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R.699. Treatment of primary middlings and magnetic products from the Razorback Mine, Dundas.

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This report deals with the metallurgical treatment of primary middlings and primary magnetics, produced in investigations R.686 and R.691.

The treatment aimed to determine the recovery of market grade tin concentrates that could be obtained from the retreatment of primary gravity middlings and primary magnetics.

The investigation was performed separately on four composite samples individually compiled on a weighted basis from:

(1) H1 primary middlings.
(2) H1 primary magnetics.
(3) C7 U/F primary middlings.
(4) C7 U/F primary magnetics.

These products were produced in investigation R.691.

Each sample was subjected to the following treatment:

(*a*) Stage grinding in a laboratory ball mill to -150 µm.

(*b*) Wet magnetic separation of the -150 µm material in a Jones magnetic separator. Wash water was set at 1.5 litres per minute, pole current at 40 A and pulse water at 345 kPa (50 p.s.i.). Magnetic fractions from the first pass were given a further treatment in the magnetic separator using the same initial conditions. Respective products from both operations were bulked.

(*c*) Jones non-magnetic fractions were sized prior to gravity concentration. Gravity concentration was performed on a Deister table where a sufficient quantity of sized material was available. Where only small amounts of material were available, gravity concentration was performed on a super panner.

(*d*) The Jones non-magnetic gravity concentrates of composite sample C7 U/F primary middlings were further separated on a Rapid high intensity dry magnetic separator.

RESULTS

The concentration of primary middlings of Sample H1. (T1), ball mill ground to -150 µm.

(a) Jones wet magnetic separation

Fraction		*% Mass*	*% Sn*	*% Sn Distn*
M/S	M/A1	0.02	0.55	Trace
M/S	M/A2	0.79	0.35	0.4
M/S	M	0.11	0.71	0.1
M/S	N	1.05	0.68	0.9
Head		1.97	(0.55)	1.4

(b) Gravity concentration of Jones non-magnetics

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
+38 µm PC	Trace (0.002)	60.20	0.1
+38 µm PM	0.01	5.30	0.1
+38 µm PT	0.37	0.23	0.1
+38 µm F	0.38	(0.63)	0.3
-38 µm TC	0.01	21.30	0.3
-38 µm TM	0.19	0.43	0.1
-38 µm TT	0.47	0.30	0.2
-38 µm F	0.67	(0.62)	0.7
Jones M/S N	1.05	(0.62)	0.9

(c) Overall concentration summary

Fraction	*% Mass*	*% Sn*	*% Sn Distn*	*Individual % Sn Distn*
M/S N ΣTC	0.01	(27.30)	0.4	28.8
M/S N ΣTM	0.20	(0.66)	0.2	13.4
M/S N ΣTT	0.84	(0.27)	0.3	22.0
M/S M	0.11	0.71	0.1	7.9
ΣM/S M/A	0.81	(0.35)	0.4	27.9
Head	1.97	(0.52)	1.4	100.0

M from Jones M/S is the washings
P is the super panner

The concentration of primary magnetics of Sample H1, (T1). Ball mill ground to -150 µm.

(a) Jones wet magnetic separation

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
M/S M/A1	0.03	1.49	0.1
M/S M/A2	2.12	0.86	2.8
M/S M	0.15	5.20	1.2
M/S N	0.85	7.20	9.3
Head	3.15	(2.78)	13.4

(b) Gravity concentration of Jones non-magnetics

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
+38 µm PC	0.02	72.0	2.8
+38 µm PT	0.10	5.0	0.8
+38 µm F	0.12	(18.4)	3.6
-38 µm TC	0.11	23.20	4.2
-38 µm TT	0.62	(1.46)	1.5
-38 µm F	0.73	(4.77)	5.7
Jones M/S N	0.85	(6.70)	9.3

(c) Overall concentration summary

Fraction	*% Mass*	*% Sn*	*% Sn Distn*	*Individual % Sn Distn*
M/SN ΣTC	0.13	(32.00)	7.0	51.7
M/SN ΣTT	0.72	(1.94)	2.3	16.6
M/S M	0.15	5.20	1.2	9.3
ΣM/S M/A	2.15	(0.87)	2.9	22.4
Head	3.15	(2.65)	13.4	100.0

The concentration of primary middlings of Sample C7 U/F, (T11). Ball mill ground to -150 µm.

(a) Jones wet magnetic separation

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
M/S M/A1	0.06	0.28	Trace
M/S M/A2	4.64	0.48	2.0
M/S M	1.86	0.70	1.2
M/S N	4.34	0.98	3.9
Head	10.90	(0.72)	7.1

(b) Gravity concentration and Rapid dry magnetic separation of Jones non-magnetics

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
+105 µm TC M/S N	0.01	53.1	0.4
+105 µm TC M/S M/A	0.03	1.5	Trace
+105 µm TC	0.04	(11.4)	0.4
+105 µm TM	0.09	1.0	0.1
+105 µm TT	0.44	0.21	0.1
+105 µm F	0.57	(1.15)	0.6
+75 µm TC M/S N	0.01	52.5	0.5
+75 µm TC M/S M/A	0.03	0.75	Trace

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
+75 µm TC	0.04	(16.5)	0.5
+75 µm TM	0.09	1.0	0.1
+75 µm TT	0.45	0.23	0.1
+75 µm F	0.58	(1.32)	0.7
+38 µm TC M/S N	0.02	40.5	0.9
+38 µm TC M/S M/A	0.05	0.44	Trace
+38 µm TC	0.07	(14.1)	0.9
+38 µm TM	0.25	0.50	0.1
+38 µm TT	0.61	0.20	0.1
+38 µm F	0.93	(1.38)	1.1
-38 µm TC M/S N	0.04	21.6	0.7
-38 µm TC M/S M/A	0.20	1.8	0.3
-38 µm TC	0.24	(4.7)	1.0
-38 µm TM	0.09	0.47	Trace
-38 µm TT	1.93	0.30	0.5
-38 µm F	2.26	(0.77)	1.5

(c) Summary of gravity concentration and Rapid dry magnetic separation

Fraction	*% Mass*	*% Sn*	*% Sn Distn*	*Individual % Sn Distn*
TC M/S N	0.08	(35.0)	2.5	61.8
TC M/S M/A	0.31	(1.47)	0.3	10.2
TM	0.52	(0.67)	0.3	7.7
TT	3.43	(0.26)	0.8	20.3
Jones M/S N	4.34	(1.02)	3.9	100.0

(d) Overall concentration summary

Fraction	*% Mass*	*% Sn*	*% Sn Distn*	*Individual % Sn Distn*
TC M/S N	0.08	(35.0)	2.5	34.4
TM	0.52	(0.67)	0.3	4.3
TT	3.43	(0.26)	0.8	11.3
M/S M/A	5.01	(0.54)	2.3	33.7
M/S M	1.86	0.70	1.2	16.3
Head	10.90	(0.73)	7.1	100.0

The concentration of primary magnetics of sample C7 U/F, (T11). Ball mill ground to -150 µm

(a) Jones wet magnetic separation

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
M/S M/A1	0.02	2.45	0.1
M/S M/A2	1.76	2.00	4.2
M/S M	0.09	16.0	1.7
M/S N	0.59	19.5	13.5
Head	2.46	(6.69)	19.5

(b) Gravity concentration of Jones non magnetics

Fraction	*% Mass*	*% Sn*	*% Sn Distn*
+38 µm PC	0.06	72.9	5.1
+38 µm PT	0.04	7.5	0.4
+38 µm F	0.10	(46.1)	5.5
-38 µm TC	0.18	29.1	6.6
-38 µm TM	0.20	4.1	1.1
-38 µm TT	0.11	2.4	0.3
-38 µm F	0.49	(12.8)	8.0
Jones M/S N	0.59	(18.1)	13.5

(c) Overall concentration summary

Fraction	*% Mass*	*% Sn*	*% Sn Distn*	*Individual % Sn Distn*
M/S N ΣTC	0.24	(39.4)	11.7	58.8
M/S N ΣTM	0.24	(4.6)	1.5	7.2
M/S N ΣTT	0.11	2.40	0.3	1.7
M/S M	0.09	16.0	1.7	9.5
ΣM/S M/A	1.78	(2.01)	4.3	22.8
Head	2.46	(6.36)	19.5	100.0

DISCUSSION

The quantity of material available for concentration in each case was too small for satisfactory concentration on the Deister table. Some fractions were so small that it was necessary to use the super-panner for concentration.

It was shown on the super-panner that high grade (saleable) concentrates could be produced. The larger fractions which were concentrated on the Deister table were still too small for satisfactory table concentration in that the effect of 'feed on' and 'feed off' had a large influence on the grade of concentrate produced.

Discussion of the retreatment of the individual samples is as follows:

H1 Primary middlings

Stage ball mill grinding to -150 µm enabled a concentrate assaying 60.2% Sn to be produced by super-panning the +38 µm fraction for an increase in recovery of 0.1%. Tabling of the -38 µm fraction recovered a further 0.3% of the tin in a concentrate assaying 21.3%.

H1 Primary magnetics

After grinding to -150 µm and further magnetic separation about 68% of the tin in the primary magnetics reported in the non-magnetics at a grade of 7.2% Sn. However, the resulting magnetic product was still high in tin content (0.87% Sn) and may require further size reduction and magnetic separation. A concentrate assaying 72.0% Sn was produced by super-panning the +38 µm fraction of the non-magnetics with an increase in recovery of 2.8% of the tin. A further 4.2% of the tin was recovered by tabling the -38 µm fraction to produce a concentrate assaying 23.2% Sn.

C7 U/F Primary middlings

This sample responded poorly to separation in the Jones wet magnetic separator when reduced to -150 µm. The resulting non-magnetic fraction contained significant amounts of chromite and iron-rich minerals, mainly hematite. The gravity concentrates produced from this sample were therefore given a further magnetic separation on the Rapid dry magnetic separator. Table concentration of the +105 µm and +75 µm fractions followed by magnetic separation of the table concentrate yielded a product grade of 52.8% Sn and recovered an additional 0.9% of the tin. Similar treatment of the +38 µm and -38 µm fractions yielded a concentrate grade of 35.9% Sn with a further recovery of 1.6% of the tin.

C7 U/F Primary magnetics

After grinding to -150 µm and further magnetic separation about 69% of the tin in the primary magnetics now reported in the non-magnetics at a grade of 19.5% Sn. However, the resulting magnetic product was still high in tin content (2.01% Sn) and may require further size reduction and magnetic separation. A concentrate assaying 72.9% Sn was produced by super-panning the +38 µm fraction of the non-magnetics with an increase in recovery of 5.1%. A further 6.6% of the tin was recovered by tabling the -38 µm fraction to produce a concentrate assaying 29.1% Sn.

Selected magnetic concentrates and non-magnetic gravity concentrates were examined by XRF for niobium and tantalum but neither was observed in significant amounts.

CONCLUSIONS

Grinding and concentration of primary middlings and primary magnetics from H1 in investigation R.691 produced saleable concentrate assaying 71.2% Sn for a 2.9% improvement in recovery. Concentrate assaying 23.1% Sn was also produced for a further improvement of 4.5% in recovery. It should be possible to produce a saleable grade of concentrate from this latter product with some loss in the recovery stated.

Grinding and concentration of primary middlings and primary magnetics from C7 U/F in investigation R.691 produced saleable concentrate assaying 67.9% Sn for a 6.0% improvement in tin recovery. Concentrate assaying 29.2% Sn was also produced for a further improvement of 8.2% in recovery. It should

be possible to produce a saleable grade of concentrate from this latter product with some loss in the recovery stand.

Grinding the primary magnetics in both H1 and C7 U/F to -150 µm and again subjecting the respective materials to Jones wet magnetic separation enabled about 68% of the tin in the primary magnetics to report in the non-magnetics in each case.

Niobium and tantalum were not detected in significant amounts in selected concentrates.

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