TR18_157-172

R.653. Cassiterite recovery tests on ore from the Razorback mine, Dundas.

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Minops Pty Ltd requested that cassiterite recovery tests be carried out on samples of oxidised ore from the Razorback mine, Dundas. Initially it was proposed that the investigation use a sample composited from head samples 1 to 25, but later the investigation was extended to include a coarser run of mine sample. Minops defined the test method for the second sample.

SAMPLE

Composite sample (Sample A)

This sample was made from residual portions of head samples 1 to 25 submitted for tin and sizing analysis. The composite was not made on a weighed basis. In general, the material from each sample had a similar oxidised nature, containing minor amounts of a white clay material, probably talc, and small amounts of a grey unoxidised rock material. Sample 13 was the only exception, being composed entirely of a grey unoxidised rock material.

The composite sample, reduced to -4.76 mm, assayed as follows:

Sn 0.78% S 0.24% Cr 0.54% (Cr_2O_3 0.79%)

The -4.76 mm composite sample gave the following results for sizing analysis and tin distribution. The cyclosizing was done at 11°C.

Fraction	*% Mass*	*% Cum. Mass*	*% Sn*	*% Sn Distn*	*% Cum. Sn Distn*
+2.36 mm	10.0	10.0	0.34	4.5	4.5
+1.18 mm	14.1	24.1	0.47	8.8	13.3
+600 µm	11.3	35.4	0.64	9.6	22.9
+300 µm	9.9	45.3	0.82	10.8	33.7
+150 µm	7.6	52.9	1.31	13.3	47.0
+75 µm	11.7	64.6	1.48	23.1	70.1
C/S1	1.5	66.1	9.51	19.0	89.1
C/S2	2.9	69.0	0.56	2.2	91.3
C/S3	4.1	73.1	0.40	2.2	93.5
C/S4	4.3	77.4	0.31	1.8	95.3
C/S5	2.5	79.9	0.22	0.7	96.0
O/F	20.1	100.0	0.15	4.0	100.0
Head	100.0	-	(0.75)	100.0	-

Note: Wet then dry screened; -75 mm material cyclosized.

The head samples used to make the composite were as follows:

Reg. No.	*Minops Test No.*	*% Sn*	*Remarks*
722774	1	0.40	
722784	3	0.39	Fines only.
722788	5	0.30	
722789	6	0.42	
722960	7	0.84	
722961	8	0.51	
722962	9	0.34	
722963	10	1.42	

Reg. No.	*Minops Test No.*	*% Sn*	*Remarks*
722964	11	0.87	
722965	12	1.31	
722966	13	0.59	Rock material different from rest.
723003	14	0.39	
723007	15	0.59	
723011	16	5.80	
723015	17	0.65	Two tests combined (17 and 18).
723019	19	0.60	
723320	20	0.23	
723324	21	0.35	
723328	22	0.29	
723332	23	0.10	
723336	24	0.13	
723340	25	0.26	

Run of mine sample. (Sample B)

The sample, as received, consisted of large lumps of heavily oxidised iron rich material, (which was relatively easily broken), together with minor amounts of white clay lumps and undecomposed rock material. The particle size of the material and proposed ore dressing treatment, prevented an immediate head sample analysis, but, after autogenous grinding the results given in Table 1 were obtained from samples taken.

METHOD

SAMPLE A

Test N1

(1) 10 kg of -4.76 mm ore were staged ground through 150 µm in a laboratory ball mill. Grinding conditions were as follows:
  (*a*) approximately 60% solids;
  (*b*) 1 kg ore charges;
  (*c*) grinding time 3 minutes.

  Note: No screening was carried out prior to stage grinding.

(2) The -150 µm ore was wet screened on a Sweco vibrating screen producing +76 µm (Sweco +200#), +53 µm (Sweco +300#) and -53 µm size fractions.

  The +76 µm fraction was wet screened by hand giving a further fraction of +106 µm. (No suitable Sweco screen was available).

(3) The four sized fractions were individually concentrated on a Deister laboratory table producing a concentrate, middling and tailing. No table middling was produced for the -53 µm fraction.

(4) The four table concentrates were dried, and then individually magnetically separated on a Rapid high-intensity dry magnetic separator.

(5) The non-magnetics from the -53 µm table concentrate was subjected to froth flotation in a Denver D1 laboratory flotation cell. Two stages of cleaning were employed and the flotation tailings

Table 1. ANALYSIS OF RUN OF MINE SAMPLE AFTER AUTOGENOUS GRINDING

Fraction	Fraction µm	% Mass	% Sn	% S	% Fe	% Cr	% As	% Sn Distn	% S Distn	% Fe Distn	% Cr Distn	% As Distn
+½ inch	+12 700	10.95	0.54	0.08	36.8	0.21	0.12	9.0	12.3	12.9	4.5	5.5
Sweco +28#	+590	25.10	0.67	0.02	32.8	0.48	0.21	25.7	7.0	26.3	23.7	22.1
Secondary Sweco -28#	-590	36.05	(0.63)	(0.04)	(34.0)	(0.40)	(0.18)	34.7	19.3	39.2	28.2	27.6
Primary Sweco -28#	-590	63.95	0.67	0.09	29.7	0.57	0.27	65.3	80.7	60.8	71.8	72.4
Head		100.00	(0.66)	(0.07)	(31.3)	(0.51)	(0.24)	100.0	100.0	100.0	100.0	100.0

Note: The origin of the above fractions is explained more fully later in this report.

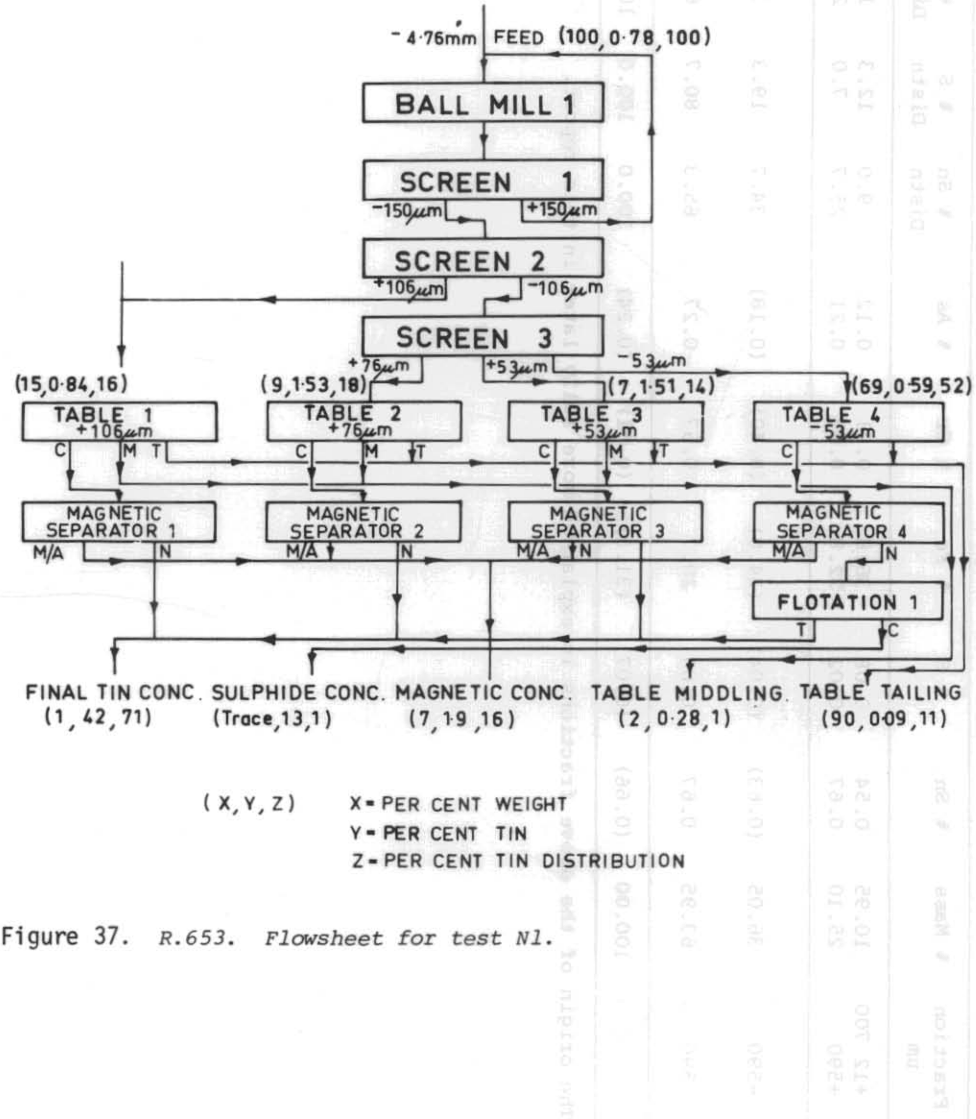

Figure 37. *R.653. Flowsheet for test N1.*

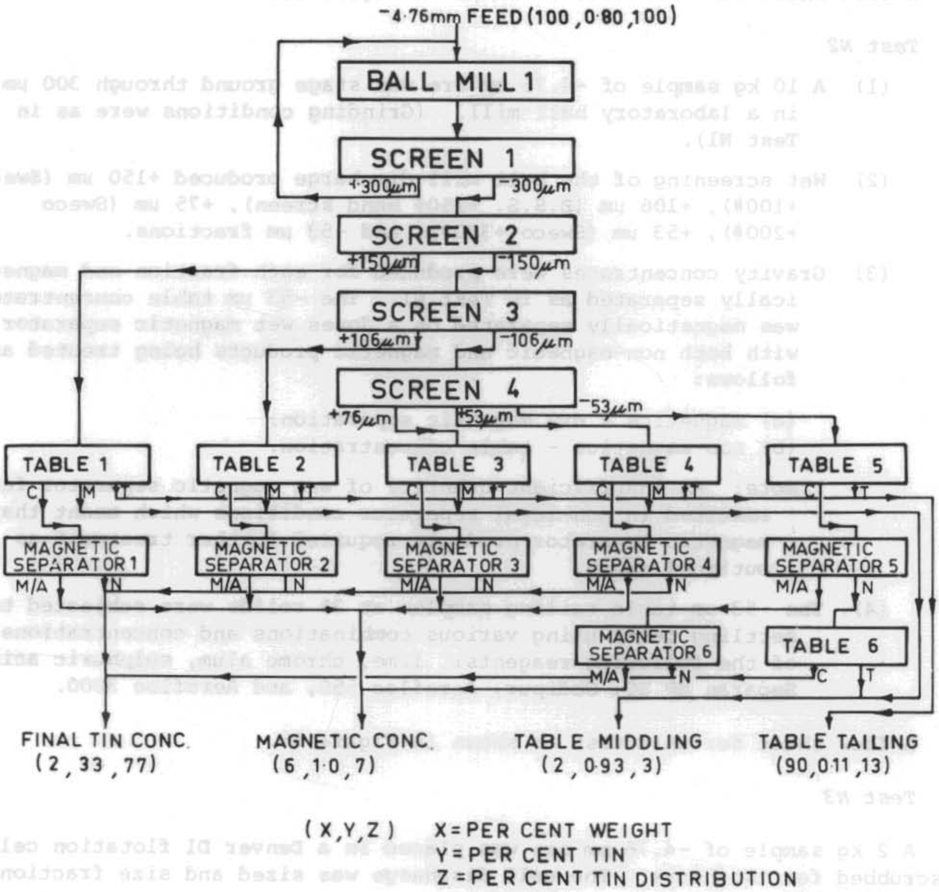

Figure 38. *R.653. Flowsheet for test N2.*

were bulked. The following reagents were used:

(*a*) copper sulphate + sulphuric acid;
(*b*) potassium amyl xanthate + sodium ethyl xanthate;
(*c*) methyl iso-butyl carbinol (MIBC).

Note: Insufficient quantities of other non-magnetic fractions of table concentrates prevented their flotation. No grinding prior to flotation was carried out.

A flow sheet for this test is shown in Figure 37.

Test N2

(1) A 10 kg sample of -4.76 mm ore was stage ground through 300 μm in a laboratory ball mill. (Grinding conditions were as in Test N1).

(2) Wet screening of the ball mill discharge produced +150 μm (Sweco +100#), +106 μm (B.S.S. +150# hand screen), +75 μm (Sweco +200#), +53 μm (Sweco +300#), and -53 μm fractions.

(3) Gravity concentrates were produced for each fraction and magnetically separated as in Test N1. The -53 μm table concentrate was magnetically separated on a Jones wet magnetic separator with both non-magnetic and magnetic products being treated as follows:

(*a*) magnetics - dry magnetic separation;
(*b*) non-magnetics - table concentration.

Note: An insufficient quantity of wet magnetic separator feed resulted in non-ideal separator conditions which meant that magnetic separator products required further treatment as outlined above.

(4) The -53 μm table tailing samples at 3% solids were subjected to settling tests using various combinations and concentrations of the following reagents: lime, chrome alum, sulphuric acid, Separan NP 20, Sedipur, Aerofloc 550, and Aerofloc 3000.

A flow sheet for this test is shown in Figure 38.

Test N3

A 2 kg sample of -4.76 mm ore was placed in a Denver D1 flotation cell and scrubbed for two hours. The cell discharge was sized and size fractions were assayed for tin.

SAMPLE B

Test N4

(1) Run of mine ore was crushed to -3¾ inch and autogenously ground in a 31 cm diameter x 102 cm mill fitted with a discharge grate containing ½ inch diameter openings.

(2) The -½ inch grate discharge was wet screened on a Sweco vibrating screen at 590 μm (28#). The -590 μm fraction was termed primary -590 μm.

(3) The +½ inch material was removed from the ball mill and jaw crushed to -½ inch and added to the +590 μm fraction from the Sweco screening.

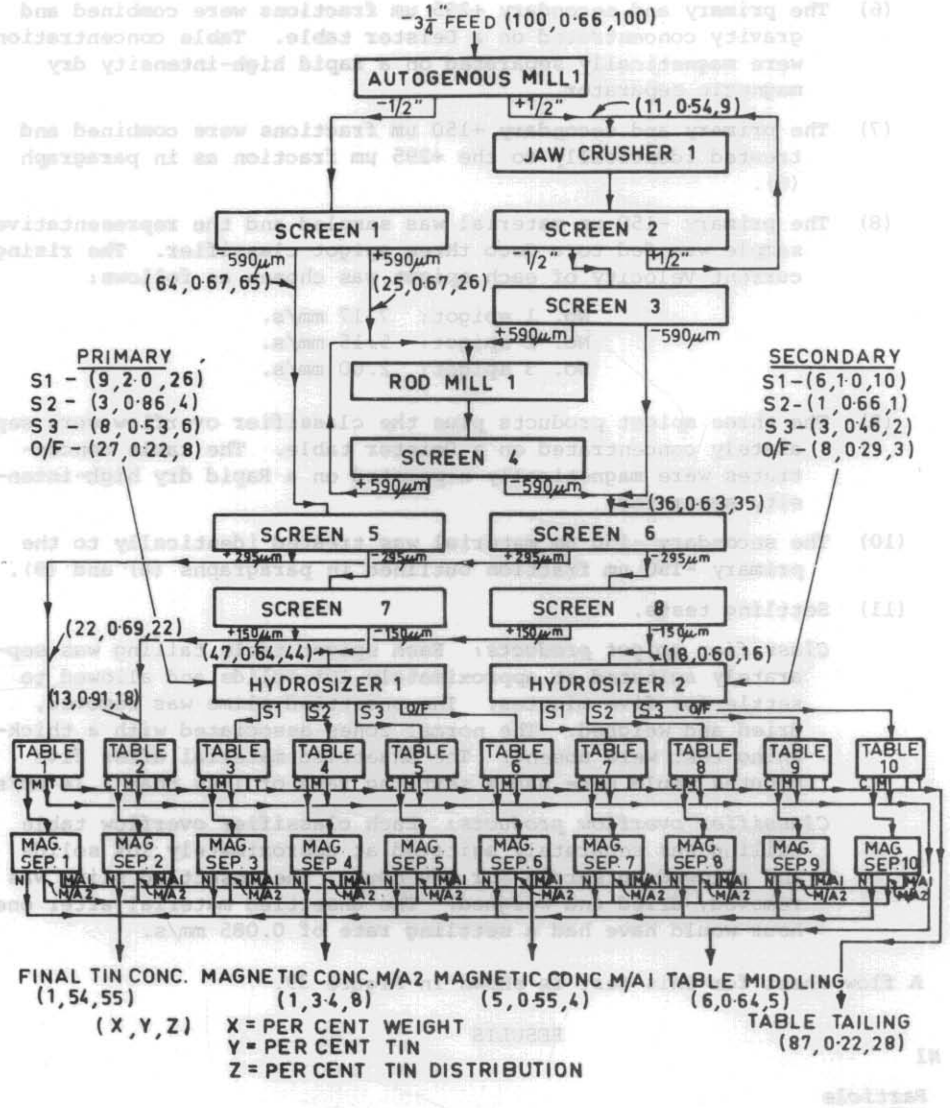

Figure 39. *R.653. Flowsheet for test N4.*

(4) The total +590 µm fraction was fed to a 31 cm diameter x 102 cm rod mill in closed circuit with a 590 µm Sweco screen. The -590 µm material produced was termed secondary -590 µm.

(5) Both the primary and secondary -590 µm fractions were separately screened on a Sweco vibrating screen producing -590 µm +295 µm (Sweco +50#), -295 µm +150 µm (Sweco +90#) and -150 µm fractions.

(6) The primary and secondary +295 µm fractions were combined and gravity concentrated on a Deister table. Table concentrations were magnetically separated on a Rapid high-intensity dry magnetic separator.

(7) The primary and secondary +150 µm fractions were combined and treated identically to the +295 µm fraction as in paragraph (6).

(8) The primary -150 µm material was sampled and the representative sample was fed to a Geco three spigot classifier. The rising current velocity of each spigot was chosen as follows:

No. 1 spigot: 7.17 mm/s.
No. 2 spigot: 5.15 mm/s.
No. 3 spigot: 2.00 mm/s.

(9) The three spigot products plus the classifier overflow were separately concentrated on a Deister table. The table concentrates were magnetically separated on a Rapid dry high-intensity separator.

(10) The secondary -150 µm material was treated identically to the primary -150 µm fraction outlined in paragraphs (8) and (9).

(11) Settling tests.

Classifier spigot products: Each spigot table tailing was separately agitated at approximately 10% solids and allowed to settle for five minutes. The unsettled slime was removed, dried and weighed. The normal zones associated with a thickening test were absent. The unsettled material after five minutes would have had a settling rate of less than 1.14 mm/s.

Classifier overflow products: Each classifier overflow table tailing was separately agitated at approximately 10% solids and allowed to settle for one hour. The unsettled slime was removed, dried and weighed. The unsettled material after one hour would have had a settling rate of 0.085 mm/s.

A flow sheet for this test is shown in Figure 39.

RESULTS

Test N1

Particle Size (µm)	*Fraction*	*% Mass*	*% Sn*	*% Sn Distn*
-150 +106	M/S1 N	0.19	51.5	12.5
	M/S1 M/A	1.15	1.11	1.6
	T1C	1.34	(8.26)	14.1
	T1M	0.80	0.26	0.3
	T1T	12.51	0.08	1.3
	H1	14.65	(0.84)	15.7

Particle Size (µm)	*Fraction*	*% Mass*	*% Sn*	*% Sn Distn*
+76	M/S2 N	0.21	58.6	15.7
	M/S2 M/A	0.82	1.47	1.6
	T2C	1.03	(13.1)	17.3
	T2M	0.48	0.33	0.2
	T2T	7.76	0.07	0.7
	H2	9.27	(1.53)	18.2
+53	M/S3 N	0.19	51.4	12.5
	M/S3 M/A	0.77	1.18	1.1
	T3C	0.96	(11.1)	13.6
	T3M	0.26	0.24	0.1
	T3T	6.18	0.07	0.6
	H3	7.40	(1.51)	14.3
-53	F1T	0.73	32.8	30.6
	F1C	0.09	13.0	1.5
	M/S4 N	0.82	(30.7)	32.1
	M/S4 M/A	3.92	2.30	11.5
	T4C	4.74	(7.21)	43.6
	T4T	63.94	0.10	8.2
	H4	68.68	(0.59)	51.8
	H	100.00	(0.78)	100.0
Summary	Total C	1.32	(42.3)	71.3
	Total TM	1.54	(0.28)	0.6
	Total M/S M/A	6.66	(1.86)	15.8
	F1C	0.09	13.0	1.5
	Total TT	90.39	(0.09)	10.8
	Head	100.00	(0.78)	100.00

Test N2

Concentration

Particle size (µm)	*Fraction*	*% Mass*	*% Sn*	*% Sn Distn*
-300 +150	M/S1 N	0.25	27.8	8.7
	M/S1 M/A	0.51	0.65	0.4
	T1C	0.76	(9.58)	9.1
	T1M	1.01	0.37	0.5
	T1T	10.33	0.08	1.0
	H1	12.10	(0.70)	10.6

Particle size (μm)	*Fraction*	*% Mass*	*% Sn*	*% Sn Distn*
+106	M/S2 N	0.41	38.3	19.7
	M/S2 M/A	1.01	0.72	0.9
	T2C	1.42	(11.6)	20.6
	T2M	0.52	0.40	0.3
	T2T	16.74	0.10	2.1
	H2	18.68	(0.98)	23.0
+76	M/S3 N	0.23	40.9	11.8
	M/S3 M/A	0.53	0.92	0.6
	T3C	0.76	(13.0)	12.4
	T3M	0.16	0.49	0.1
	T3T	5.16	0.09	0.6
	H3	6.08	(1.72)	13.1
+53	M/S4 N	0.23	36.2	10.4
	M/S4 M/A	0.39	1.23	0.6
	T4C	0.62	(14.2)	11.0
	T4M	0.12	0.46	0.1
	T4T	4.33	0.08	0.4
	H4	5.07	(1.82)	11.5
-53	M/S6 N	0.16	31.4	6.3
	M/S6 M/A	3.25	1.13	4.6
	M/S5 M/A	3.41	(2.55)	10.9
	T6C	0.61	26.2	20.0
	T6T*	0.78	2.20	2.2
	M/S5 N	1.39	(12.7)	22.2
	T5C	4.80	(5.50)	33.1
	T5T	53.27	0.13	8.7
	H5	58.07	0.57	41.8
	Head	100.00	0.80	100.00

*added to 'Total TM' in summary

Summary

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
Total C	1.89	(32.50)	76.9
Total T/M	2.59	(0.93)	3.2
Total T/T	89.83	(0.11)	12.8
Total M/S M/A	5.69	(1.00)	7.1
Head	100.00	(0.80)	100.0

-53 µm T5T settling tests. These tests were conducted at 12°C, 3% solids and at an initial pH of 6.9.

Flocculant or Reagent	*Reagent g/t*	*Free settling velocity mm/s*	*Overflow Turbidity*
Lime	1000	0.095	Murky
Nil	-	0.100	Murky
Lime	330	0.102	Murky
Chrome alum	330	0.105	Murky
H_2SO_4	330	0.108	Clear
H_2SO_4	1000	0.113	Very clear
Chrome alum	1000	0.115	Murky
Separan NP20	7	0.127	Clear
Sedipur	7	0.127	Murky
Aerofloc 3000	7	0.143	Murky
Aerofloc 550	7	0.175	Murky
Separan NP20	20	0.197	Clear
Separan NP20 H_2SO_4	7 330	0.198	Reasonably clear
Separan NP20 Lime	13 1000	0.230	Murky
Sedipur	20	0.240	Murky
Aerofloc 3000	20	0.278	Murky
Aerofloc 550	70	0.400	Murky
Separan NP20 H_2SO_4	70 330	0.600	Very clear

Settled solids contained approximately 20% solids.

Test N3

Fraction	*% Mass*	*% Sn*	*% Sn Distn*	*Cum. % Sn Distn*
-4.76 mm +2.36 mm	0.1	1.47	0.2	0.2
+1.18 mm	4.0	0.56	2.9	3.1
+600 µm	6.8	0.56	5.0	8.1
+300 µm	4.2	0.99	5.4	13.5
+150 µm	2.7	2.32	8.2	21.7
+75 µm	3.4	2.78	12.4	34.1
C/S1	4.0	7.37	35.3	69.4
C/S2	3.6	1.67	7.2	76.6
C/S3	5.8	1.05	7.3	83.9
C/S4	8.7	0.60	6.3	90.2
C/S5	5.8	0.44	3.1	93.3
O/F	50.9	0.11	6.7	100.0
Head	100.0	(0.81)	100.0	-

The cyclosizing was done at 11°C.

Comparing the sizing analysis and tin distribution obtained in Test N3 with the sizing analysis and tin distribution of the original -4.76 mm composite sample, shown at the beginning of this report, it can be seen that vigorous scrubbing gives an appreciable diminution in particle size. Fifty per cent of the ore (instead of 20%) is now situated in the -8 µm fraction. A great alteration in tin distribution has also occurred. A suitable scrubbing and cycloning operation could dispose of 50% of the ore without the loss of any recoverable tin. The effect of this operation would be to double mill feed tin grade.

Test N4

Summary of autogenous products

Fraction	*Fraction µm*	*% Mass*	*% Sn*	*% Distn*
+½ inch	+12 700	10.95	0.54	9.0
Sweco +28	+590	25.10	0.67	25.7
Secondary Sweco -28	Secondary -590	36.05	(0.63)	100.0
Primary Sweco -28	Primary -590	63.95	0.67	65.3
Head		100.00	(0.66)	100.0

Summary of tin distribution in -590 µm fraction

Fraction	*% Mass*	*% Sn*	*% Sn Distn*	*Cum. % Sn Distn*
-590 µm +295 µm	21.47	(0.69)	21.7	21.7
+150 µm	13.34	(0.91)	17.9	39.6
S1	15.15	(1.59)	35.3	74.9
S2	4.24	(0.80)	5.0	79.9
S3	11.14	(0.51)	8.3	88.2
O/F	34.66	(0.23)	11.8	100.0
Head -590 µm	100.00	(0.68)	100.0	-

Concentration of total -590 µm +295 µm

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
M/S1 M/A1	0.60	0.35	0.3
M/S1 M/A2	0.08	15.40	1.8
M/S1 N	0.10	50.5	7.4
T1C	0.78	(8.32)	9.5
T1M	0.65	1.37	1.3
T1T	20.04	0.37	10.9
H1	21.47	(0.69)	21.7

Concentration of total -295 µm +150 µm

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
M/S2 M/A1	0.48	0.42	0.3
M/S2 M/A2	0.11	11.9	1.9
M/S2 N	0.09	63.6	8.4
T2C	0.68	(10.6)	10.6
T2M	0.76	1.66	1.9
T2T	11.90	0.31	5.4
H2	13.34	0.91	17.9

The composition of the -590 µm +150 µm fraction

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
Primary -590 µm +150 µm	16.70	0.83	20.3
Secondary -590 µm +150 µm	18.11	0.73	19.6
H1 + H2	34.81	0.78	39.6

The concentration of the primary -150 µm classifier products

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
M/S3 M/A1	0.61	0.14	0.1
M/S3 M/A2	0.50	2.20	1.6
M/S3 N	0.23	63.3	21.4
T3C	1.34	(11.8)	23.1
T3M	0.70	0.55	0.6
T3T	6.79	0.21	2.1
H/S1 S1 H	8.83	(1.99)	25.8
M/S4 M/A1	0.23	0.24	0.1
M/S4 M/A2	0.02	10.1	0.3
M/S4 N	0.03	60.1	2.6
T4C	0.28	(7.36)	3.0
T4M	0.14	0.48	0.1
T4T	2.69	0.20	0.8
H/S1 S2 H	3.11	(0.86)	3.9
M/S5 M/A1	0.21	0.44	0.1
M/S5 M/A2	0.05	6.31	0.5
M/S5 N	0.05	50.9	3.7
T5C	0.31	(9.53)	4.3
T5M	0.51	0.53	0.4
T5T	7.21	0.14	1.5
H/S1 S3 H	8.03	(0.53)	6.2
M/S6 M/A1	1.43	1.06	2.2
M/S6 M/A2	0.25	2.44	0.9
M/S6 N	0.06	11.0	0.9
T6C	1.74	(1.60)	4.0
T6M	2.89	0.14	0.6
T6T	22.65	0.12	4.0
H/S1 O/F H	27.28	(0.22)	8.6
Primary -150 µm Head	47.25	(0.64)	44.5

The concentration of the secondary -150 μm classifier products

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
M/S7 M/A1	0.40	0.15	0.1
M/S7 M/A2	0.29	0.14	Tr.(0.06)
M/S7 N	0.09	60.5	8.0
T7C	0.78	(7.11)	8.1
T7M	0.89	0.33	0.4
T7T	4.65	0.14	1.0
H/S2 S1 H	6.32	(1.03)	9.5
M/S8 M/A1	0.12	0.19	Tr.(0.03)
M/S8 M/A2	0.04	1.70	0.1
M/S8 N	0.01	51.9	0.8
T8C	0.17	(3.59)	0.9
T8M	0.11	0.19	Tr.(0.03)
T8T	0.85	0.13	0.2
H/S2 S2 H	1.13	(0.66)	1.1
M/S9 M/A1	0.14	0.32	0.1
M/S9 M/A2	0.03	3.27	0.1
M/S9 N	0.02	46.8	1.4
T9C	0.19	(5.68)	1.6
T9M	0.36	0.19	0.1
T9T	2.56	0.11	0.4
H/S2 S3 H	3.11	(0.46)	2.1
M/S10 M/A1	0.42	0.67	0.4
M/S10 M/A2	0.17	1.66	0.4
M/S10 N	0.02	16.4	0.5
T10C	0.61	1.46	1.3
T10M	1.55	0.24	0.6
T10T	5.22	0.17	1.3
H/S2 O/F H	7.38	(0.29)	3.2
Secondary -150 μm Head	17.94	0.60	15.9

Summary of concentration Test N4

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
Total T/C	0.70	(53.7)	55.1
Total M/S M/A1	4.64	(0.55)	3.7
Total M/S M/A2	1.54	(3.41)	7.6
Total T/M	5.67	(0.64)	5.4
Total T/T	87.45	(0.22)	28.2
Head	100.00	(0.68)	-

Note: Total tailings figures given incorporate the fraction primary H/S1 O/F TM or T6M.

The distribution of tin in the -590 μm +295 μm table tailings (T1T)

Screen Aperture (μm)	% Mass	% Sn	% Sn Distn	Cum. % Sn Distn
+600	0.24	0.86	0.3	0.3
+500	2.87	0.47	1.9	2.2
+425	3.91	0.36	2.0	4.2
+355	3.57	0.36	1.9	6.1
+300	3.24	0.34	1.6	7.7
+250	3.63	0.39	2.0	9.7
+212	1.06	0.35	0.5	10.2
+150	0.60	0.28	0.2	10.4
+75	0.28	0.26	0.1	10.5
+38	0.08	0.41	0.1	10.6
-38	0.56	0.34	0.3	10.9
Head T1T	20.04	0.38	10.9	-

The distribution of tin in the -295 μm +150 μm table tailing (T2T)

Screen Aperture (μm)	% Mass	% Sn	% Sn Distn	Cum. % Sn Distn
+600 +300	0.05	0.47	Tr. (0.03)	Tr.
+250	2.05	0.41	1.3	1.3
+212	3.03	0.29	1.4	2.7
+180	3.22	0.29	1.4	4.1
+150	0.43	0.31	0.2	4.3
+125	1.32	0.24	0.5	4.8
+75	0.51	0.19	0.1	4.9
+38	0.29	0.17	0.1	5.0
-38	1.00	0.24	0.4	5.4
Head T2T	11.90	(0.30)	5.4	-

Settling tests of classifier sands, table tailing products

Product	% Mass	
	Settling Velocity >1.14 mm/s	Settling Velocity <1.14 mm/s
T3T	99.7	0.3
T4T	98.6	1.4
T5T	97.0	3.0
T7T	99.6	0.4
T8T	97.6	2.4
T9T	98.7	1.3

Although these products are from hydraulic classification the oxidised nature of the ore has meant the generation of slime at every subsequent handling.

Settling tests of the classifier overflow table tailing products

Product	% Mass of material Settling velocity >0.085 mm/s
T6T	99.5
T10T	99.0

CONCLUSION

A summary of concentrates produced is given below:

Test No.	Sample	Size of Grind	Concentrate		
			% Mass	*% Sn*	*% Recovery*
N1	A	-150 µm	1.32	42.3	71.3
N2	A	-300 µm	1.89	32.5	76.9
N4	B	-590 µm	0.70	53.7	55.1

Tests N1 and N2 produced lower tin contents in tailings than the corresponding tailings of the much coarser grind test N4. The two coarsest tailings of Test N4 have tin distributions such that the tin present is contained in coarse particles as composites. Secondary grinding and concentration of these tailings would enhance the low recovery (55.1%) of Test N4.

Magnetic separation has indicated that some magnetic cassiterite is present in the ore. The high tin content of some of the coarser magnetic fractions has also shown that composite tin particles may require regrinding.

Lack of gravity concentrate quantity prevented overall sulphide removal by flotation. However this was attempted with the product M/S4 N of Test N1 and proved quite conventional. It should be noted that samples A and B varied quite considerably in sulphur content (0.24% and 0.07% respectively).

The nature of the ore is such that slimes could be generated at every subsequent handling operation if high intensity scrubbing is not incorporated initially in the ore treatment programme. The possibility of rejection of fine slime material by cycloning still requires investigation. The value of the use of a high intensity scrubber followed by cycloning must not be overlooked. It could allow the immediate removal of half the ore without loss of recoverable tin, double the mill feed tin grade, and prevent overloading or large duplication of concentration equipment such as vanners etc.

Sulphuric acid was found to aid flocculation (during settling tests of -53 µm material) producing a clear overflow. The optimum addition of sulphuric acid would need to be established.

[8 June 1973]