O T T A W A March 24th, 1942.

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ORE DRESSING AND METALLURGICAL LABORATORIES.

Investigation No. 1182.

Concentration Tests on a Sample of Sluice Box Concentrate, Containing Ferberite, from the Canadian Creek Property of Canadian Tungsten Limited, Britannia Creek, Yukon Territory.

(Copy No. 24.)

BUREAU OF MINES
DIVISION OF METALLIC MINERALS

ORE DRESSING AND
METALLURGICAL LABORATORIES

CANADA
DEPARTMENT
OF
MINES AND RESOURCES
MINES AND GEOLOGY BRANCH

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Shipments:

Sixteen bags of sluice box concentrate, net weight 1,587 pounds, was received on November 24th, 1941. The shipment was submitted by A. R. Allen, President, Canadian Tungsten Limited, Britannia Creek, Yukon Territory.

Location of Property:

This property is located at the head of Canadian creek which is the largest tributary of Britannia creek. Britannia creek enters the Yukon river 56 miles below Fort Selkirk, Yukon Territory. The property is 14 miles distant from the mouth of Britannia creek.

Character of the Sample:

Some of the products of preliminary magnetic concentration tests were examined microscopically to determine the relationship of the magnetite and tungsten minerals. Thirty-two polished sections failed to reveal any association at all of magnetite and ferberite. Other minerals noticed in the sections include hematite, limonite, ilmenite, scheelite, quartz, and feldspar.

Sampling and Assaying:

A head sample cut from the shipment as received was assayed and reported as follows:

Iron	=	51.45 per cent
Manganese	=	0.66 "
Tungstic oxide (WO_3)	=	14.79 "
Tin	=	Nil
Sulphur	=	0.01 "
Titanium oxide (TiO_2)	=	0.35 "
Gold	=	5.78 oz./ton.

Experimental Tests:

A series of tests was conducted on the sample to determine the most suitable method to use for recovery of the ferberite in the form of a marketable grade of concentrate.

A screen analysis of the material as received is as follows:

(See table on next page)

(Experimental Tests, 'cont'd) -

Mesh	Weight, per cent	Assay of WO_3, per cent	Distribution of WO_3, per cent
+ 3	1.28	5.04	0.50
- 3 + 6	12.40	11.64	11.08
- 6 +14	47.92	15.20	55.92
-14 +35	27.81	14.09	30.09
-35 +48	5.07	4.20	1.63
-48 +65	3.34	1.94	0.50
-65	2.18	1.68	0.28
Feed sample (cal.)	100.00	13.02	100.00

The screen analysis indicates that 88.1 per cent of the material comes within the size range -3+35 mesh and contains 97 per cent of the tungsten.

Preliminary magnetic concentration tests indicate the need of crushing to minus 14 mesh in order to get a high-grade product and a high recovery.

The tests were conducted as follows:

Magnetite was first removed in a comparatively weak magnetic field.

The non-magnetic portion from this operation was then treated in either of two ways:

(1) reconcentration in a stronger magnetic field to pick up the ferberite

or (2) concentrated on a table to separate the ferberite from the gangue.

The material as received was treated by the first method only, which resulted in 80 per cent recovery of the tungsten in a concentrate of satisfactory grade.

By crushing to minus 14 mesh, recovery was raised to 95 per cent of the tungsten, with the major portion of the gold reporting in the non-magnetic final tailing produced in the all-magnetic process. When tables were used to concentrate the ferberite, the gold reported in the table

(Experimental Tests, cont'd) -

concentrate.

Considered together these results indicate that most of the gold is free and can be concentrated by gravity.

Details of Tests:

Test No. 1.

The sample as received was fractionated on a series of screens from 3 to 65 mesh. The fractions were then treated on an Ullrich magnetic separator to remove the magnetite in a comparatively weak field. The non-magnetic portion from this operation was then re-treated in a stronger field to remove the ferberite. The ferberite was repassed through the machine to clean it, the rejected portion being kept separate as a middling product.

The results of this test indicate that the material should be crushed minus 14 mesh in order to reduce tailing losses to a minimum, although a concentrate of the required grade can be produced with about 80 per cent recovery of the tungsten minerals without crushing.

The fraction coarser than 3 mesh, containing only 0.50 per cent of the total tungsten and yielding an extremely low-grade concentrate with low recovery, might very well be rejected from the feed screen. The product in the size-range -3+35 mesh contains 97 per cent of the total tungsten and when a sufficiently strong magnetic field is used to remove magnetite, a ferberite concentrate assaying 60 per cent WO_3 can be produced containing about 80 per cent of the total tungsten.

The following tailing assays were obtained from

(Experimental Tests, cont'd) -

the various sized fractions in this test:

	Per cent, WO_3
+ 3 mesh	29.50
- 3 + 6 "	41.88
- 6 +14 "	19.11
-14 +35 "	1.50
-35 +48 "	2.57
-48 +65 "	2.85
-65 "	15.65

Summary of Results:

Product	Weight, per cent	Assay, WO_3, per cent	Distribution of WO_3, per cent
Magnetite concentrate	64.6	0.25	1.1
Ferberite concentrate	18.7	65.13	80.0
Middling	9.1	23.17	13.6
Tailing	7.6	10.22	5.1
Feed sample (cal.)	100.0	15.24	100.0

Test No. 2. - All-Magnetic Concentration.

The products of Test No. 1 were re-mixed after those coarser than 14 mesh had been reduced to minus 14 mesh.

The head sample, thus reconstituted, was riffled into four quarters and tested as follows:

A sample of the minus 14 mesh material was fed to an Ullrich magnetic separator to remove magnetite. The non-magnetic portion was repassed in a stronger field to pick up the ferberite and leave a non-magnetic tailing. The ferberite concentrate was repassed through the machine under the same conditions, to produce a final concentrate and middling.

(Continued on next page)

(Test No. 2, cont'd) -

Summary of Results, Test No. 2.:

Product	Weight, per cent	Assays WO_3, per cent	Assays Au, oz./ton	Distribution, per cent WO_3	Distribution, per cent Au
Magnetite conc.	71.07	0.32	0.31	1.74	9.22
Ferberite conc.	21.05	59.32	0.32	96.11	2.83
Middling	0.11	6.30	7.98	0.05	0.37
Tailing	7.77	3.52	26.86	2.10	87.58
Feed sample (cal.)	100.00	12.99	2.38	100.00	100.00

Test No. 3. - Magnetic Concentration and Tabling.

Another sample of the minus 14 mesh material was treated on the Ullrich machine to remove the magnetite. The non-magnetic portion from this operation was then sized by screening and a ferberite concentrate produced by tabling. In this case the greater proportion of the gold reported in the table concentrate.

Summary of Results, Test No. 3.:

Product	Weight, per cent	Assays WO_3, per cent	Assays Au, oz./ton	Distribution, per cent WO_3	Distribution, per cent Au
Magnetite conc.	67.65	0.68	0.06	3.12	1.00
Table conc.	22.03	62.77	18.14	93.95	98.48
Table middling	1.33	9.05	0.46	0.82	0.15
Table sand tailing	8.50	2.07	0.14	1.20	0.29
Table slime tailing	0.49	27.39	0.62	0.91	0.08
Feed sample (cal.)	100.00	14.72	4.06	100.00	100.00

Tests Nos. 2 and 3 indicate that satisfactory recoveries and grades of concentrate can be obtained by either method of concentration. They also indicate that the greater part of the gold is free and can be concentrated by gravity.

(Experimental Tests, cont'd) -

Test No. 4.

All products of tests, assay rejects, and retains were mixed together, giving almost 1,500 pounds of feed for a large-scale test, which was conducted as follows:

The material was fed to a magnetic separator to remove the magnetite. The machine used for this purpose was a wet-belt-type machine and was apparently not quite strong enough to remove all of the magnetite. The non-magnetic portion was then fed through a launder classifier to tables where clean ferberite concentrates were taken off and middling products were re-treated in batches to produce further quantities of lower-grade concentrates.

In the following table the concentrates listed as No. 1 are those produced in the first operation, while those marked No. 2 are the ones produced by re-treating the first middlings:

Summary of Results, Test No. 4.:

Product	Weight, per cent	Assays: WO_3, per cent	Assays: Au, oz./ton	Distribution, per cent: WO_3	Distribution, per cent: Au
Magnetite	63.2	0.17	0.14	0.8	2.6
Butchart conc. #1	16.0	60.52	18.30	68.9	86.0
Butchart conc. #2	7.5	38.26	4.34	20.4	9.6
Deister conc. #1	0.6	54.66	2.14	2.3	0.4
Deister conc. #2	0.5	22.76	0.74	0.8	0.1
Wilfley conc. #1	0.8	55.60	2.02	3.2	0.5
Wilfley conc. #2	0.5	37.68	0.62	1.3	0.1
Butchart middling	2.9	2.10	0.40	0.4	0.2
Deister middling	0.9	2.39	0.20	0.2	0.1
Wilfley table middling	0.3	3.25	0.98	0.2	0.1
Butchart tailing	4.6	1.13	0.04	0.4	0.1
Deister tailing	1.4	1.46	0.18	0.2	0.1
Wilfley tailing	0.8	16.68	0.70	0.9	0.1
Feed sample (cal.)	100.0	14.05	3.40	100.0	100.0

It will be noted that the two Butchart table concentrates contain the majority of both the gold and the tungsten while smaller amounts are contained in the other

(Test No. 4, cont'd) -

products.

Owing to the inefficient removal of magnetite by the separator used in this case, the average grade of all the above-mentioned concentrates is 52.62 per cent WO_3.

To complete the removal of the magnetite, the concentrates were re-treated on the Ulrich machine at 1.0 ampere with a 3/16-inch gap and this brought the average grade of the concentrates up to 59.97 per cent WO_3. By sacrificing a very little on recovery this figure could be brought well over 60 per cent by discarding some of the lowest-grade concentrates listed in the foregoing table.

Conclusions:

The tests have established that in the sample submitted 95 per cent of the tungsten is contained in the size range -3+35 mesh and that the greater part of the gold is free. It was further established that no association at all existed between the magnetite and ferberite.

A good flow-sheet would be to screen the gravel first on a grizzly to remove course gravel and boulders, after which a trommel would eliminate all plus 3 mesh material.

The trommel undersize would be fed to a magnetic separator where the magnetite would be taken out and discarded. The non-magnetic product would be fed to a jig fitted with a 35-mesh screen leading to the hutch, where gold and a low-grade tungsten product would collect. The gangue would be discharged from the jig overflow while -3+35 mesh ferberite could be discharged under a gate.

(Continued on next page)

(Conclusions, cont'd) -

The hutch product could be treated for recovery of its gold content and the tailing rejected. The gate discharge should be a fairly good grade of ferberite but if necessary it could be treated on an auxiliary magnetic separator to complete removal of magnetite. At this size range some ferberite will have to be sacrificed to obtain the required grade. If the non-magnetic ferberite should carry any plus 35 mesh gold this would have to be taken care of by other means. Large nuggets could be removed by hand, while finer gold could be recovered by barrel amalgamation.

Should a 'Doodle-Bug' type of dredge with fixed riffles to treat this deposit be contemplated, very low capacity will result due to shut-downs to clean up the riffles. Jigs taking $\frac{1}{2}$-inch feed from the trommels and fitted with a 3-mesh top screen would operate continuously making hutch and gate concentrates. These magnetite-ferberite concentrates would be taken ashore and cleaned up over a magnet separator to remove magnetite and then over amalgamating devices to recover gold.

Should a fixed shore plant be installed to which the gravel would be transported, a flow-sheet such as indicated on Page 8 would be suitable.

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