R. 575

CLASSIFICATION OF ROUGHER CONCENTRATE FROM CLEVELAND TIN, N.L.

At the request of Cleveland Tin, N.L., classification tests were carried out on a sample of rougher concentrate from the Cleveland mill, in an endeavour to remove slime from the concentrate.

Sample

About 220 lb of sample was submitted. The sample was stated to be taken from the non-magnetics from the magnetic separator after the rougher concentrate thickener. The sample appeared to have been a de-canted pulp when it was drummed.

Note 1. No responsibility will be accepted for the results shown in this report except insofar as they apply to the sample received.

Note 2. All screens used were from the British Standard Screen series.

Test Work

The whole sample was dried, and then riffled to provide two samples. One sample was used for a head assay, and the other used for a sizing analysis.

The head assay result was as follows:—

Cassiterite Sn	11.7%
Stannite Sn	Nil
Fe	15.0%
S	1.1%
Insoluble	53.0%

The sizing analysis result is as follows:—

Size-Fraction	% Weight	% Cum. Weight	Assay % Sn	Sn Distribution %	Sn Distribution % Cum.
+ 72 #	0.9	0.9	12.6	1.0	1.0
+ 100 #	2.4	3.3	32.1	6.8	7.8
+ 150 #	5.8	9.1	30.1	15.4	23.2
+ 200 #	14.4	23.5	16.1	20.5	43.7
+ 300 #	17.7	41.2	8.95	14.0	57.7
C.S. 1	22.6	63.8	15.2	30.4	88.1
" 2	19.7	83.5	4.05	7.1	95.2
" 3	11.4	94.9	3.65	3.7	98.9
" 4	4.1	99.0			
" 5	0.7	99.7	2.40	1.1	100.0
" 6	0.3	100.0			
Calculated Head	100.0		11.3		

Note: Insufficient material was available in fractions C.S. 5 and C.S. 6 for assay, and they were bulked together with fraction C.S. 4 for assay purposes.

It was decided to obtain the cyclone conditions which gave a minimum loss of recoverable Sn in the cyclone overflow. Accordingly, a cyclone circuit was set up. A 1"/¾" split case Warman pump was connected to a conical sump. The pump discharged to a 3" Warman cyclone mounted over the sump. Both cyclone products discharged back into the sump. A pair of valves enabled the cyclone to be bypassed, if desired, with the bypass returning to the sump. The cyclone was fitted with a 3/16" diam. nozzle, and a ⅜" diam. vortex finder. A pressure gauge was mounted on the cyclone feed line just in front of the cyclone. The pump was driven by a variable speed motor. By varying the motor speed it was possible to vary the pressure on the cyclone. An agitator was installed in the sump to keep the contents well mixed.

The cyclone was operated at 15 psi, 22.5 psi, and 30 psi, with a feed pulp density of 30% solids. Samples of products at each pressure were taken and sized. The vortex finder was changed to one of ½" diam. and the test repeated, and samples of products at each pressure were again taken and sized.

An examination of the results showed that the test with the ⅜" diam. vortex finder at a cyclone pressure of 30 psi gave the best results.

The ⅜" diam. vortex finder was again fitted to the cyclone and the test repeated, with pressures of 30 psi and 45 psi. The cyclone products were sampled and sized for each pressure. The results at 45 psi were only marginally better than at 30 psi.

A flow test was made on the combined cyclone products, and indicated that the rate of treatment was 1.16 tons per hour at 30 psi.

A continuous test (N5), was then made at a flow rate of 1.16 tons per hour, at 30 psi, and the cyclone products were collected in separate containers. It was proposed to keep the feed pulp density at 30% solids, but more water had to be added to prevent the pump sucking air while maintaining the pressure so that the pulp density, in fact, was less than in the batch tests.

Five hundred gram lots of the cyclone underflow from the continuous test were sized in the Geco hydrosizer in successive batch tests, and the water inlet orifices were adjusted after each test until a reasonable separation was obtained in the Geco test 3. In this test the weight distribution was as follows:—

Product	% Weight
Geco Spigot 1	7.6
Spigot 2	14.4
Spigot 3	32.8
Geco Overflow	28.7
Cyclone Overflow	16.5
Head	100.0

The collection of the Geco spigot products was made in bottles connected by the hose to each spigot. The whole collection arrangement was water filled so that it was possible to carefully control the rising currents in the respective compartments.

The result of the Geco test 3 are shown in table 1.

The remainder of the cyclone underflow was fed to the 30" diam. Denver hydroclassifier by means of a Lockers vibrating feeder, which delivered into a launder where the material was pulped. Discharge from the launder gravitated by hose to the hydroclassifier. Products from the hydroclassifier were collected in separate containers. The bed that formed in the hydroclassifier was put in with the hydroclassifier underflow.

The weight of the distribution in the hydroclassifier test was as follows:—

Product	% Weight
Hydroclassifier Underflow	78.5
Hydroclassifier Overflow	5.0
Cyclone Overflow	16.5
Head	100.0

The results of the hydroclassifier test are shown in table 2.

Conclusions

A satisfactory desliming of the rougher concentrate can be achieved by cycloning in a 3" cyclone at 30 psi at a pulp density somewhat less than 30% solids with a 3/16" diam. apex valve and a $\frac{3}{8}$" vortex finder. A slime fraction carrying 16.5% of the original weight, and 2.1% of the total Sn can be rejected.

Hydrosizing of the cyclone sand proved very satisfactory. The first spigot product assayed 48.0% Sn, and accounted for 33.8% of the total Sn. The first, second, and third spigots carried 4.7% and 23.9%, and 52.1% of the minus 300 mesh material and emphasises the need for carefully controlled rising currents in the hydrosizer. The hydrosizer overflow would make ideal vanner feed since 89.9% of the product is minus 300 mesh (85.2% is in the range C.S.1 to C.S.3—23 microns to 12 microns cassiterite grain size) and carried 15.9% of the total Sn.

The test on the cyclone sand using the Denver hydroclassifier showed that suitable vanner feed could be produced in the overflow product, which contained 99.1% minus 300 mesh. (96.6% is in the range C.S.1 to C.S.4—23 microns to 8 microns cassiterite grain size.) However, 53.6% of the material in the hydroclassifier underflow was minus 300 mesh. Due to the limited nature of the test, it is probable that the bulk of this fraction was present in the material that settled on the bottom of the hydroclassifier under the sweep of the rakes and which was included in the underflow. In a continuous operating test the major part of this fraction would report in the overflow when the suspended solids content of the water in the hydroclassifier reached equilibrum.

A study of the size analysis of the original feed sample shows that 42.3% of the Sn in the rougher concentrate is in the minus 300 mesh fraction. Of this, 2.3% of the Sn is removed by the desliming cyclone and discarded, leaving 40% of the Sn in this size range remaining. It is highly desirable that Sn of this size should report to the vanners.

In the existing flowsheet, the overflow from the Stokes hydrosizer reports to the vanner section. If the desliming cyclone is installed, then the hydrosizer will be required to pass 40% of the Sn (the minus 300 mesh fraction) into the overflow; **i.e.**, almost half of the Sn in the hydrosizer feed. This situation is not at all desirable for good operation in the hydrosizer, and a further classification step should be given to the cyclone underflow before presenting the sand product to the hydrosizer.

A suitable product for feeding to the hydrosizer could be provided by classifying in a hydroclassifier, and sending the overflow to the vanner section and the underflow to the hydrosizer. Alternatively secondary cycloning of the cyclone sand under controlled conditions would provide suitable vanner and hydrosizer feeds. Further work would be required to establish the required secondary cyclone conditions.

The suggested flowsheet would then be as follows:—

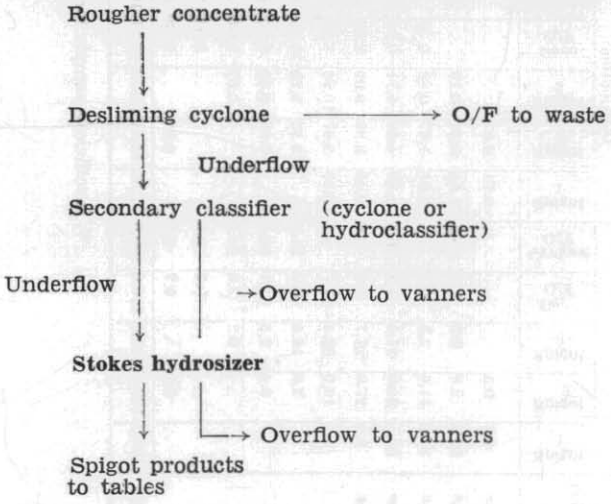

TABLE 1

Size Fraction	Product Sizing Analyses					Overall % Weight Distribution					Calc. Head Size Analysis	Original Head Size Analysis	Assays % Sn					Overall % Sn Distribituon					Calc. Head Sn Dist.	Original Head Sn Dist.
	Spigot 1	Spigot 2	Spigot 3	Geco O/F	Cyclone O/F	Spigot 1	Spigot 2	Spigot 3	Geco O/F	Cyclone O/F			Spigot 1	Spigot 2	Spigot 3	Geco O/F	Cyclone O/F	Spigot 1	Spigot 2	Spigot 3	Geco O/F	Cyclone O/F		
+ 72#	9.3	0.5	..	..	..	0.71	0.07	..	..	..	0.78	0.9	14.0	*	..	..	..	0.9	..	..	..	..	0.9	1.0
+100#	20.3	2.8	0.3	..	0.1	1.54	0.40	0.10	..	0.02	2.06	2.4	44.4	4.72	*	..	*	6.3	0.2	..	..	..	6.5	6.8
+150#	35.2	11.6	2.5	0.1	..	2.68	1.67	0.82	0.03	..	5.20	5.8	56.3	6.87	2.42	*	..	14.0	1.0	0.2	..	..	15.2	15.4
+200#	24.1	34.0	17.4	1.8	0.3	1.83	4.90	5.71	0.52	0.05	13.01	14.4	58.1	14.6	4.97	1.10	*	9.8	6.7	2.6	0.1	..	19.2	20.5
+300#	6.4	27.0	27.7	8.2	2.0	0.49	3.89	9.09	2.35	0.33	16.15	17.7	42.0	18.2	5.74	1.02	1.15	2.0	6.6	4.8	0.2	0.0	13.6	14.0
CS1	4.7	19.9	33.4	27.7	4.4	0.36	2.87	10.96	7.95	0.73	22.87	22.6	25.3	27.5	15.9	10.1	3.37	0.8	7.3	16.1	7.4	0.2	31.8	30.4
CS2	..	3.6	16.0	36.4	21.2	..	0.52	5.25	10.45	3.50	19.72	19.7	..	4.49	3.99	4.85	0.72	..	0.3	2.0	4.7	0.3	7.3	7.1
CS3	..	0.4	2.5	21.1	39.0	..	0.06	0.82	6.06	6.44	13.38	11.4	..	*	4.17	5.27	1.40	..	..	0.4	3.0	0.8	4.2	3.7
CS4	..	..	0.2	3.8	24.3	..	..	0.07	1.09	4.01	5.17	4.1	..	..	*	3.85	1.67	..	..	..	0.5	0.6	1.1	1.1
CS5	..	..	..	0.2	5.0	..	..	..	0.06	0.83	0.89	0.7	..	..	..	*	1.62	..	..	..	..	0.2	0.2	..
CS6	..	0.2	..	0.7	3.7	..	0.03	..	0.20	0.61	0.84	0.3	..	*	..	*	*	..	..	..	..	..	..	..
Total	100.0	100.0	100.0	100.0	100.0	7.61	14.41	32.82	28.71	16.52	100.07	100.0	48.0	16.5	8.56	5.96	1.39	33.8	22.1	26.1	15.9	2.1	100.0	100.0

* Insufficient sample for assay purposes—bulked with adjacent size fraction.

TABLE 2

Size Fraction	Product Sizing Analysis			Overall % Weight Distribution			Calc. Head Sizing Analysis	Original Head Sizing Analysis	Assays % Sn			Overall % Sn Distribution			Calc. Head Sn Dist.	Original Head Sn Dist.
	H/S U/F	H/S O/F	Cyclone O/F	H/S U/F	H/S O/F	Cyclone O/F			H/S U/F	H/S O/F	Cyclone O/F	H/S U/F	H/S O/F	Cyclone O/F		
+ 72#	0.7	..	..	0.55	..	..	0.55	0.9	*	..	..	..	..	..	..	1.0
+100#	2.2	0.1	0.1	1.73	0.01	0.02	1.76	2.4	21.6	*	*	5.0	..	..	5.0	6.8
+150#	6.3	0.1	..	4.95	0.01	..	4.96	5.8	28.2	*	..	14.2	..	..	14.2	15.4
+200#	16.6	0.2	0.3	13.03	0.01	0.05	13.09	14.4	14.9	*	*	19.7	..	..	19.7	20.5
+300#	20.6	0.5	2.0	16.17	0.03	0.33	16.53	17.7	8.19	3.03	1.15	13.5	0.0	0.0	13.5	14.0
CS1	24.2	3.6	4.4	19.00	0.18	0.73	19.91	22.6	16.5	10.9	3.37	31.9	0.2	0.2	32.3	30.4
CS2	20.8	24.4	21.2	16.33	1.22	3.50	21.05	19.7	4.49	4.69	0.72	7.4	0.6	0.3	8.3	7.1
CS3	7.4	50.4	39.0	5.81	2.52	6.44	14.77	11.4	5.17	4.59	1.40	3.6	1.2	0.9	5.7	3.7
CS4	1.2	18.2	24.3	0.94	0.91	4.01	5.86	4.1	*	3.62	1.67	..	0.3	0.7	1.0	1.1
CS5	..	1.9	5.0	..	0.10	0.83	0.93	0.7	..	1.86	1.62	..	0.0	0.2	0.2	..
CS6	..	0.6	3.7	..	0.03	0.61	0.64	0.3	..	*	*	..	..	..	..	..
Total	100.0	100.0	100.0	78.51	5.02	16.52	100.05	100.0	12.0	4.58	1.39	95.3	2.3	2.3	99.9	100.0

* Insufficient sample for assay purposes—bulked with adjacent size fraction.