CANADA

DEPARTMENT OF ENERGY, MINES AND RESOURCES

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 70-6

HIGH-INTENSITY MAGNETIC SEPARATION ON A TUNGSTEN ORE, FROM THE GREY RIVER PROPERTY OF AMERICAN SMELTING AND REFINING COMPANY, BUCHANS, NEWFOUNDLAND

by

G. I. MATHIEU AND R. W. BRUCE

MINERAL PROCESSING DIVISION

NOTE: THIS REPORT RELATES ESSENTIALLY TO THE SAMPLES AS RECEIVED. THE REPORT AND ANY CORRESPONDENCE CONNECTED THEREWITH SHALL NOT BE USED IN FULL OR IN PART AS PUBLICITY OR ADVERTISING MATTER.

COPY NO. O

JANUARY, 1970.

Mines Branch Investigation Report IR 70-6

HIGH-INTENSITY MAGNETIC SEPARATION ON A TUNGSTEN ORE, FROM THE GREY RIVER PROPERTY OF AMERICAN SMELTING AND REFINING COMPANY, BUCHANS, NEWFOUNDLAND

by

G.I. Mathieu* and R.W. Bruce**

SUMMARY OF RESULTS

The ore sample was high-grade, containing 13.6% WO_3 occurring essentially as coarse wolframite interspersed in quartz. Pyrite, chalcopyrite, native bismuth and bismuth sulphides are the other metallic minerals appearing in appreciable amounts in the ore.

High-intensity magnetic separation, after grinding to minus 35 mesh, was sufficient to produce a 72% WO_3-grade concentrate with an 83% tungsten recovery. Further grinding to minus 65 mesh and flotation of the sulphides prior to magnetic concentration of the wolframite failed to improve these results. However, it reduced slightly the impurity levels in the concentrate, the copper being lowered from 0.29% to 0.10% and the bismuth from 0.15% to 0.09%.

Because of the very small sample available for investigation (about 1 lb), no attempt was made to recover the copper and bismuth values.

---

*Research Scientist and **Head, Non-Ferrous Minerals Section, Mines Branch, Department of Energy, Mines and Resources, Ottawa, Canada.

INTRODUCTION

On September 9, 1969, a lump of richly mineralized ore (1 1/4 lb) was given to Messrs A. Stemerowicz and G.I. Mathieu of the Mineral Processing Division (on a field trip to Newfoundland) by Mr. E.M. Martin, General Manager, American Smelting and Refining Company, Buchans, Newfoundland. Mr. Martin said that the specimen was from their Grey River project, and he was interested in the identification of the black mineral it contained as well as in its magnetic susceptibility. The sample was brought back to Ottawa and a covering letter was sent by Mr. Martin.

Property

The Asarco Grey River property is located 90 miles due south of Buchans, Newfoundland. Extensive underground development work was done on this tungsten discovery during 1969 and the company is now considering putting the property into production.

Sampling and Analysis

The ore sample was crushed to minus one inch and a few representative pieces were selected for mineralogical examination. The remainder was reduced to minus 10 mesh and a head sample was riffled out for chemical analysis.

TABLE 1

Chemical Analysis* of Head Sample

Tungsten trioxide (WO_3)	-	13.60%
Copper (Cu)	-	1.44"
Zinc (Zn)	-	0.15"
Bismuth (Bi)	-	1.33"
Sulphur (S)	-	19.90"

*From Internal Reports MS-AC-69-817 and -936.

Mineralogical Examination*

Four hand specimens and a portion of the head sample (about 100 grams) were sent to the Mineralogy Section of the Mineral Sciences Division for identification of the minerals and determination of their grain sizes and textural relationships. As a separate investigation report has been issued on this work, only the summary of results of the mineralogical studies and some of its conclusions will be repeated here.

"Mineralogical studies show that the ore consists essentially of coarse to massive wolframite and pyrite, interspersed with quartz. The tungsten-bearing minerals consist largely of wolframite with smaller amounts of scheelite. Copper is represented by chalcopyrite, and zinc by sphalerite. The ore contains small amounts of native bismuth, bismuth sulphides and tellurides. Small amounts of the silver telluride, hessite, and an unidentified silver sulphide are also present. Other minerals in the ore include: arsenopyrite, pyrrhotite, galena, and quartz."

"The minerals of interest in the ore are wolframite, scheelite, chalcopyrite, native bismuth, bismuthinite, sphalerite, galena, the two tellurides, hessite and the unidentified silver phase. The silver and lead content is probably too low to be of economic importance.

The wolframite and much of the chalcopyrite is largely of a coarse-grained nature, and should be readily liberated. However, some of the chalcopyrite and scheelite is very fine-grained and will be difficult to liberate from their hosts. In the case of scheelite, since it occurs chiefly with the wolframite, they can be expected to concentrate together. The bismuth tellurides and sulphides will, to a large degree, be difficult to liberate from their host minerals. The same characteristic holds true for some of the sphalerite."

OUTLINE OF TESTWORK

Because of the small size of the sample, only two tests were carried out on the ore. Both were aimed at the recovery of the wolframite by magnetic separation using a Jones high-intensity separator. The first test was done on the ore ground to minus 35 mesh, while the second was carried out at a finer size (minus 65 mesh). Prior to the magnetic separation in the second test, a flotation stage was inserted in the procedure with the purpose of reducing the amount of middling recovered by the Jones separator and, possibly, of decreasing the impurity level in the final wolframite concentrate.

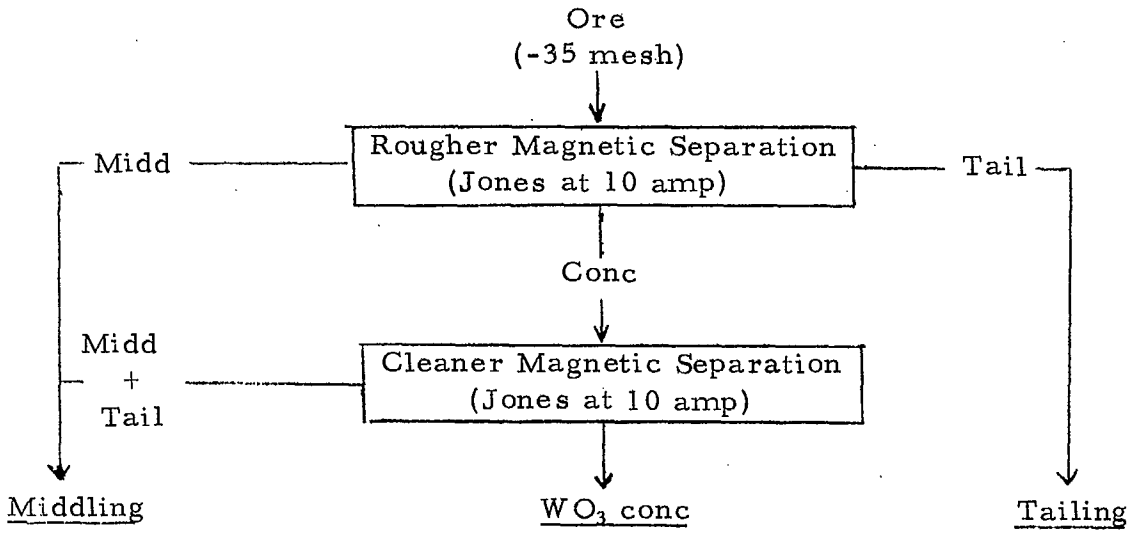
---

*From Mines Branch Investigation Report IR-69-89 by D.R. Owens.

DETAILS OF INVESTIGATION

Test 1, Magnetic Separation (-35 mesh)

A 200-g sample of crushed ore was staged ground to minus 35 mesh and fed to a Jones high-intensity magnetic separator according to the following scheme.



All the products were analysed for tungsten and sulphur, and the metal distributions were calculated with the following results:

TABLE 2

Results of High-Intensity Magnetic Separation

Product	Weight %	Analysis* %		Distribution %	
		WO_3	S	WO_3	S
WO_3 conc	16.0	72.1	0.69	83.2	0.6
Middling	38.5	3.0	22.80	8.3	45.8
Tailing	45.5	2.6	22.60	8.5	53.6
Feed (calcd)	100.0	13.9	19.20	100.0	100.0

Additional analyses on WO_3 conc: Cu - 0.29%, Bi - 0.15%

*From Internal Reports MS-AC-69-817 and 936.

Test 2, Flotation and Magnetic Separation (-65 mesh)

A 200-g sample was ground by stages to 100% minus 65 mesh and floated using the following procedure.

TABLE 3

Reagents and Conditions for Flotation of Sulphides

Operation	Time min	Reagent	lb/ton	pH
Rougher flotation	9	Xanthate 301	0.10	7.5
		Pine oil	0.06	
Cleaner stage	4	Xanthate 301	0.01	7.4
		Pine oil	0.008	

The rougher and cleaner flotation tailings were combined and fed to a Jones separator set at 10 amperes as in the preceding test. The results of the flotation and magnetic separation are shown in Table 4.

TABLE 4

Results of Flotation and Magnetic Separation

Product	Weight %	Analysis %		Distribution %	
		WO_3	S	WO_3	S
WO_3 conc	13.9	72.2	0.16	82.7	0.1
Middling	8.6	14.3	17.2	10.1	6.9
Sulphide conc	36.3	0.7	48.1	2.1	81.5
Jones tailing	41.2	1.5	6.0	5.1	11.5
Feed (calcd)	100.0	12.1	21.4	100.0	100.0

Additional analyses on WO_3 conc: Cu - 0.10%, Bi - 0.09%

*From Internal Reports MS-AC-69-817 and 936.

SUMMARY AND CONCLUSIONS

Although the ore sample contained copper (1.44%) and bismuth (1.33%) in economic amount, the investigation, as requested by Mr. Martin, was only concerned with the identification of the dark mineral in the ore and, (if wolframite), its recovery by magnetic separation. Effectively, the dark material which constituted about 20% of the sample was identified as wolframite by microscopic examination and electron microprobe analysis. The mineral responded well to concentration by high-intensity magnetic separation to produce a 72% WO_3-grade concentrate with an 83% tungsten recovery.

Despite the significant quantities of copper and bismuth in the ore, these reported only in very minor amount (0.1 to 0.3%) in the wolframite concentrate.

If the presence of copper and bismuth proves to be consistent through the orebody, their recovery might well be worthwhile and could be investigated if a larger sample were provided.

ACKNOWLEDGEMENTS

The writers wish to acknowledge the contribution to this investigation by members of the Mineral Sciences Division, namely, D.R. Owens for the Mineralogical Examination, R.W. Buckmaster and P. Lanthier for the chemical analysis.

GIM/RWB/cw