Roper Bar Iron Ore: Stage 5 Testwork

Summary of Results

A series of flotation tests was conducted on Roper Bar ore using different starch depressants and different collectors and different degrees of desliming.

A composite feed comprising three parts sample 3 and one part sample 2 was prepared and riffled into 1 kg batches of rod mill feed (top size 2.3 mm). Each batch was ground in a laboratory rod mill and put aside for further processing. Of these, 2 kg were deslimed at Optimet Laboratories, 2 kg were deslimed at the Wark using a 50mm Mozley cyclone and 2 kg were undeslimed.

The cyclone underflows were filtered and dried and split into approximately 200 g lots for flotation testing. The undeslimed material was filtered, dried and split int approximately 250 g lots for flotation testing.

Flotation testing was carried out in a 1.25 litre Magotteaux cell with an agitation rate of 800 rpm and an air flow rate of 3 l/min. Tests were normally conducted at pH 9.5. Two samples of starch (corn and regular maize) were used as an iron depressant. Four collectors (Flotigam EDA from Clariant, and Lilaflot 819M1, 811M and 817M from Akzo Nobel) were used. Where necessary, Huntsman W22 was used as a frother. In all cases calgon was added as a dispersant prior to any other reagent addition.

The general flotation scheme used in the initial tests is given in Table 1. It should be noted that in a number of cases not all stages were used due to the large mass of concentrate produced in the early stages.

Product	pH	Reagent	Amount	Time	Collector	Amount	Time	Float time
Conditioning	natural	1% Calgon	10 ml	5 min				
Conc 1	9.5	1% starch	10 ml	5 min	1% soln	10 ml	5 min	2 min
Conc 2	9.5				1% soln	10 ml	5 min	2 min
Conc 3	9.5	1% starch	2 ml	5 min	1% soln	10 ml	5 min	2 min
Conc 4	9.5			5 min	1% soln	10 ml	5 min	2 min
Conc 5	9.5				1% soln	10 ml	5 min	2 min

Table 1. Flotation scheme for initial tests.

The results are summarised in Tables 2 to 5 below. In each case the Fe, SiO_2 and LOI grades and recoveries of the final product (flotation tail) are reported. It should be noted that for SiO_2 and LOI the aim is to achieve low grade and recovery values in the final product, while achieving high Fe grade and recovery values.

Collector	Fe		SiO_2		LOI	
	Grade %	Recovery %	Grade %	Recovery %	Grade %	Recovery %
EDA	48.03	63.69	20.08	39.96	7.01	58.55
819M1	49.84	46.62	17.97	24.99	6.11	36.21
811M	50.62	33.89	16.37	16.27	5.96	25.12
817M	48.39	62.70	19.58	38.69	6.76	55.42

Table 2. Final flotation results using corn starch for sample deslimed at UniSA .

Collector	Fe		SiO_2		LOI	
	Grade %	Recovery %	Grade %	Recovery %	Grade %	Recovery %
EDA	47.76	63.77	19.15	38.92	7.11	59.61
819M1	50.15	44.47	17.11	22.75	6,42	35.95
811M	50.02	36.62	17.17	18.73	5.89	30.41
817M	47.81	62.96	19.11	36.77	7.00	58.00

Table 3. Final flotation results using regular maize starch for sample deslimed at UniSA.

Collector	Fe		SiO_2		LOI	
	Grade %	Recovery %	Grade %	Recovery %	Grade %	Recovery %
EDA	44.79	72.17	24.02	68.48	6.91	80.25
819M1	45.72	52.87	22.06	44.96	7.57	63.95
811M	48.87	39.99	17.77	25.87	5.95	39.56
817M	44.62	80.77	25.30	81.06	6.66	87.84

Table 4. Final flotation results using regular maize starch for undeslimed sample.

Collector	Fe		SiO_2		LOI	
	Grade %	Recovery %	Grade %	Recovery %	Grade %	Recovery %
EDA	47.65	63.49	19.29	38.82	6.74	56.37
819M1	49.89	45.84	21.49	24.22	5.65	32.83
811M	50.08	36.57	16.89	18.13	5.94	27.15
817M	47.02	69.69	20.30	45.35	6.79	62.09

Table 5. Final flotation results using regular maize starch for sample deslimed at Optimet.

These results are somewhat disappointing in that Fe grades approaching 50% were only achieved at low recovery values. In an attempt to overcome this problem another series of tests was conducted using Lilaflot 811M (which had given the highest grades

but very low recovery values) but at reduced rates. Regular maize starch was used as the collector. Other variables investigated were flotation pH, the amount of dispersant, and the amount of collector added to the first flotation stage. The details are summarised in Table 6 and the results given in Table 7.

Test No.	Desliming	Calgon (mls)	pH	Collector to Stage 1 (mls)	Collector to Stage 2 + (mls)
17	Optimet	5	10	1	1
18	Optimet	5	10	2	1
19	Optimet	5	9	2	1
20	Undeslimed	5	10	2	1
21	Indeslimed	10	10	2	1

Table 6. Details for subsequent tests.

Test No.	**Fe**		**SiO_2**		**LOI**	
	Grade %	Recovery %	Grade %	Recovery %	Grade %	Recovery %
17	47.80	67.66	18.07	35.99	7.39	64.79
18	47.11	64.18	18.80	36.59	7.18	60.16
19	49.25	51.54	18.18	27.67	6.19	40.25
20	46.42	62.97	20.23	46.68	7.58	74.00
21	47.14	60.63	18.80	41.16	7.57	71.24

Table 7. Results for tests 17-21.

Comments

The calculated head grade for the composite feed was 44.5% Fe, 25.2% SiO_2 and 6.2% LOI. After desliming the Fe grade decreased to 42% and the SiO_2 and LOI increased to 28.4% and 6.6% respectively. This would appear to be due to losses of soft oolitic hematite to the slimes, which previous work has shown to contain around 52% Fe, 17% SiO_2 and 4% LOI.

The initial work showed the importance of deslimimg. Despite the higher grade of the undeslimed feed, the final product grades were lower, and SiO_2 and LOI values higher than for the equivalent tests using deslimed feed.

The best Fe grade achieved was 50%. However, to obtain this grade the recovery values were very low.

Silica values in the final product were high. In general they were between 18 and 20%. Similarly, LOI values in the final product were often higher than in the feed. This suggests that:

1) silica flotation was inadequate, possibly due to the presence of coarse particle;

2) siderite is depressed and remains with the final product (float tail), thus lowering the overall grade;
3) that fine hematite is lost to the flotation (silica) concentrate, again lowering grade and reducing recovery.

WHIMS Testing

The use of wet high intensity magnetic separation was tested at RMG Services. In one test deslimed feed was used, while in the other test the flotation product obtained using the method used in Test 17 above was used. The concentrate from the first test was then used as feed to flotation using the same flotation method.

WHIMS treatment of the flotation product produced a slight improvement in Fe grade from 47.8% to 49.1% at 85% recovery. The SiO_2 content was reduced from 18.1% to 15.9% while the LOI value was reduced slightly from 8.0% to 7.6%.

WHIMS treatment of the deslimed feed resulted in an increase in Fe grade from 42.3% to 48.7% while the SiO_2 grade decreased from 27.7% to 16.9% and LOI increased from 6.6 to 8.0%.

Flotation of the WHIMS concentrate resulted in a slight increase in Fe grade to 50.2% while SiO_2 and LOI decreased to 14.5% and 7.8% respectively.

Future Work

The results reported above were disappointing. One possible reason is the presence of coarse silica, which is difficult to float and/or the presence of composites which will also cause problems. Another possibility is the presence of coating or smearing of iron on silica and vice versa.

It is recommended that the next stage of the work should be diagnostic to try to determine the reason for the poor separation performance. This would involve size by assay analyses at different grind times in conjunction with flotation tests with more closely sized feeds to determine particle size effects and XPS analysis to examine surface effects.