furnish the basis for comparison. The sixth test shows this system on unground middlings.

TABLE 2

Comparison of Silica Collectors

Test No.	Silica Collector	Feed Used	Product		
			Weight %	Acid Soluble %	Recovery %
44	Armac T	Ore	42.0	99.10	68.2
46	"	"	39.1	99.19	63.0
50	"	"	41.6	98.99	68.3
51	"	"	39.8	99.00	65.1
53	"	"	37.0	99.10	60.3
121	"	Midd: U	40.8	97.82	46.0
113	Duomac T	"	10.7	99.27	18.5
122	"	Midd: U*	43.7	98.70	49.4
123	"	" : R*	30.2	99.50	34.2
114	Armacflote A-101	Ore	31.3	99.14	53.5
124	"	Midd: U	33.2	98.68	38.0
126	"	" : R	38.4	97.38	43.5
115	Armacflote A-201	Ore	22.7	99.34	39.2
127	"	Midd: U	21.4	98.56	24.3
128	"	" : R	30.2	99.16	34.5
116	Armacflote A-251	Ore	32.9	98.52	55.4
129	"	Midd: U	21.2	97.57	24.2
130	"	" : R	31.5	98.43	35.6
117	Armacflote A-252	Ore	34.7	98.99	58.1
131	"	Midd: U	19.5	97.78	22.0
132	"	" : R	40.8	98.25	46.1
118	Ethomeen 18/60 Duomac T	Ore	35.3	99.10	59.2
119	"	"	39.9	99.17	67.8
120	"	"	39.4	99.03	67.3

*U = Unground, R = Reground

Table 2 indicates that among the alternative reagents tested, only the combination of Ethomeen 18/60 and Duomac T produced results equivalent to the Armac T.

An additional comparison was made of the product obtained when Aerofroth 70 instead of pine oil was used to float talc. The feed in each case was ore.

TABLE 3

Armac T Results with Alternate Talc Collectors

Test No.	Talc Collector	Product		
		Weight %	Acid Soluble %	Recovery %
44	Pine oil	42.0	99.10	68.2
53	"	37.1	99.10	60.3
111	Aerofroth 70	25.3	99.26	44.3
112	"	20.2	99.37	35.2

c) Flotation with Starch as Depressant

The tests shown in this comparison include three levels of starch addition. Otherwise the regular pine oil-Armac T method was applied in the usual way. Ore was used as feed.

TABLE 4

Starch as Depressant

Test No.	Starch lb/ton	Product		
		Weight %	Acid Soluble %	Recovery %
44	0	42.0	99.10	68.2
53	0	37.1	99.10	60.3
137	0.25	39.5	98.80	63.9
136	0.50	44.3	97.69	70.5
138	1.00	33.8	99.29	54.2

No benefit is indicated through the use of starch.

d) Ultraflotation

This comparison may not be conclusive because only nominal testing was done to explore the possibilities of the system. Typical results are given in Appendix D and a summary comparison in Table 5. Tests 44 and 53 are, of course, not ultraflotation, but the usual comparison test.

TABLE 5

Comparison with Ultraflotation Tests

Test No.	Mineral Floated	Product		
		Weight %	Acid Soluble %	Recovery %
44	Silica	42.0	99.10	68.2
53	"	37.1	99.10	60.3
133	"	61.4	80.17	80.4
134	"	31.4	97.65	50.3
135	Magnesite	17.8	96.08	28.2

DISCUSSION

Aerofroth 70, as a substitute for pine oil, in floating talc, was tried in Test No. 111 and Test No. 112. No significant improvement was noted. Pine oil was therefore employed for the remaining tests; its price is lower than the alcohol's.

Of all the reagents tried for floating silica and iron minerals, none gave better results than those obtained with Armac T in previous work (Progress Report No. 1). Direct comparison is risky with the limited number of experiments done. In Tests No. 118, No. 119 and No. 120 where Duomac T was used with Ethomeen 18/60 as a collector aid, recovery was significantly improved. Ethomeen 18/60 is specific with Duomac T and Armac C; it does not work with Armac T.

The Armacflote "A" series 101, 201, 251 and 252 all floated silica and the iron minerals present. None appeared to be equivalent to Armac T. Plant practice, however, might show special applications.

The use of starch as a depressant shows very little to recommend it.

Ultraflotation, as tried, does not seem to improve recovery or grade.

Where the middlings have been reground as in Tests No. 123, No. 126, No. 128, No. 130 and No. 132, better results are evident.

CONCLUSIONS

1. Pine oil, as used in previous work, is a satisfactory reagent to float talc.

2. Armac T as a collector plus Aerofroth 73 as a frother give good results when compared with other silica-iron collectors on the market.

3. The collector aid Ethomeen 18/60 shows promise in the silica-iron flotation step when used with Duomac T. It is not recommended by the manufacturer for use with Armac T.

4. Little benefit, if any, appears to be obtained when starch is used as a depressant.

5. Ultraflotation, as tried, shows no promise in this type of mineral processing.

6. Grinding the middlings before refloating might improve grade and recovery in plant practice.

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APPENDIX A

Flotation Test Data: Silica Collectors

Mineral Floated Reagent Tested	lb/ton	Fractions	Weight %	Acid Soluble %	Acid Soluble Distribution %	Fe as Fe_2O_3 Soluble %	Fe as Fe_2O_3 Total %
		Ground Ore Flotation Test No. 113					
Talc							
Pine oil	0.10	Talc Conc	29.8	23.83	12.3	-	-
Silica							
Duomac T	0.24	Silica Conc 1	43.8	55.87	42.4	-	-
Aerofroth 73	0.46	Silica Conc 2	15.7	98.65	26.8	-	-
		Rougher Tails	10.7	99.27	18.5	-	-
		Total	100.0	57.60	100.0	-	-
		Middlings: Unground Flotation Test No. 122					
Silica							
Duomac T	0.08	Silica Conc 1	14.7	93.69	15.8	4.38	5.20
Aerofroth 73	0.15	Silica Conc 2	41.6	73.14	34.8	4.73	9.64
		Rougher Tails	43.7	98.70	49.4	3.34	3.82
		Total	100.0	87.20	100.0	3.98	6.44
		Middlings: Ground (1 hour) Flotation Test No. 123					
Silica							
Duomac T	0.12	Silica Conc 1	45.0	79.88	40.6	5.67	7.02
Aerofroth 73	0.23	Silica Conc 2	24.8	89.51	25.2	6.00	9.62
		Rougher Tails	30.2	99.50	34.2	3.25	3.28
		Total	100.0	88.10	100.0	5.03	6.53
		Ground Ore Flotation Test No. 114					
Talc							
Pine oil	0.10	Talc Conc	28.4	22.59	11.0	-	-
Silica							
Armacflote A-101	0.24						
Aerofroth 73	0.46	Silica Conc	40.3	50.99	35.5	-	-
		Rougher Tails	31.3	99.14	53.5	-	-
		Total	100.0	58.00	100.0	-	-
		Middlings: Unground Flotation Test No. 124					
Silica							
Armacflote A-101	0.12	Silica Conc 1	49.2	79.38	45.4	3.77	7.86
Aerofroth 73	0.23	Silica Conc 2	17.6	81.24	16.6	3.50	8.08
		Rougher Tails	33.2	98.68	38.0	3.28	3.48
		Total	100.0	86.00	100.0	3.57	6.46
		Middlings: Ground (1 hour) Flotation Test No. 126					
Silica							
Armacflote A-101	0.12	Silica Conc 1	47.0	85.33	46.5	3.70	6.00
Aerofroth 73	0.23	Silica Conc 2	14.6	59.00	10.0	3.55	12.81
		Rougher Tails	38.4	97.38	43.5	3.49	4.51
		Total	100.0	86.10	100.0	3.60	6.43

(Continued)

APPENDIX A (Continued)

Mineral Floated / Reagent Tested	lb/ton	Fractions	Weight %	Acid Soluble %	Acid Soluble Distribution %	Fe as Fe_2O_3 Soluble %	Fe as Fe_2O_3 Total %
		Ground Ore Flotation Test No. 115					
Talc							
Pine oil	0.10	Talc Conc	27.8	21.29	10.2	-	-
Silica							
Armacflote A-201	0.24	Silica Conc	49.5	59.37	50.6	-	-
Aerofroth 73	0.46						
		Rougher Tails	22.7	99.34	39.2	-	-
		Total	100.0	57.90	100.0	-	-
		Middlings: Unground Flotation Test No. 127					
Silica							
Armacflote A-201	0.04	Silica Conc 1	49.4	84.17	47.8	4.38	7.70
Aerofroth 73	0.08	Silica Conc 2	29.2	82.93	27.9	3.67	6.40
		Rougher Tails	21.4	98.56	24.3	3.23	3.44
		Total	100.0	86.90	100.0	3.92	6.40
		Middlings: Ground (1 hour) Flotation Test No. 128					
Silica							
Armacflote A-201	0.12	Silica Conc 1	53.9	78.04	48.5	3.88	7.66
Aerofroth 73	0.23	Silica Conc 2	15.9	92.70	17.0	4.18	7.97
		Rougher Tails	30.2	99.16	34.5	3.46	3.60
		Total	100.0	86.90	100.0	3.81	6.48
		Ground Ore Flotation Test No. 116					
Talc							
Pine oil	0.10	Talc Conc	28.7	22.81	11.2	1.10	3.47
Silica							
Armacflote A-251	0.24	Silica Conc	38.4	51.18	33.4	2.95	6.52
Aerofroth 73	0.46						
		Rougher Tails	32.9	98.52	55.4	3.33	4.45
		Total	100.0	58.55	100.0	2.54	4.92
		Middlings: Unground Flotation Test No. 129					
Silica							
Armacflote A-251	0.12	Silica Conc 1	56.2	88.08	57.4	3.59	7.62
Aerofroth 73	0.23	Silica Conc 2	22.6	70.46	18.4	3.08	6.42
		Rougher Tails	21.2	97.57	24.2	3.42	3.73
		Total	100.0	86.20	100.0	3.44	6.50
		Middlings: Ground (1 hour) Flotation Test No. 130					
Silica							
Armacflote A-251	0.12	Silica Conc 1	57.3	81.90	53.7	4.43	6.68
Aerofroth 73	0.23	Silica Conc 2	11.2	83.05	10.7	5.55	11.83
		Rougher Tails	31.5	98.43	35.6	3.55	4.23
		Total	100.0	87.10	100.0	4.28	6.48

(Continued)

APPENDIX A (Concluded)

Mineral Floated / Reagent Tested	lb/ton	Fraction	Weight %	Acid Soluble %	Acid Soluble Distribution %	Fe as Fe_2O_3 Soluble %	Fe as Fe_2O_3 Total %
		Ground Ore Flotation Test No. 117					
Talc							
Pine oil	0.10	Talc Conc	29.4	25.49	12.7	1.87	3.55
Silica							
Armacflote A-252	0.16*	Silica Conc*	35.9	48.37	29.2	3.50	6.71
Aerofroth 73	0.32	Rougher Tails	34.7	98.99	58.1	3.66	4.26
		Total	100.0	59.20	100.0	3.08	4.93
		Middlings: Unground Flotation Test No. 131					
Silica							
Armacflote A-252	0.08	Silica Conc 1	56.4	82.51	53.8	3.70	7.91
Aerofroth 73	0.15	Silica Conc 2	24.1	86.56	24.2	3.33	5.38
		Rougher Tails	19.5	97.78	22.0	3.16	3.56
		Total	100.0	86.50	100.0	3.50	6.45
		Middlings: Ground (1 hour) Flotation Test No. 132					
Silica							
Armacflote A-252	0.08	Silica Conc 1	32.7	81.90	30.9	3.88	6.78
Aerofroth 73	0.15	Silica Conc 2	26.5	75.06	23.0	4.39	9.62
		Rougher Tails	40.8	98.25	46.1	3.34	4.19
		Total	100.0	86.70	100.0	3.79	6.47
*Further additions of Armacflote produced no froth.							
		Ground Ore Flotation Test No. 118					
Talc							
Pine oil	0.10	Talc Conc	29.5	24.83	12.4	1.54	3.58
Silica							
Ethomeen 18/60	0.12	Silica Conc 1	21.8	25.84	9.6	2.23	3.91
Duomac T	0.20	Silica Conc 2	13.4	82.71	18.8	7.39	12.39
Aerofroth 73	0.40	Rougher Tails	35.3	99.10	59.2	3.30	3.74
		Total	100.0	59.08	100.0	3.10	4.88
		Ground Ore Flotation Test No. 119					
Talc							
Pine oil	0.10	Talc Conc	24.3	18.53	7.7	0.95	3.10
Silica							
Ethomeen 18/60	0.24	Silica Conc 1	23.5	23.11	9.4	1.60	4.11
Duomac T	0.16	Silica Conc 2	12.3	71.75	15.1	4.41	13.77
Aerofroth 73	0.32	Rougher Tails	39.9	99.17	67.8	3.65	4.10
		Total	100.0	58.38	100.0	2.61	5.05
		Ground Ore Flotation Test No. 120					
Talc							
Pine oil	0.10	Talc Conc	28.8	23.50	11.7	1.24	3.46
Silica							
Ethomeen 18/60**	0.12	Silica Conc 1	9.3	31.78	5.1	2.15	3.96
Duomac T	0.20	Silica Conc 2	22.5	41.04	15.9	3.02	8.77
Aerofroth 73	0.32	Rougher Tails	39.4	99.03	67.3	3.39	3.82
		Total	100.0	58.08	100.0	2.58	4.85
**Added to last rougher addition - Silica Conc 2.							
		Middlings: Unground Flotation Test No. 121					
Silica							
Armac T	0.08	Silica Conc	59.2	79.28	54.0	4.16	9.90
Aerofroth 73	0.15	Rougher Tails	40.8	97.82	46.0	3.29	3.69
		Total	100.0	86.60	100.0	3.80	7.35

APPENDIX B

Flotation Test Data: Talc Collectors

Mineral Floated / Reagent Tested	lb/ton	Ground Ore Flotation Test No. 111					
		Fraction	Weight %	Acid Soluble %	Acid Soluble Distribution %	Fe as Fe_2O_3 Soluble %	Fe as Fe_2O_3 Total %
Talc							
Aerofroth 70	0.10	Talc Conc	24.1	18.01	7.6	-	-
Silica							
Armac T	0.24	Silica Conc	50.6	54.37	48.1	-	-
Aerofroth 73	0.46	Rougher Tails	25.3	99.26	44.3	-	-
		Total	100.0	57.05	100.0	-	-
		Ground Ore Flotation Test No. 112					
Talc							
Aerofroth 70	0.40	Talc Conc	30.7	24.78	13.4	-	-
Silica							
Armac T	0.24	Silica Conc 1	37.0	47.08	30.6	-	-
Aerofroth 73	0.46	Silica Conc 2	12.1	97.80	20.8	-	-
		Rougher Tails	20.2	99.37	35.2	-	-
		Total	100.0	56.76	100.0	-	-

APPENDIX C

Flotation Test Data: Starch as Depressant

Mineral Floated / Reagents Tested	lb/ton	Fractions	Weight %	Acid Soluble %	Acid Soluble Distribution %	Fe as Fe_2O_3 Soluble %	Fe as Fe_2O_3 Total %
		Ground Ore (-100 mesh) Flotation Test No. 137					
Talc							
Pine oil	0.10	Talc Conc	26.5	19.73	8.6	0.94	2.79
Silica*							
Starch	0.25	Silica Conc 1	16.6	36.51	9.9	2.08	5.27
Armac T	0.32	Silica Conc 2	17.4	61.21	17.6	3.21	8.58
Aerofroth 73	0.61						
		Rougher Tails	39.5	98.80	63.9	3.28	3.98
		Total	100.0	61.0	100.0	2.45	4.69
		Ground Ore (-100 mesh) Flotation Test No. 136					
Talc							
Pine oil	0.10	Talc Conc	27.4	20.43	9.1	0.95	5.76
Silica*							
Starch	0.50	Silica Conc 1	19.4	37.64	11.9	2.26	2.76
Armac T	0.24	Silica Conc 2	8.9	58.52	8.5	4.31	8.62
Aerofroth 73	0.46						
		Rougher Tails	44.3	97.69	70.5	3.50	4.64
		Total	100.0	61.42	100.0	2.63	4.94
		Ground Ore (-100 mesh) Flotation Test No. 138					
Talc							
Pine oil	0.10	Talc Conc	25.6	19.04	7.9	0.87	2.78
Silica*							
Starch	1.0	Silica Conc 1	23.3	35.39	13.3	2.45	5.48
Armac T	0.32	Silica Conc 2	17.8	85.39	24.60	4.83	9.04
Aerofroth 73	0.61						
		Rougher Tails	33.8	99.29	54.2	3.19	3.48
		Total	100.0	61.93	100.0	2.73	4.78

* Reground to 70% -200 mesh feed to silica flotation.

APPENDIX D

Flotation Test Data: Ultraflotation

Mineral Floated / Reagent Tested	lb/ton	Fractions	Weight %	Acid Soluble %	Acid Soluble Distribution %	Fe as Fe_2O_3 Soluble %	Fe as Fe_2O_3 Total %
		Ground Ore (-100 mesh) Flotation Test No. 133					
Talc							
Pine oil	0.10	Talc Conc	29.5	24.81	12.1	1.20	3.40
Silica*							
Armac T	0.24	Silica Conc	9.1	50.18	7.5	2.84	5.34
Aerofroth 73	0.08	Rougher Tails	61.4	80.17	80.4	3.08	5.22
		Total	100.0	60.99	100.0	2.50	4.69
		Ground Ore (-100 mesh) Flotation Test No. 134					
Talc							
Pine oil	0.10	Talc Conc	30.2	22.88	11.3	1.13	3.32
Silica*							
Armac T	0.60	Silica Conc 1	11.8	57.90	11.2	3.28	5.41
Aerofroth 73	0.30	Silica Conc 2	26.6	62.27	27.2	3.28	6.88
		Rougher Tails	31.4	97.65	50.3	3.36	4.37
		Total	100.0	61.04	100.0	2.77	4.84
		Ground Ore (-100 mesh) Flotation Test No. 135					
Talc							
Pine oil	0.10	Talc Conc	29.7	21.77	10.5	1.22	2.94
Magnesite*							
Soda Ash	4	Rougher Tails	7.0	37.01	4.2	1.70	4.23
Oleic Acid	0.7	1st Cleaner Tails	13.6	57.68	12.8	2.82	5.43
		2nd Cleaner Tails	13.3	77.14	16.8	3.60	6.24
		3rd Cleaner Tails	10.1	87.97	14.5	4.25	6.32
		4th Cleaner Tails	8.5	93.53	13.0	3.76	5.52
		Magnesite Conc	17.8	96.08	28.2	3.34	4.36
		Total	100.0	61.19	100.0	2.69	4.63

* Reground to 73% -200 mesh and separated into ± 200 mesh fractions prior to flotation.