TR17-213-217

R.650. Further flotation tests of chromite, Barnes Hill.

Investigations R.632 and R.644 have shown that good recoveries of high grade chromite flotation concentrate can be obtained from the Barnes Hill deposit using amine fortified with fuel oil in pulps acidified to pH 2.5-3.0 with sulphuric acid.

The samples submitted for these investigations consisted of chromite bearing sands and gravels with varying amounts of clay like slimes. The removal of slimes and +22# (710 µm) gravel left virtually simple mixtures of quartz sand and chromite.

More extensive sampling of the deposit has revealed the presence of chromite bearing materials completely different in character to the samples already submitted. The object of this investigation is to test the response of these types of material to the process already established as suitable for the quartz chromite samples.

SAMPLES

Five samples were submitted for examination. The samples weighed from 15-20 kg each and were denoted by sampling coordinates only. The following table shows the laboratory registered numbers, sample co-ordinates (local) and brief descriptions of the material.

Reg. No.	*Coordinate*	
723343	45N 58E	Red soil, brown clay, some iron stained quartz sand, and some quartz pebbles up to 2 cm.
723344	50N 53E	Grey gravel.
723345	48N 57E	Brown gravel and sand.
723346	47N 51E	Green pug, probably weathered serpentinite.
723347	43N 52E	Severely weathered grey to green serpentinite(?).

FLOTATION FEED PREPARATION

The method of flotation feed preparation was that adopted in Investigation R.632, that is, slacking in water, disintegration of lumps and aggregates by agitation, screening out of +22 µm gravel where applicable, preliminary decantation of slimes, high density scrubbing of -22# material with dispersant followed by further desliming by settlement and decantation.

Notes on the disintegration of individual samples are given later in the report.

FLOTATION TESTS

Preliminary tests indicated that some difficulty would be experienced in obtaining the required concentrate grade (+55% Cr_2O_3). A further stage of concentrate cleaning was therefore introduced, making three flotation stages in all compared with two in Investigation R.632. The same reagents were used as in Investigation R.632 N23, but quantities were varied in some cases to ensure that flotation of chromite did occur.

Reg. No. 723343

Disintegration. Agitation in the flotation cell causes ready disintegration. An addition of 1.8 kg/t of sodium silicate was made to ensure dispersion of the large amount of brown clay present. Some magnetite was present but was removed by hand magnet from the gently stirred pulp. The +22# fraction was removed by wet screening.

Reagents. As in Investigation R.632, Test N23.

Fuel oil	1.4 kg/t
Aeromine 3035	0.45 kg/t
H_2SO_4	to pH 2.5
Calgon	0.9 kg/t

Result.

Product	*% Wt*	*% Cr_2O_3*	*% Cr_2O_3 Distn*
+22#	9.6	45.5	3.0
Slime	54.8	5.3	30.6
M/A	2.0	5.0	1.0
FT	23.6	7.0	17.4
F3C	10.0	45.5	48.0
Head	100.0	9.5	100.0

Reg. No. 723344

Disintegration. Gentle agitation was sufficient to effect disintegration. Addition of 0.9 kg/t of sodium silicate dispersed the clay. The sample was wet screened on ¼ inch, 22#, deslimed, scrubbed at 70% solids for 5 minutes and again deslimed.

Reagents. The same reagents as used for the previous sample.

Result.

Product	*% Wt*	*% Cr_2O_3*	*% Cr_2O_3 Distn*
+¼ in	14.9	0.7	2.0
+22#	18.1	0.3	1.0
Slime	31.7	5.1	30.4
FT	27.3	0.5	2.4
F3C	8.0	44.8	64.2
Head	100.0	10.5	100.0

Reg. No. 723345

Disintegration. as in Reg. No. 723344.

Reagents. The same reagents as used for the previous sample.

Result.

Product	*% Wt*	*% Cr_2O_3*	*% Cr_2O_3 Distn*
+¾ in	13.7	6.4	8.3
+22#	18.6	4.2	7.4
Slime	36.4	6.8	23.5
FT	19.3	1.4	2.5
F3C	12.0	51.2	58.3
Head	100.0	10.5	100.0

Reg. No. 723346

Disintegration. The breakdown of the green puggy lumps in this sample was difficult. Violent agitation for 6 minutes effected complete disintegration. The addition of 1.8 kg/t of sodium silicate was necessary for dispersion of the large amount of near colloidal pale brown clay. There was no +22# material present after disintegration and dispersion. After decantation of the slime generated, a further large quantity was removed by scrubbing and secondary desliming. The sample was high grade (19.0% Cr_2O_3) and removal of slime resulted in a flotation feed of 56.4% Cr_2O_3 containing 77% of the total chromite.

Reagents.

Fuel Oil	3.6 kg/t	High density conditioning for one minute.
Aeromine 3035	0.6 kg/t	
H_2SO_4	to pH 2.5	
Calgon	0.9 kg/t after dilution to 30% solids.	

Result.

Product	*% Wt*		*% Cr_2O_3*		*% Cr_2O_3 Distn*	
Slime	74.0		5.9		23.0	
FT	3.5	26.0	28.1	56.4	5.1	77.0
F3C	22.5		60.8		71.9	
Head	100.0		19.0		100.0	

Reg. No. 723347

Disintegration. This does not appear to be difficult, agitation in flotation with 1.8 kg/t sodium silicate being adequate. However, the secondary desliming operation was not effective, as after the usual scrubbing, large amounts of colloidal slimes continued to be generated during flotation procedures causing massive reagent consumption and lack of selectivity.

An attempt to overcome this was made by ball mill grinding of the material followed by the usual desliming. This was only partially successful as colloidal slime continued to occur during flotation although in somewhat lesser amounts.

No +22# material occurred in the feed after disintegration.

In the test reported, the feed was batch ball mill ground with 1.8 kg/t of sodium silicate followed by the usual preliminary desliming, high density scrub and secondary desliming.

Reagents.

Fuel oil	2.3 kg/t	High density
Aeromine 3035	2.3 kg/t	conditioning for
H_2SO_4	to pH 2.5	one minute.
Calgon	0.9 kg/t after dilution to 30% solids.	

Result.

Product	*% Wt*	*% Cr_2O_3*	*% Cr_2O_3 Distn*
Slime	59.0	13.0	30.0
FT	12.9	14.3	7.3
F3C	28.1	56.9	62.7
Head	100.0	25.5	100.0

Composite: Equal weight portions of each sample

Disintegration. The sample was ball milled for 3 minutes followed by dilution, desliming, high density scrub, dilution, low intensity magnetic separation and further desliming.

Reagents.

Fuel oil	2.3 kg/t	High density
Aeromine 3035	0.6 kg/t	conditioning for
H_2SO_4	to pH 2.5	one minute.
Calgon	0.9 kg/t after dilution to 30% solids.	
Sodium fluoride	0.2 kg/t to second cleanser (to depress serpentine).	

Result.

Product	*% Wt*	*% Cr_2O_3*	*% Cr_2O_3 Distn*
Slime	48.2	4.6	16.4
M/A	0.9	8.2	0.5
FT	31.6	4.5	10.4
F3C	19.3	51.1	72.7
Head	100.0	13.6	100.0

SUMMARY

The test work has shown that the samples submitted will not give the same satisfactory results obtained from the quartz-chromite materials previously submitted, using the processes detailed in Investigation R.632.

The concentrates from the first three samples were contaminated by iron oxides floating with the chromite. A superficial visual examination of the concentrates indicated that the oxides are of an earthy character. More efficient attrition in a suitably designed machine could have the effect of converting much of this material to slime which would then be removed by the secondary desliming operation. Careful blending of this material with ore containing more sand and less iron oxide could result in both more effective attritioning and a lesser overall iron oxide content in the flotation feed.

Although the oxides would float with the chromite, it should be possible in these circumstances to produce a chromite concentrate of the required grade.

Tests on the other two samples indicate that separation of chromite from serpentine can be achieved by amine flotation of chromite at low pH values. However, because of the severely weathered nature of the materials tested, more work would be needed to confirm this and using samples containing chromite in unaltered serpentine.

An interesting feature of Sample 723345 is that desliming alone is sufficient to produce a chromite concentrate of the required grade. If sufficient of this material can be selectively mined, simple disintegration and desliming would be a cheap and effective method of concentration.

With regard to the last sample, the most harmful effect encountered was the continual generation of colloidal slime which consumed large and probably uneconomic quantities of reagent, severely inhibiting flotation and destroying selectivity. Once again, careful ore blending and more effective attrition could overcome this problem.

The benefits of ore blending are clearly demonstrated in the test conducted on the composite sample. Reasonably high chromite recovery with a grade intermediate between the highest and lowest value from individual samples was obtained.