

R.606. Magnetic separation of Cleveland vanner tailing

Rougher vanner tailing from the Cleveland Tin N.L. mill is currently being examined for the application of cassiterite flotation. This material contains appreciable amounts of siderite (FeCO_3). This mineral's response to froth flotation is generally similar to that of cassiterite and separation by this means is difficult. Gravity separation is also inefficient in the fine size ranges occurring in the product.

Aberfoyle Management Pty Ltd has stated that test work conducted elsewhere, on a Gill magnetic separator has shown that the separation efficiency of siderite decreases in sizes finer than 20 μm .

Tests on the Jones High intensity wet magnetic separator were requested to:

- (1) Determine the separation efficiency using this machine
- (2) Produce material low in siderite content for the continuation of cassiterite flotation tests by C.S.I.R.O.

SAMPLE

The sample was received in thickened pulp form, net weight being 65 lb; equivalent to about 42 lb dry weight.

Assays

Sn	0.44%	S	1.40%
Fe	10.0 %	CO_2	4.6 %

PROCEDURE

The test programme suggested by the Company was followed. This was:

- (1) Mix pulp and extract 10 lb head sample.
- (2) Feed remainder to Jones separator with
 - (a) maximum field strength,
 - (b) minimum pole gap,
 - (c) minimum wash water,
 - (d) Feed pulp density: 30% solids.
- (3) Rougher magnetics and rougher wash product: combine, thicken and reseparator under conditions as (2) above.
- (4) Perform sizing analyses on the original feed and cleaner magnetics.
- (5) Assay all products and size fractions for Sn, Fe, S and CO_2 .

NOTE: No chemicals have been added to any of the pulps and all samples have been dried by low temperature infra-red means.

TEST CONDITIONS

Rougher Separation

Feed:	30% solids. Rate 1.66 lb/min
Wash water:	1 gal/min (including pulse)
Pulse:	Slight

TEST RESULTS

Products	Per cent					Per cent Distribution			
	Wt	Sn	Fe	S	CO ₂	Sn	Fe	S	CO ₂
Cleaner M/A	28.2	0.19	17.3	1.58	8.5	12.2	48.2	32.7	53.8
Cleaner Wash	25.9	0.37	8.68	1.21	3.5	21.9	22.2	23.0	20.4
Cleaner N	15.6	0.57	6.99	1.29	2.9	20.3	10.8	14.7	10.1
Rougher N	30.3	0.66	6.27	1.33	2.3	45.6	18.8	29.6	15.7
Head	100.0	0.44	10.1	1.36	4.5	100.0	100.0	100.0	100.0
Cleaner Separator Feed (Rougher Magnetic + Rougher Wash)									
Assays: Sn 0.35% Fe 11.8% S 1.51% CO ₂ 5.5%									

SIZING ANALYSES. Separator Feed

Fraction	Per cent					Per cent Distribution				
	Wt	Sn	Fe	S	CO ₂	Sn	Fe	S	CO ₂	
+100#	2.0	0.17	5.65	0.20	2.3	0.8	1.1	0.3	0.9	
+200#	7.1	0.17	6.65	0.37	3.6	2.7	4.6	1.8	5.3	
+300#	7.8	0.12	6.20	0.31	6.1	2.1	4.7	1.7	9.8	
C/S1	13.5	0.36	10.1	1.50	5.8	10.8	13.4	14.1	16.2	
C/S2	17.7	0.36	9.13	1.09	4.8	14.2	15.8	13.5	17.5	
C/S3	17.7	0.56	10.3	1.35	5.2	22.1	17.9	16.7	19.0	
C/S4	14.0	0.70	11.8	1.75	5.5	21.8	16.2	17.1	15.9	
C/S5	4.7	0.66	12.9	2.09	5.7	6.9	5.9	6.8	5.5	
C/S6	15.5	0.54	13.4	2.95	3.1	18.6	20.4	28.0	9.9	
Composite	100.0	0.45	10.2	1.43	4.9	100.0	100.0	100.0	100.0	
+300#	3.2	0.12	11.1	0.34	2.0	2.2	4.8	3.2	2.4	
+100#	3.8	0.12	3.02	0.32	2.2	3.2	1.3	0.2	1.3	
ELEVATION	MC	SN	Fe	S	CO ₂	SN	Fe	S	CO ₂	

SIZING ANALYSES. Cleaner Magnetics

Fraction	Per cent					Per cent Distribution			
	Wt	Sn	Fe	S	CO ₂	Sn	Fe	S	CO ₂
+100#	2.8	0.16	7.06	0.36	3.5	2.5	1.2	0.6	1.2
+200#	7.5	0.16	11.1	0.74	6.0	6.6	4.8	3.5	5.4
+300#	6.3	0.09	11.0	0.70	5.6	3.2	4.0	2.8	4.3
C/S1	19.4	0.18	16.7	1.82	8.2	19.3	18.8	22.3	19.3
C/S2	20.4	0.18	16.8	1.56	7.9	20.3	19.9	20.0	19.6
C/S3	18.8	0.20	18.8	1.52	8.5	20.8	20.5	18.0	19.4
C/S4	12.7	0.20	21.2	1.36	10.0	14.1	15.6	10.9	15.4
C/S5	3.7	0.22	23.0	1.69	10.2	4.5	4.9	4.0	4.6
C/S6	8.4	0.19	21.0	3.37	10.6	8.7	10.3	17.9	10.8
Composite	100.0	0.18	17.2	1.59	8.2	100.0	100.0	100.0	100.0

From the sizing analyses above, the overall percentage distribution of Sn, Fe, S and CO₂ in the cleaner magnetics has been calculated.

In each individual size fraction, the percentage of these elements obtained in the cleaner magnetics is also shown.

Fraction	Overall % Wt	Distribution % Overall				Percentage Recovered*			
		Sn	Fe	S	CO ₂	Sn	Fe	S	CO ₂
+100#	0.8	0.3	0.6	0.2	0.7	38.2	50.0	72.5	60.9
+200#	2.1	0.8	2.3	1.1	2.9	28.1	49.4	58.9	49.2
+300#	1.8	0.4	1.9	0.9	2.3	17.0	40.9	52.9	21.2
C/S1	5.4	2.4	8.9	7.2	10.3	20.0	66.1	48.4	56.6
C/S2	5.8	2.5	9.7	6.6	10.5	16.5	60.3	46.9	53.9
C/S3	5.3	2.5	9.9	5.9	10.4	10.7	54.7	33.7	49.0
C/S4	3.6	1.7	7.6	3.6	8.3	7.3	46.2	20.0	46.8
C/S5	1.0	0.5	2.3	1.3	2.5	7.1	38.0	17.2	38.1
C/S6	2.4	1.1	5.0	5.9	5.8	5.5	24.2	20.1	52.9
Composite	28.2	12.2	48.2	32.7	53.8	-	-	-	-

* Percentage recovered from each size fraction was calculated as follows: $\frac{\text{Overall Units/Cleaner M/A}}{\text{Feed Units}} \times 100$

Scour water: 50 lb/in²

Field Current: 36 A

Pole Plates: High extraction grooved plates; pitch 0.08 in, gap 0.025 in

Cleaner Separation (Reseparation of rougher magnetics and rougher wash)

Feed: 25% solids. Rate 1.31 lb/min

Other conditions: as above.

COMMENT

The programme suggested by the Company has been adhered to and, in fact, limitations in sample quantity precluded any extension to it.

The siderite rejection of 53.8% (CO₂) is lower than should be expected and possible improvement could be obtained by including scavenger and re-cleaner operations in the process.

The test confirms that siderite rejection decreases in the finer size ranges. This is probably related to the pole gap of the plates used. These plates are the finest supplied with the machine, but it is possible that for a specific application such as this (feed size 83%-300#) more finely grooved plates could be obtained or manufactured.

The tin loss of 12.2% in the cleaner magnetics is considered reasonable.

TEST PROCEDURE

All flotation tests were conducted on two litres of pulp in the Denver D-1 '505-A' laboratory flotation machine, with an impeller speed of 1,500 rpm. The weight of dry feed in each test was approximately 350 g.

The following conditions were applied in individual tests.

Test M1

Flotation for 5 minutes with no reagent additions.

Test M2

Conditioning with 1 g of sodium sulphite for 5 minutes followed by flotation for 5 minutes.

Test M3

Conditioning with 1 g of sodium sulphite for 15 minutes followed by flotation for 5 minutes.

Test M4

Conditioning with 0.2 g of I.O.I. reagent Alkanate MD for 5 minutes followed by flotation for 5 minutes.