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R832

ROSSARDEN SLIME TAILINGS RETREATMENT

Introduction

Mr. H. Stacpoole submitted two samples from tailings dams at Rossarden with a view to assessing tin and tungsten recovery from retreating this material.

The samples submitted were:-

830790 from Dam 1
830791 " Dam 2

As a preliminary assessment a sizing and distribution of tin and tungsten has been done on both samples.

Results

The results of these sizing tests are:-

830790: Dam 1

Fraction (μm)	Mass (%)		Assay (%)		Distribution (%)			
					Tin		Tungsten	
	Indiv.	Cum	Sn	WO_3	Indiv.	Cum	Indiv.	Cum
+4750	0.01	0.01	0.08	0.07	Tr.	Tr.	Tr.	Tr.
+2360	0.16	0.17	0.06	0.09	0.03	0.03	0.04	0.04
+1180	1.98	2.15	0.10	0.06	0.47	0.50	0.29	0.33
+ 600	3.09	5.24	0.07	0.06	0.52	1.02	0.45	0.78
+ 300	3.91	9.15	0.08	0.09	0.74	1.76	0.86	1.64
+ 150	4.75	13.90	0.15	0.14	1.69	3.45	1.63	3.27
+ 75	7.95	21.85	0.14	0.12	2.65	6.10	2.33	5.60
+ 38	16.48	38.33	0.19	0.17	7.44	13.54	6.86	12.46
C/S1	0.46	38.79	13.6	15.0	14.27	27.81	17.71	30.17
C/S2	1.02	39.81	2.9	2.6	6.75	34.56	6.80	36.97
C/S3	11.29	51.10	0.68	0.65	17.51	52.07	18.83	55.80
C/S4	11.96	63.06	0.52	0.43	14.18	66.25	13.20	69.00
C/S5	6.51	69.57	0.45	0.36	6.68	72.93	6.01	75.01
O/F	30.43	100	0.39	0.32	27.07	100	24.99	100
Head	100		0.41	0.40	100		100	

C/S Temperature 150

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830791: Dam 2

Fraction (μm)	Mass (%)		Assay (%)		Distribution (%)			
					Tin		Tungsten	
	Indiv.	Cum	Sn	WO_3	Indiv.	Cum	Indiv.	Cum
+9530	0.16	0.16	0.01	0.01	Tr.	Tr.	Tr.	Tr.
+4750	0.08	0.24	0.50	0.01	0.10	0.10	Tr.	Tr.
+2360	0.27	0.51	0.17	0.08	0.11	0.21	0.05	0.05
+1180	5.45	5.96	0.14	0.07	1.82	2.03	0.78	0.83
+ 600	11.52	17.48	0.11	0.06	3.01	5.04	1.40	2.23
+ 300	12.75	30.23	0.13	0.05	3.94	8.98	1.30	3.53
+ 150	10.86	41.09	0.15	0.07	3.88	12.86	1.54	5.07
+ 75	11.75	52.84	0.19	0.10	5.31	18.17	2.39	7.46
+ 38	14.02	66.86	0.61	0.60	20.34	38.51	17.10	24.56
C/S1	0.52	67.38	14.1	19.7	17.51	56.02	21.40	45.96
C/S2	0.83	68.21	3.6	4.6	7.13	63.15	7.98	53.94
C/S3	7.13	75.34	0.81	1.18	13.79	76.94	17.58	71.52
C/S4	7.38	82.72	0.53	0.73	9.34	86.28	11.26	82.78
C/S5	3.90	86.62	0.41	0.57	3.82	90.10	4.64	87.42
O/F	13.38	100	0.31	0.45	9.90	100	12.58	100
Head	100		0.41	0.48	100		100	

C/S Temperature 15°C.

Discussion

In order to assess possible recovery these two sizing analyses will be considered in three size ranges, namely:-

1. The plus 600μm material which is considered too coarse for retreatment and contains insufficient values for regrinding can be excluded from further consideration.

2. The material passing 600μm but retained in C/S2 can be considered that most likely to be recovered in retreatment and should be a reasonable guide to what can be achieved by a gravity recovery circuit such as is envisaged, and

3. The slime material, C/S3 and finer, may be worth concentrating although recovery from slime material cannot be expected to be very high in a gravity circuit.

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Applying the above to the results we have:-

830790 Dam 1

1. The coarse reject, -9.53mm; + 600µm, contains:-
   Mass 5%; Tin 1%; Tungsten 1%.
   and Assays 0.08% Sn; 0.06% WO_3
2. The main fraction for retreatment, -600µm to C/S2 contains:-
   Mass 35%; Tin 34%; Tungsten 36%
   and Assays 0.4% Sn; 0.4% WO_3.
3. The slime fraction, C/S3 and lower, contains:-
   Mass 60%; Tin 65%; Tungsten 63%
   and Assays 0.5% Sn; 0.4% WO_3.

830791 Dam 2

1. The coarse reject, -19.05mm; + 600µm, contains:-
   Mass 17%; Tin 5%; Tungsten 2%
   and Assays 0.1% Sn; 0.06% WO_3.
2. The main fraction for retreatment, -600µm to C/S2 contains:-
   Mass 51%; Tin 58%; Tungsten 52%
   and Assays 0.5% Sn; 0.5% WO_3.
3. The slime fraction, C/S3 and finer, contains:-
   Mass 32%; Tin 37%; Tungsten 46%
   and Assays 0.5% Sn; 0.7% WO_3.

Thus it can be seen that from 830790 about a third of the tin and tungsten are contained in what can be regarded as a recoverable fraction. Not all of this would be recovered in practice but some could be recovered from the slime material so that as a preliminary guide a recovery in a low grade tin product of say one third of the values seems at this stage a reasonable estimate.

With 830791 the prospects look better with the possible recovery of half the values in a low grade product.

The nature of the tin and tungsten occurrence can be gauged from the close relationship between the distribution of mass and values in the fractions of interest above. This suggests a fairly uniform distribution of the values indicating a uniform composition in the grains of the various sizes although in both C/S1 fractions, where density becomes a factor in the sizing, there is a tin concentration indicating some non uniformity of grain composition. However to achieve a marketable concentrate

(say 50% Sn) any retreatment would have to include grinding of the low grade concentrate followed by further concentration and magnetic separation of the wolfram.

A closer study of the results for 830791 shows that the fractions +38µm, C/S1 and C/S2 together contain 15% of the mass, 45% of the tin and 46% of the wolfram and would assay 1.2% Sn and 1.5% WO_3. If this material could be separated by hydraulic cyclones it offers a reasonably high grade gravity feed containing just under half the values.

Conclusion

There would appear to be better prospects for retreating 830791, Dam 2 with a recovery of around half the values in a low grade concentrate which would have to be further ground and concentrated, with losses, to achieve market products.

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DEPARTMENT OF MINES TASMANIA

27th May 1983

R829

TIN AND TUNGSTEN DISTRIBUTION IN COARSE TAILINGS FROM THE ABERFOYLE MINE AT ROSSARDEN AND A RECOVERY TEST INCORPORATING GRINDING OF A SELECTED SIZE RANGE OF THE TAILINGS.

Introduction

Research project R827 examined grab samples from the face from several locations around the coarse tailings dump at Rossarden.

The samples in this investigation were derived by drilling the tailings dump from top to bottom at selected localities. Holes 2 and 3 were reported to be very successful holes in which sample recovery was maintained from the top to the bottom of the hole. The remaining holes were ~~less successful as sample recovery was not so good.~~ The samples from these latter holes were bulked to provide the feed for rod milling and a recovery test.

The details of the samples which were submitted by Dr. H. Stacpoole are as follows:-

Registered Number	Description
821925	Hole 2
821926	Hole 3
821927	Hole 1, Hole 4, Hole 5, Bag 6, Bag 7, Hole 8 (top Hole 8, 8.5-15, Hole 9, Hole 10-11 metre

Tin and WO_3 Distributions

Samples 821925 (Hole 2) and 821926 (Hole 3) were screened and the size fractions were assayed for tin (Sn) and tungstic oxide (WO_3).

The sizings and distribution of Sn and WO_3 were as follows:-

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Reg. No 821925 Hole 2

Size Fraction	Mass		Assay %		% Distribution			
	%	% Cum	Sn	WO_3	Sn	Sn Cum	WO_3	WO_3 Cum
+ 12.70 mm	7.1	7.1	0.02	0.01	1.3	1.3	2.9	2.9
+ 9.53 mm	9.1	16.2	0.03	0.01	2.4	3.7	2.6	5.5
+ 5.6 mm	18.3	34.5	0.04	0.01	6.4	10.1	8.9	14.4
+ 4.75 mm	8.9	43.4	0.12	0.01	10.2	20.3	4.0	18.4
+ 4.0 mm	8.0	51.4	0.05	0.00	3.9	24.2	1.3	19.7
+ 3.35 mm	11.1	62.5	0.07	0.01	7.3	31.5	3.1	22.8
+ 2.8 mm	9.2	71.7	0.10	0.03	8.7	40.2	12.0	34.8
+ 2.36 mm	6.6	78.3	0.05	0.04	3.2	43.4	10.9	45.7
+ 1.4 mm	13.9	92.2	0.14	0.04	18.4	61.8	23.6	69.3
- 1.4 mm	7.8	100.0	0.53	0.10	38.2	100.0	30.7	100.0
Calc. Head	100.0		(0.11)	(0.02)	100.0		100.0	

Reg. No 821926 Hole 3

Size Fraction	Mass		Assay %		% Distribution			
	%	% Cum	Sn	WO_3	Sn	Sn Cum	WO_3	WO_3 Cum
+ 12.70 mm	17.5	17.5	0.04	0.02	6.6	6.6	9.2	9.2
+ 9.53 mm	9.7	27.2	0.04	0.02	3.4	10.0	5.1	14.3
+ 5.6 mm	20.2	47.4	0.05	0.01	9.7	19.7	7.8	22.1
+ 4.75 mm	9.2	56.6	0.16	0.02	13.5	33.2	7.7	29.8
+ 4.0 mm	8.0	64.6	0.11	0.04	8.5	41.7	11.8	41.6
+ 3.35 mm	9.3	73.9	0.11	0.01	9.2	50.9	4.2	45.8
+ 2.8 mm	6.8	80.7	0.06	0.02	3.9	54.8	3.8	49.6
+ 2.36 mm	4.8	85.5	0.13	0.08	5.5	60.3	13.6	63.2
+ 1.4 mm	9.5	95.0	0.23	0.06	20.0	80.3	20.7	83.9
- 1.4 mm	5.0	100.0	0.43	0.09	19.7	100.0	16.1	100.0
Calc. Head	100.0		(0.11)	(0.03)	100.0		100.0	

These results show that it would be desirable to screen the material on 5.6 mm to produce a coarse product for paving use, since the -5.6mm + 4.75mm fraction carries a considerable quantity of tin. Removal of the oversize material lifts the grade of the undersize material as follows:-

-5.6 mm	% Mass	Assay %		% Recovery	
		Sn	WO_3	Sn	WO_3
Hole 2	65.5	(0.15)	(0.03)	89.9	85.6
Hole 3	52.6	(0.17)	(0.04)	80.3	77.9

Inserting a 2.36 mm screen would give two products as follows:-

	% Mass	Assay % Sn	Assay % WO_3	% Distribution Sn	% Distribution WO_3
Hole 2					
-5.6mm + 2.36mm	43.8	(0.08)	(0.02)	33.3	31.3
-2.36mm	21.7	(0.28)	(0.06)	56.6	54.3
Hole 3					
-5.6mm + 2.36mm	38.1	(0.12)	(0.03)	40.6	41.1
-2.36mm	14.5	(0.30)	(0.07)	39.7	36.8

Inserting a 1.4 mm screen would give two products as follows:-

	% Mass	Assay % Sn	Assay % WO_3	% Distribution Sn	% Distribution WO_3
Hole 2					
-5.6mm + 1.4mm	57.7	(0.10)	(0.02)	51.7	54.9
-1.4mm	7.8	0.53	0.10	38.2	30.7
Hole 3					
-5.6mm + 1.4mm	47.6	(0.16)	(0.04)	60.6	61.8
-1.4mm	5.0	0.43	0.09	19,7	16.1

Recovery Test

The composite sample, Reg. No 821927 was wet screened on a 0.457 m. dia. Sweco screen fitted with a 4.75 mm and a 1.24 mm screen cloths. The -1.24 mm product was pumped to a Vickers 5 turn CC series spiral.

The spiral concentrate was sized by hand screening using 200 mm dia. laboratory test screens with 500µm and 250µm apertures. The +500µm fraction was further concentrated in the 60mm X 40mm Denver jig. This concentrate was magnetically separated with the dry Rapid high intensity magnetic separator and the non-magnetics were further concentrated by panning. Sulphides were skin floated out during the panning operation.

The -500µm + 250µm fraction was concentrated on the Deister table and the concentrate was further concentrated by panning and sulphides were removed by skin flotation during panning. The pan concentrate was magnetically separated with the dry Rapid high intensity magnetic separator.

The -250µm fraction was concentrated on the Deister table, and the table concentrate was subjected to low intensity magnetic separation using a hand magnet to remove highly magnetic material, possibly ferro-silicon. The non-magnetics were then floated in a flotation cell to remove sulphides. The flotation tail was further upgraded by panning and the pan concentrate was magnetically separated using the dry Rapid high intensity magnetic separator.

The results of this part of the recovery test were as follows:-

Spiral Concentrate

Product	% Mass	Assay % Sn	Assay % WO_3	% Distribution Sn	% Distribution WO_3
-1.24mm S/L C					
+500µm JT	1.743	0.05	0.02	0.9	0.7
JC M/A	0.001		49.9		1.2
JC N PC.	0.001	68.7		0.9	
-500µm + 250µm TT	1.240	0.04	0.02	0.4	0.4
TC PT	0.059	0.65	0.18	0.4	0.2
PC M/A	0.003		49.9		2.8
PC N	0.004	72.4		2.9	
-250µm TT	1.498	0.04	0.02	0.6	0.6
TC M/A	0.006				
TC PC	0.022	1.21	0.21	0.3	0.1
FT PT	0.052	0.82	0.34	0.4	0.4
PC M/A	0.007		49.9		7.5
PC N	0.008	66.5		5.3	

Because of the poor recovery of tin and tungsten in the +500µm fraction, it was decided to retreat the spiral tailing.

The spiral tailing was wet screened by hand using 200mm dia. laboratory test screens with 500µm and 125µm apertures.

The +500µm fraction and the -500µm + 125µm fractions were concentrated by panning. The pan concentrate in each case was magnetically separated using the dry Rapid high intensity magnetic separator. The -125µm fraction was table concentrated using the Deister table to give a concentrate T1C and a tailing T1T. The concentrate was retabled to give a concentrate T2C and a tailing T2T. This table concentrate T2C was magnetically separated with a low intensity hand magnet to remove highly magnetic material. The non-magnetics were then floated in a flotation cell to remove sulphides. The flotation tail was magnetically separated with the dry Rapid high intensity magnetic separator, and the non-magnetics were panned to produce a final concentrate.

The results of this retreatment of the spiral tailing were as follows:-

Spiral Tailing

Product			% Mass	Assay % Sn	Assay % WO_3	% Distribution Sn	% Distribution WO_3
-1.24mm S/L T							
+500µm	PC	M/A	0.002		50.8		2.0
	PC	N	0.005	69.4		3.1	
	PT		1.066	0.15	0.05	1.5	1.1
-500µm+250µm							
	PC	M/A	0.000		50.8		0.2
	PC	N	0.000	51.2		0.2	
	PT		0.083	0.11	0.03	0.1	0.1
-125µm	T1T		3.101	0.08	0.09	2.4	5.8
	T2T		0.467	0.07	0.05	0.3	0.5
	T2C	M/A1	0.003				
		FC	0.010	1.23	0.78	0.1	0.2
		M/A2	0.014	0.29	2.56	Trace	0.8
		PC	0.001	51.8		0.4	
		PT	0.011	0.88	0.08	0.1	Trace

The distribution in the two sets of results from the recovery test reported so far relate to the tin and tungsten in the original feed.

The actual recovery performance of the spiral in the -1.24mm +500µm size range in a final product was only 13.6% for tin and 23.5% for tungsten. A further 48.9% of the tin and 40.4% of the tungsten was recovered by panning this size fraction in the spiral tailing to give final concentrates.

The spiral did much better in the size ranges finer than 500µm. The actual recovery performance of the spiral in the size ranges finer than 500µm was 58.6% for tin and 52.4% for tungsten. Retreatment of these size fractions in the spiral tailing recovered a further 4.7% of the tin and 5.2% of the tungsten.

The -4.75mm + 1.24mm fraction of the original feed was ground in the 0.31m. dia. X 1.0m Denver rod mill in closed circuit with the 0.457m. dia. Sweco screen fitted with a 1.24mm screen cloth.

The screen undersize was concentrated with the 150mm X 100mm Denver jig. The jig concentrate was hand screened using 200mm. dia. laboratory test screens with 500µm and 125µm apertures.

The +500µm size fraction was then further concentrated using the 60mm X 40mm Denver jig. The jig concentrate and the jig bed were panned. A sulphide concentrate was removed by skin flotation. The pan concentrate was magnetically separated with the dry Rapid high intensity magnetic separator. The first three magnetic products were bulked for a wolfram concentrate and the fourth magnetic product was put with the non-magnetics to give a tin concentrate.

The -500µm + 125µm fraction was tabled to produce a concentrate and a tailing. The table concentrate was panned. The pan concentrate was skin floated to remove sulphides, and then was magnetically separated. The first three magnetic products were bulked for a wolfram concentrate and the fourth magnetic product was put with the non-magnetics to give a tin concentrate.

The -125µm fraction was floated in a flotation cell to remove sulphides. The floation tail was panned, and the pan concentrate was magnetically separated. The first three magnetic products were bulked for a wolfram concentrate, and the fourth magnetic product was put with the non-magnetics for a tin concentrate.

The results of cleaning the jig concentrate are as follows:-

Product		Mass %	Assay %		% Distribution	
			Sn	WO_3	Sn	WO_3
J1C						
+500µm	J1C PCN + M/A4	0.009	66.7		5.9	
	FC	0.025	4.69	0.60	1.1	0.3
	PT	0.048	1.16	0.34	0.5	0.4
	M/A1+M/A2+M/A3	0.004		49.0		4.8
	J2T	6.259	0.08	0.02	4.7	3.2
-500µm+125µm	TC PCN + M/A4	0.014	65.3		8.6	
	FC	0.052	2.80	0.53	1.4	0.6
	PT	0.043	0.81	0.19	0.3	0.2
	M/A1+M/A2+M/A3	0.009		49.0		10.2
	TT	2.391	0.06	0.03	1.4	1.7
-125µm	PCN + M/A4	0.002	66.6		1.4	
	M/A1+M/A2+M/A3	0.002		49.0		1.9
	FC	0.012	2.52	0.91	0.3	0.2
	PT	0.056	0.17	0.11	0.1	0.1

Because of the poor recovery of tin and tungsten in the -125µm fraction, it was decided to retreat the jig tailing. The jig tailing was screened on the 0.457 m. dia. Sweco screen fitted with a 152µm screen cloth. The +152µm material was not further treated. The -152µm material was concentrated on the Deister table. The table concentrate was floated in the flotation cell to remove sulphides, and the flotation tailing was magnetically separated.

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The third and fourth magnetic products and the non-magnetics were individually panned. The panned tails from each were combined with the first two magnetic products.

The results of the retreatment of the jig tailings were as follows:-

Product	Mass	Assay %		% Distribution	
	%	Sn	WO_3	Sn	WO_3
J1T + 152µm	15.562	0.05	0.02	7.2	5.2
- 152µm TT	10.114	0.06	0.02	5.5	5.4
TC FC	0.030	1.67	0.14	0.5	0.1
FT M/A1+M/A2 etc	0.019	2.42	3.14	0.4	1.3
M/A3 PC	0.002		54.3		2.9
M/A4 PC	0.003	34.1	15.9	0.8	0.9
N PC	0.005	59.2		2.6	

Retreatment of the -152µm fraction of the jig tailings increased the overall tin recovery from the grinding of the -4.75mm + 1.24mm fraction of the original feed from 37.2% to 45.2%. The wolfram recovery was increased from 43.0% to 52.7%.

A summary of the whole operation is as follows:-

Product	Mass	Assay %		% Distribution	
	%	Sn	WO_3	Sn	WO_3
+4.75mm	55.93	0.07	0.03	37.0	36.6
-4.75mm + 1.24mm Tin Conc.	0.03	(62.5)		19.3	
WO_3 Conc.	0.02		(45.6)		20.7
Combined Other Products	34.61	(0.07)	(0.02)	23.4	18.7
-1.24mm Tin Conc.	0.02	(67.8)		12.8	
WO_3 Conc.	0.01		(50.0)		13.7
Combined Other Products	9.38	(0.08)	(0.05)	7.5	10.9
	100.00			100.0	100.0

Disregarding the tin and tungsten in the +4.75mm fraction which is destined for sale as paving material, then the recoveries in each operation and the total recovery from the material that was treated is summarised as follows:-

	Recovery	
	Sn	WO_3
-4.75mm + 1.24mm rod milled	45.2	52.5
-1.24mm fines treatment	63.1	55.7
Overall	51.0	53.8

Discussion

Examination of the tin and tungsten distributions in Holes 2 and 3 suggest that the rod mill feed should be -5.6mm instead of 4.75mm, as in both of these holes a considerable quantity of tin appears in the -5.6mm + 4.75mm fraction. Unfortunately this size fraction could not be included in the rod milling recovery test because there was no 5.6mm screen cloth to fit the Sweco screen. The tin and tungsten distributions also suggest a further variation from the size range used to feed the rod mill in the recovery test, and that is that the lower size of the rod mill feed be lifted to about 2.0mm, and thus increase the size range of the material for fines treatment.

Neither the spiral or the jig proved to be satisfactory as a rougher concentrator of the -1.24mm material. The spiral lost significant quantities of tin and wolfram in the coarse end of the size range, and the jig lost significant quantities of tin and wolfram in the fine end of the size range.

Probably if the -2.0mm material was screened on about 300µm, and the +300µm material was fed to a jig and the -300µm material was fed to spirals, the best recovery would be obtained in rougher concentration.

Conclusions

After screening coarse tailings from the old Aberfoyle Mine at Rossarden on a 4.75mm screen, 51% of the tin and 53% of the wolfram in the undersize can be recovered at a saleable grade.

The recovery obtained by rod milling the -4.75mm + 1.24mm fraction was 45% of the tin and 52% of the wolfram.

The recovery obtained by treatment of the -1.24mm fraction was 63% of the tin and 55% of the wolfram.

Senior Metallurgist.....

(H. K. Wellington)
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