O T T A W A November 13th, 1942.

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ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1323.

Tabling and Flotation Tests on Scheelite Ore
from the Jack Nutt Prospecting Syndicate,
Herb Lake, Manitoba.

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Shipment:

Two separate lots of tungsten ore, marked Lot No. 1 and Lot No. 2 respectively, were received at the Ore Dressing Laboratories on September 10th, 1942, Mr. J. Nutt, President, Jack Nutt Prospecting Syndicate, 122 King Street East, Toronto, Ontario, being the shipper. The ore was from the Herb Lake area, Manitoba.

Sampling and Analysis:

After examination the ore was stage-crushed through a 20-mesh screen and a sample of each lot was obtained by standard methods. The analysis of each lot is as follows:

	Lot No. 1	Lot No. 2
Weight -	2,458 pounds.	916 pounds.
Tungsten trioxide (WO_3) -	46.64 per cent.	8.04 per cent.
Sulphur (S) -	0.50 "	1.41 "
Arsenic (As) -	0.30 "	1.45 "
Phosphorus (P) -	0.03 "	0.07 "
Iron (Fe) -	1.76 "	3.73 "
Gold (Au) -	0.02 oz./ton.	0.27 oz./ton.

Characteristics of the Ore:

Both lots were very much the same except for the differences shown by the analyses given above. They appear to have been taken from different portions of the same ore body. As the two samples were identical except for the relative abundance of the minerals, the following examination covers the mineralogy of both lots:

The gangue is a mixture of siliceous, fine-grained material and small irregular patches of translucent, bluish grey quartz. It bears local light brown stains of iron oxides and contains a small quantity of finely disseminated carbonate, especially along fractures.

The tungsten occurs as scheelite in the ore and is in the form of very fine grains roughly collected into small local patches or distributed along incipient fractures.

The metallic minerals, in their approximate order of abundance in the ore, are: arsenopyrite, pyrite, pyrrhotite, and magnetite.

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Purpose of Tests:

The purpose of the milling was two-fold. The main objective was the recovery of the scheelite in a merchantable concentrate. The second objective was to study the metallurgy so that a satisfactory flow-sheet could be determined.

Results of Tests:

1. The tests showed that the ore, especially in the case of Lot No. 2, should be crushed to minus 20 mesh. It is possible that crushing to minus 14 mesh might have been satisfactory for Lot No. 1.

2. Tabling followed by flotation of the sulphides from the table concentrate gave an 85 per cent recovery of the tungsten at a grade of 74 per cent WO_3.

3. In the case of Lot No. 1, the Wilfley table tailing could be sent directly to a chemical treatment plant without further processing.

4. In the case of Lot No. 2, the Wilfley table tailing would require treatment by flotation to raise the grade for shipment for chemical treatment.

5. Slime losses were somewhat high due to the finer grind required and also to the manner of occurrence of the scheelite in the ore.

6. The flow-sheets accompanying this report would give good results on this ore.

DETAILS OF TESTS:

Due to the desire for a maximum recovery of the tungsten, it was necessary to combine these ores with other ores on hand to obtain the minimum tonnage for milling purposes. The ores were fed to the circuit separately. Lot No. 1 was fed to the circuit first and samples were taken when the circuit appeared to be balanced. Lot No. 1 was followed by Lot No. 2 and again sampling was delayed until such time as it appeared that the circuit was balanced with ore from the second lot. It is somewhat difficult to obtain the exact metallurgy due to the large circulating load involved at various points in the circuit. The obtaining of reliable data on the flotation of the scheelite from the Wilfley table tailings and the determining of the slime loss were practically impossible due to the different ores used and their different physical characteristics. The mill run will be divided into three separate parts: (1) tabling operation; (2) sulphide flotation of table concentrates, and (3) scheelite flotation of Wilfley table tailing.

Table Concentration:

The ore, crushed to minus 20 mesh, was fed to the Richards hydraulic classifier at the rate of 600 pounds per hour. Three sized products were obtained from the classifier and treated on separate tables, each giving a finished product, a middlings product, and a tailing product. The screen used on the Hummer vibrating screen was 65 mesh.

As reported above, the slime losses were somewhat

(Table Concentration, cont'd) -

high. This was due, to a large extent, to the fine crushing but could be lessened to some extent by the use of larger settling areas and the use of the overflow waters as hydraulic water in the classifiers. Some of the loss is due to sampling, and also to spills which were difficult to clean up completely.

Table I gives the composite metallurgy in the tabling of Lots Nos. 1 and 2, while Table II gives the assays of the products obtained on each lot separately.

Sheet No. 1 gives the details of the flow.

Table I. - Composite Tabling Operation.

Product	Weight, per cent	Assays		Recovery of WO_3, per cent
		WO_3, per cent	Au, oz./ton	
Heads	100.00	36.16	0.11	100.00
Table concentrate	42.53	72.51	2.02	85.28
Table tailing	57.47	9.26	0.035	14.72

(See Table II on next page)

(Table Concentration, cont'd)

Table II. - Assays of Table Products.

Product	- Lot No. 1 -				- Lot No. 2 -			
	ASSAYS				ASSAYS			
	Per cent			Au,	Per cent			Au,
	WO_3	S	As	oz./ton	WO_3	S	As	oz./ton
Head	46.64	0.50	0.30	0.22	8.04	1.41	1.45	0.27
Butchart table feed	42.59	0.62			7.45	1.63		
" " conc.	69.96	0.43	0.50	0.14	54.26	5.34	4.55	2.22
" " tailing	32.23	0.47			5.49	0.77		
Deister table feed	31.33	0.50			10.57	2.22		
" " conc.	71.89	0.80	0.89	0.66	46.83	7.75	7.05	1.15
" " tailing	23.54	0.45			5.21	0.69		
Wilfley table feed	22.14	0.45			5.30	0.79		
" " conc.	74.11	1.01	1.21	0.24	56.51	6.61	7.09	0.94
" " tailing	20.08	0.32		0.035	3.00	0.33	0.34	0.03
Pilot table conc.	72.58				54.67	5.93	6.27	0.65
" " tailing	14.80				4.46	0.71		
Dewatering class. overflow	17.13				13.32	0.72		
Thickener overflow	29.40	0.39			10.64	0.57		
Slime loss	29.35	0.45			9.62	0.58		

(Table Concentration, cont'd) -

Conclusions from Tabling Operation:

1. The flow-sheet (Flow-Sheet No. 1) as used appears to be satisfactory for either the high-grade or the low-grade portion of the ore body.

2. A marketable product cannot be made from either lot by straight tabling. It is necessary that the sulphides be removed by flotation either before or after tabling.

3. A good recovery at an excellent grade can be expected.

4. The Wilfley table tailing from Lot No. 1 is of sufficiently high grade to be suitable for immediate shipment for chemical treatment.

5. The Wilfley table tailing from Lot No. 2 would require treatment by flotation to bring up the grade for chemical treatment.

6. Slime losses would be lessened by grinding somewhat coarser and by having sufficient settling area to take care of the various overflow products.

Flotation of Sulphides from Table Concentrate:

The flotation of the sulphides from the table concentrate did not present any great difficulty. The flow-sheet as given in Sheet No. 3 covers the circuit quite thoroughly.

Rate of Feed: 120 pounds per hour.

Reagent Consumption:	Lb./ton
Potassium amyl xanthate	- 0.20
Aerofloat 208	- 0.10
Sulphuric acid	- 0.40
Frother (25% tarol :) (75% pine oil)	- 0.12

(Continued on next page)

(Flotation of Sulphides from Table Concentrate, cont'd) -

Table III. - Composite of Lots Nos. 1 and 2.

Product	Weight, per cent	ASSAYS WO_3, per cent	ASSAYS Au, oz./ton	Recovery of WO_3, per cent
Head	100.00	72.51	2.02	100.00
Sulphide conc.	2.48	2.19	6.67	0.08
Tailing (scheelite conc.)	97.52	74.30	0.035	99.92

Conclusions from Sulphide Flotation:

1. The final scheelite concentrate after the sulphide flotation assayed 0.10 per cent sulphur and 0.04 per cent arsenic, well below the maximum limits allowed.

2. While the sulphides were floated from the table concentrates, it would be considerably more desirable to remove these sulphides before tabling. This would simplify the flow-sheet and would require less machinery.

Flotation of Scheelite from Wilfley Table Tailing:

The flotation of the scheelite from the Wilfley table tailing is only applicable in the case of Lot No. 2, the tailings from Lot No. 1, as previously mentioned, being of a sufficiently high grade for direct shipment to a chemical treatment plant without further beneficiation.

Due to the fact that these ores were small in bulk and were combined with other ores for milling treatment, it is impossible to separate the metallurgies of the various ores. Accordingly, only the flow-sheet (Sheet No. 2) and the reagent consumption are given here.

It should be quite possible, however, to extract

(Flotation of Scheelite from Wilfley Table Tailing, cont'd) -

about 90 per cent of the remaining tungsten, at a grade of approximately 20 per cent WO_3, by means of flotation.

Table IV. - Reagent Consumption.

		Lb./ton
Grinding Circuit:		
Sodium carbonate	=	0.35
Sodium silicate	=	1.25
Potassium amyl xanthate	=	0.12
Aerofloat Reagent 208	=	0.15
Conditioner:		
Potassium amyl xanthate	=	0.05
Cresylic acid	=	0.25
Scheelite Flotation:		
Emulsol X-1, to feed	=	0.09
Orso " "	=	0.15
Cresylic acid - scavenger feed		0.10
Orso - 2nd cell scavenger circuit		0.05
" 4th " " "		0.05

Grind: 80 per cent minus 200 mesh.

Per cent solids: Sulphide flotation feed - 35

Scheelite " " - 30

If the sulphides are floated prior to tabling, in all probability it would not be necessary, or desirable, to have a sulphide flotation circuit previous to the scheelite flotation.

If the scheelite flotation concentrate grade were sufficiently high (say about 30 per cent WO_3) it would probably be desirable to table the flotation concentrate for removal of a high-grade concentrate for combination with the table concentrate.

SUMMARY:

1. Lot No. 1 ore should be stage-crushed to minus 14 mesh.

2. Lot No. 2 ore should be stage-crushed to minus 20 mesh.

3. Flotation of the sulphides prior to tabling should be considered as giving a much simplified flow-sheet, with less machinery and easier operation.

4. Sheet No. 1, the general flow-sheet used here for the tabling circuit, is quite suitable for the ores submitted.

5. Sheet No. 2 is the general flow-sheet of the scheelite flotation from the tabling circuit tailings. It is possible that the sulphide flotation part of the circuit could be eliminated if the sulphides were floated prior to tabling.

6. Sheet No. 3 is the general flow-sheet of the sulphide flotation of the table concentrate. This entire flow-sheet would probably be eliminated if the sulphides were floated prior to tabling.

7. The sulphide concentrate carrying gold values could be stock-piled for later treatment by roasting and cyanidation for extraction of the gold.

8. The table tailing from Lot No. 1 requires no further beneficiation before shipping for chemical treatment.

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