TR6-182-189

R.379

ABERFOYLE TIN MINING COMPANY, N.L.

SLIME TABLE TAILING

The Samples

Six samples of mill slime table tailings were supplied by Aberfoyle Tin Mining Company, N.L. for investigations into the nature of the tin losses in this tailing.

Each sample represented one week's production, as follows:—

Sample No. R.379/1, production for week ending 15.4.61.
Sample No. R.379/2, production for week ending 22.4.61.
Sample No. R.379/3, production for week ending 29.4.61.
Sample No. R.379/4, production for week ending 6.5.61.
Sample No. R.379/5, production for week ending 13.5.61.
Sample No. R.379/6, production for week ending 20.5.61.

The samples were submitted as a thick pulp, and samples R.379/1-5 each contained approximately 15-20 lbs. of dry solids. Sample R.379/6 contained approximately 3 lbs. of dry solids.

The investigation was directed principally towards examination of the tin losses. However, as the WO_3 content of the tailings was approximately half of the corresponding tin content, some products, particularly concentrates, were also examined for WO_3, as well as tin.

Summary

1. The slime table tailings average about 1.2-1.3% tin, and about 0.65% WO_3. Between 20 and 40% of the tin, and about 20% of the WO_3 in these tailings is recoverable by gravity concentration in a comparatively high grade concentrate.

2. The pulp can be deslimed by cycloning without loss of recoverable tin and wolfram.

3. It is suggested that consideration be given to desliming and desulphidizing the feed to the slime tables.

4. The slime table tailings contain a fair range of recoverable sizings. Better plant performance may result from separate treatment of the coarsest and finer sizes in the slime table feed.

5. It is recommended that consideration be given to installation of vanners for treatment of slimes.

Assays

The samples, as received, assayed as follows:—

Sample No.	Week Ending	Percent Sn	Percent WO_3
R.379/1	15.4.61	1.22	0.65
R.379/2	22.4.61	1.13	0.63
R.379/3	29.4.61	1.22	0.53
R.379/4	6.5.61	1.26	0.64
R.379/5	13.5.61	1.40	0.60
R.379/6	20.5.61	1.37	0.75

Infrasizer Analyses

Infrasizer analyses were carried out on the four samples R.379/1-4.

Sample: R.379/1

Fraction	Weight		Percent Sn	Percent WO_3	Percent Distribution Sn	Percent Distribution WO_3
+ 60 mesh	0.2					
+ 85 mesh	0.2					
+ 100 mesh	0.1	3.9	0.11	0.11	0.3	0.6
+ 120 mesh	0.3					
+ 150 mesh	0.6					
+ 200 mesh	2.5					
Infrasizer 1	0.9		0.47	0.20	0.3	0.3
Infrasizer 2	13.8		0.68	0.19	7.5	4.4
Infrasizer 3	17.1		1.52	0.54	20.7	15.7
Infrasizer 4	12.8		1.65	0.68	16.8	14.8
Infrasizer 5	11.0		1.65	0.70	14.4	13.1
Infrasizer 6	11.2		1.42	0.78	12.7	14.8
Infrasizer 7	29.3		1.17	0.73	27.3	36.3
Composite	100.0		1.26	0.59	100.0	100.0

Sample: 379/2

Fraction	Weight		Percent Sn	Percent WO_3	Percent Distribution Sn	Percent Distribution WO_3
+ 60 mesh	0.1					
+ 85 mesh	0.2					
+ 100 mesh	0.2	5.8	0.25	0.05	1.3	0.5
+ 120 mesh	0.7					
+ 150 mesh	1.2					
+ 200 mesh	3.4					
Infrasizer 1	0.1	....	0.63	0.19	7.2	4.1
Infrasizer 2	13.2	13.3				
Infrasizer 3	15.5		1.33	0.62	17.8	15.7
Infrasizer 4	13.0		1.56	0.81	17.5	17.2
Infrasizer 5	11.4		1.47	0.82	14.4	15.2
Infrasizer 6	11.1		1.38	0.78	13.2	14.1
Infrasizer 7	29.9		1.11	0.68	28.6	33.2
Composite	100.0		1.16	0.61	100.0	100.0

Sample: R.379/3

Fraction	Weight	Percent Sn	Percent WO_3	Percent Distribution Sn	Percent Distribution WO_3
+ 60 mesh	0.5				
+ 85 mesh	0.1				
+ 100 mesh	0.2	0.09	0.08	0.5	1.0
+ 120 mesh	0.6				
+ 150 mesh	1.1				
+ 200 mesh	3.6				
	6.1				
Infrasizer 1	1.5	0.48	0.12	0.6	0.4
Infrasizer 2	12.4	0.68	0.23	7.1	6.1
Infrasizer 3	13.8	1.34	0.46	15.5	13.6
Infrasizer 4	12.6	1.59	0.60	16.8	16.1
Infrasizer 5	11.7	1.58	0.56	15.6	14.0
Infrasizer 6	11.2	1.42	0.56	13.4	13.4
Infrasizer 7	30.7	1.18	0.54	30.5	35.4
Composite	100.0	1.19	0.47	100.0	100.0

Sample: R.379/4

Fraction	Weight	Percent Sn	Percent Distribution Sn
+ 60 mesh	0.2		
+ 85 mesh	0.1		
+ 100 mesh	0.2	0.03	0.1
+ 120 mesh	0.3		
+ 150 mesh	1.2		
+ 200 mesh	3.0		
	5.0		
Infrasizer 1	1.1	0.31	0.3
Infrasizer 2	12.7	0.54	5.7
Infrasizer 3	15.5	1.42	18.2
Infrasizer 4	13.1	1.69	18.3
Infrasizer 5	11.4	1.60	15.1
Infrasizer 6	11.0	1.41	12.8
Infrasizer 7	30.2	1.18	29.5
Composite	100.0	1.21	100.0

The four infrasizer analyses indicate that the slime table tailings are comparatively uniform, both with regard to sizing and tin content of various fractions. The distribution of the wolfram in the various fractions is similar, but the wolfram content of the samples shows more variation than the tin content. The plus 200 mesh material is almost entirely mica flakes and wood chips.

The estimated particle sizes of quartz and cassiterite segregated by the Haultain infrasizer are:—

Cone	Quartz	Cassiterite
1	+ 56 microns	+ 45 microns
2	40 — 56 microns	30 — 45 microns
3	28 — 40 microns	20 — 30 microns
4	20 — 28 microns	14 — 20 microns
5	14 — 20 microns	10 — 14 microns
6	10 — 14 microns	8 — 10 microns
7	— 10 microns	— 8 microns

Between 20 and 30% of the tin in the four samples is contained in infrasizer fractions 1, 2 and 3 and thus is coarser than 20 microns. This tin should be recoverable by gravity concentration, if in the free state.

A further 30% of the tin is contained in infrasizer fractions of 4 and 5. Minor recovery only of the tin in these fractions is economically practicable.

Between 40 and 50% of the tin is contained in infrasizer fractions 6 and 7, and this tin is not recoverable by gravity concentration.

Concentration by Panning

Portion of each sample was concentrated by hand panning, and the resultant concentrates assayed.

Product	Weight	Percent		Percent Recovery in Panned Conc.	
		Sn	WO_3	Sn	WO_3
R.379/1 Panned Conc.	0.50	44.9	21.9	18	17
R.379/2 Panned Conc.	0.58	43.4	23.1	22	21
R.379/3 Panned Conc.	0.60	43.8	17.0	21	19
R.379/4 Panned Conc.	0.38	45.5	21.5	14	13
R.379/5 Panned Conc.	0.70	41.0	20.3	21	24
R.379/6 Panned Conc.	0.73	41.8	23.7	22	23

Concentration by panning indicates quite clearly that about 20% of both tin and wolfram in the tailings can be readily concentrated into a comparatively high grade concentrate.

Concentration by "Vanning"

The "vanning" assay used involves digestion of the sample with nitric and hydrochloric acid, followed by concentration by panning, with three intermediate stage grinds. The acid treatment effectively removes sulphides and some other heavy minerals such as siderite and iron oxides. The subsequent panning is much simplified, as the residue consists essentially of silicates and cassiterite.

The acid digestion will dissolve some wolfram, and the reported wolfram recoveries will thus tend to be low.

Product	Weight	Percent Sn	Percent WO_3	Percent Recovery in Vanned Conc. Sn	Percent Recovery in Vanned Conc. WO_3
R.379/1 Vanned Conc.	0.65	49.5	17.6	26	18
R.379/2 Vanned Conc.	0.63	47.7	24.4	27	24
R.379/3 Vanned Conc.	0.50	54.1	19.1	22	18
R.379/4 Vanned Conc.	0.50	53.7	18.7	21	15
R.379/5 Vanned Conc.	1.05	36.8	11.4	28	20
R.379/6 Vanned Conc.	1.10	49.5	21.2	40	31

Better recoveries of cassiterite were obtained in higher grade concentrates by " vanning ", as opposed to concentration by panning. This is mostly due to the prior removal of sulphides, &c., by acid treatment before concentration.

Table Concentration

From data obtained during the plant survey in September, 1959, it appears that the feed to the slime conditioner is about 8-10% solids. The pulp samples were accordingly diluted to 10% solids. Data from the infrasizer analyses, indicate that about 40% by weight of the material reports in infrasizer fractions 6 and 7. Any cassiterite in these size ranges cannot be economically recovered by gravity concentration, and these slimes may therefore be discarded without loss of recoverable cassiterite.

The six samples of pulp at 10% solids were accordingly deslimed by cycloning in a 30 mm cyclone at 40 lb. p.s.i. pressure.

The cyclone underflow was concentrated on a laboratory Diester table.

Detailed results of desliming followed by table concentration are as follows:—

Sample	Product	Weight	Percent Sn	Percent WO_3	Percent Distribution Sn	Percent Distribution WO_3
R.379/1	Table conc.	1.8	23.1	10.9	36	30
	Table tailings	77.7	0.7	....	48	....
	Slimes	20.5	0.9	....	16	
	Composite	100.0	1.14	0.65	100	100
R.379/2	Table conc.	0.8	31.2	17.0	23	22
	Table tailings	63.3	0.8	....	47	....
	Slimes	35.9	0.9	....	30	....
	Composite	100.0	1.08	0.63	100	100
R.379/3	Table conc.	0.8	31.3	12.4	22	17
	Table tailings	64.8	0.8	....	47	....
	Slimes	34.4	1.0		31	
	Composite	100.0	1.11	0.53	100	100
R.379/4	Table conc.	1.7	28.1	13.0	40	35
	Table tailings	69.8	0.6	....	36	....
	Slimes	28.5	1.0	....	24	
	Composite	100.0	1.18	0.64	100	100

Sample	Product	Percent			Percent Distribution	
		Weight	Sn	WO_3	Sn	WO_3
R.379/5	Table conc.	1.5	28.0	13.0	31	32
	Table tailings	64.1	0.8	....	38	....
	Slimes	34.4	1.25	....	31	....
	Composite .. .	100.0	1.36	0.60	100	100
R.379/6	Table conc.	2.0	28.4	13.9	43	37
	Table tailings	88.9	0.7	....	50	....
	Slimes	9.1	1.1	....	7	....
	Composite	100.0	1.33	0.75	100	100

The tabling tests gave recoveries of between 22 and 43% of the tin and between 17 and 37% of the WO_3 from the six samples. These recoveries are rather higher than those obtained by panning or " vanning ", but the table concentrates are much lower in grade.

The table concentrate grade at 23-31% tin and 10-17% WO_3 compares reasonably well with plant practice. A sample of slime table concentrates submitted in May, 1961, assayed 36.1% tin and 15.5% WO_3. (See Ore Dressing Investigation R.382).

These tabling tests show conclusively that a substantial proportion of the tin and wolfram at present lost in the slime table tailings is economically recoverable in concentrates of reasonable grade.

Examination of Slime Discards

As mentioned previously, the samples were deslimed before tabling, as it was considered that the slimes could be discarded without losing recoverable tin and wolfram.

The discard cyclone overflows from the five samples—R.379/1-5, were examined for recoverable tin by " vanning ". Sample R.379/6 was not so examined as the material available was insufficient, due to the small quantity of the original sample received. A composite of samples, R.379/1-5 was also examined.

Recovery of tin in the " vanned " concentrates is listed below. Difficulty was experienced in getting some " vanned " concentrates up to a reasonable grade, due to the very small quantity of recoverable tin present, and also due to the very fine grain size of the tin.

Vanned Conc. from:	Percent Weight	Sn	Percent Recovery in Vanned Conc.
R.379/1 slime discard ..	0.07	34.5	3
R.379/2 slime discard ..	0.10	44.8	5
R.379/3 slime discard ..	0.07	60.5	4
R.379/4 slime discard ..	0.07	62.3	4
R.379/5 slime discard ..	0.15	61.6	7
R.379/1-5 slime discard ..	0.10	59.7	5

These results may be tabulated in another manner, to show directly the " vanning " tin assay of the slimes. The " vanning " tin assay represents tin that can be recovered by gravity concentration.

Sample	Percent Total Sn	Vanning Assay
R.379/1 slime discard	0.9	0.02
R.379/2 slime discard	0.9	0.04
R.379/3 slime discard	1.0	0.04
R.379/4 slime discard	1.0	0.04
R.379/5 slime discard	1.25	0.09
R.379/1-5 slime discard	1.2	0.05

The composite sample R.379/1-5 was infrasized as follows:—

Fraction	Weight	Percent Sn	Percent Distribution Sn
+ 120 mesh	0.2		
+ 150 mesh	0.2		
+ 200 mesh	0.4	2.4	0.50	1.0
Infrasizer 1	0.2		
Infrasizer 2	1.4		
Infrasizer 3	4.9	0.63	2.5
Infrasizer 4	8.1	0.94	6.2
Infrasizer 5	10.7	1.78	15.5
Infrasizer 6	14.4	1.49	17.5
Infrasizer 7	59.5	1.18	57.3
Composite	100.0	1.23	100.0

The material coarser than infrasizer fraction 2 was mostly mica and wood chips.

The infrasizer analysis shows that only 3.5% of the tin is coarser than 20 microns, and should be recoverable by gravity concentration if in the free state. This figure agrees well with the actual recovery of 5% recovered by "vanning" the same sample.

Presence of Stannite

There is a possibility that some of the tin in the slime table tailings occurs as stannite. To check this possibility, several of the samples were examined for the presence of stannite with negative results.

Discussion

The test work detailed above shows clearly that recoverable tin is presently being lost in the slime table tailings, and that this tin constitutes between 20 and 40% of the total tin in the tailings.

From the infrasizer analyses, it is evident that a substantial proportion of the true slimes can be discarded without loss of recoverable tin. This is confirmed by examination of cyclone overflows from the various samples. Table plant performance should be improved by the prior rejection of these slimes.

The presence of sulphides tends to mask the cassiterite on the table deck. Consideration should be given to the desirability of a de-sulphidizing float prior to tabling, perhaps on the de-slimed pulp.

Sizings of the slime table tailings show a fair range of sizes present. Current practice is to split the total feed of five tables. Better plant performance might be obtained by closer sizing of the feed, perhaps by cycloning, to give a cyclone underflow feeding say two tables, and a cyclone overflow feeding say three tables. This finer feed could be more effectively treated on vanners and it is recommended that consideration be given to installation of vanners for treatment of slimes.

Recent metallurgical reports indicate that production of slime table tailings is only about 0.6-0.7 tons per hour, to give an average four weekly production of about 300 tons.

An approximate estimate of the quantity of tin and wolfram that can be recovered can be made.

Assuming—

1. tonnage of tailings produced is 300 tons per month;
2. the tailings average about 1.2-1.3% tin, of which about 30% is recoverable;
3. the tailings average 0.65% WO_3, of which about 20% is recoverable;

then about 1.2 tons of tin and about 0.4 tons of WO_3 are recoverable in a mixed concentrate of reasonable grade per month from slime table tailings.

It is suggested than consideration be given to revising the flow-sheet of the slimes treatment section to give—

1. desliming of the original pulp;
2. desulphidizing the deslimed pulp;
3. resizing the desulphidized pulp, with say two different sized fractions concentrated separately and that vanners be considered for this duty;
4. water could still be reclaimed by settling the cyclone overflow, and pumping the thickener underflow to waste.

APPENDIX

An examination by "vanning" was made on a sample of slime table tailing taken during the mill survey, in April, 1960. This examination showed similar results to those obtained in the current investigation, although the initial tin content of the tailings was much lower.

	Percent		Percent Distribution
	Weight	Sn	Sn
Vanned Concentrate	0 8	24.2	29.0
Vanned tailing	99.2	0.48	71.0
Head (calc.)	100.0	0.67	100.0
Head (actual)		0.79	

Recent related investigations are:—

R.374: A preliminary examination of a sample of slime table tailings.

R.382: An infrasizer analysis of a slime table concentrate.