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R E P O R T

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ORE DRESSING AND METALLURGICAL LABORATORIES

361

The Concentration of the Cobalt Ores of the
Agaunico Cobalt Mines, Limited, Cobalt, Ont.

By A.K. Anderson & D.S. Halford.

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REPORT

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The Concentration of the Cobalt Ores of the
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Shipment: A shipment of eight bags of ore, gross weight 594 pounds was received at the Ore Dressing Laboratories, Ottawa on March 17, 1920 consigned by D.I. Jenmeth of the Agaunico Cobalt Mines Limited, Cobalt, Ontario.

Characteristics of the Ore: The ore consisted of cobalt minerals, cobaltite, smaltite and erytherite (cobalt bloom) in a diabase gangue with small amounts of calcite. Of the cobalt minerals cobaltite predominates.

Purpose of Experimental Tests: The purpose of the tests was to determine the effects of flotation on the recovery of cobalt minerals. The practice at the property is to concentrate on tables with an apparent loss of very fine slimes and oxidized cobalt.

Sampling and Analysis: The entire lot was crushed to $\frac{1}{2}$ " mesh and passed through a Jones Riffle Sampler. One-quarter of the lot was then stage crushed through finer mesh screens with alternate quartering until a representative portion was secured for assay.

This showed the shipment to contain,-

Cobalt - 2.60% Silver - 0.22 oz./ton
 Nickel - 0.60% Gold - 0.02 oz./ton

All test work done was along the lines of concentration by flotation, unless otherwise indicated. The ore was ground 88% through 200 mesh, and floated with reagents as shown in the individual tests. Various combinations of these were tried in order to determine the most suitable for this ore. Two thousand gram representative portions of the material crushed to pass a 14 mesh screen were ground to the required fineness on a Denver Equipment Company iron ball mill containing iron balls.

Test #1

Two thousand grams ore -14 mesh, ground in a natural circuit, no reagents being added.

After grinding, the pulp was transferred to a mechanically agitated flotation machine where 0.05 pounds potassium xanthate and 0.12 pounds cresylic acid per ton were added.

Product	%	Assay		% Values	
		Wt.	Co %	Ni %	Co
Heads (calculated)	100.0	2.45	0.74	100.0	100.0
Concentrate	3.47	4.92	0.88	6.97	4.1
Tailing	96.53	2.36	0.74	93.03	95.9

Flotation in a natural circuit is not successful. A low grade cobalt concentrate results and a very low recovery.

Test #2

In this test the ore was ground in water containing 8.0 pounds soda ash per ton of ore, and floated with 0.20 pounds per ton potassium xanthate. Pine oil at the rate of 0.08 pounds per ton was added to froth.

Product	% Wt.	Assay		% Values	
		Co %	Ni %	Co	Ni
Heads (calculated)	100.0	2.42	0.84	100.0	100.0
Concentrate	6.31	9.55	5.05	24.9	37.8
Tailing	93.69	1.94	0.56	75.1	62.2

Flotation under these conditions yields a low recovery.

Test #3

The effect of lime as alkaline reagent was investigated in this test. 5.0 pounds per ton of this was added to the grinding circuit, and the pulp then floated with 0.35 pounds potassium xanthate and 0.08 pounds pine oil per ton.

Product	% Wt.	Assay		% Values	
		Co %	Ni %	Co	Ni
Heads (calculated)	100.0	2.55	0.75	100.0	100.0
Concentrate	4.67	7.50	2.00	13.7	12.4
Tailing	95.33	2.31	0.69	86.3	87.6

Flotation conditions on this test were poor, the froth was thin and slow floating. Recoveries are very low.

Test #4

In this test the ore was ground with 8.0 pounds soda ash per ton. The pulp was then treated with 1 pound per ton sodium sulphide and floated with 0.20 pounds per ton potassium xanthate and 0.08 pounds pine oil.

Product	% Wt.	Assay		% Values	
		Co %	Ni %	Co	Ni
Heads (calculated)	:100.0	: 2.40	: 0.77	: 100.0	: 100.0
Concentrate	: 7.03	: 13.88	: 4.96	: 40.5	: 44.9
Tailing	: 92.97	: 1.54	: 0.46	: 59.5	: 35.1

The use of sodium sulphide appears to be of benefit, raising the grade of concentrate produced and increasing the recovery.

Test #5

The effect of grinding the ore with 0.15 pounds thio-carbanalid per ton was studied. Soda ash, 8.0 pounds per ton was added to the grinding circuit, and 0.12 pounds cresylic acid used in the flotation cells.

Product	% Wt.	Assay		% Values	
		Co %	Ni %	Co	Ni
Heads (calculated)	:100.0	: 2.72	: 0.85	: 100.0	: 100.0
Concentrate	: 7.60	: 17.20	: 5.60	: 48.0	: 49.5
Tailing	: 92.40	: 1.53	: 0.47	: 52.0	: 50.5

Thiocarbanalid and cresylic acid appear to be more potent flotation reagents than potassium xanthate and pine oil.

Test #6

In this test, the ore was ground with 10 pounds soda ash per ton, treated with 1.0 pounds sodium sulphide and floated with 0.20 pounds potassium xanthate and 0.08 pounds pine oil per ton.

After flotation, the tailing from this process was passed over a Wilfley table and an additional concentrate removed.

Product	% Wt.	Assay		% Values	
		Co %	Ag oz/ton	Co	Ag
Heads (calculated)	100.0	2.68	0.19	100.0	100.0
Flot. concentrate	6.4	22.26	1.24	55.2	41.7
Flot. middling	9.9	7.20	0.38	26.6	19.3
Table concentrate	1.0	6.10	0.70	2.3	3.7
Table tailing	82.7	0.58	0.08	17.9	34.8

Flotation under these conditions yields a recovery of 79.8% of the cobalt in the combined middling and tailing. On cleaning, a product analyzing 22.26% cobalt is secured. A low grade table concentrate is secured representing an additional 2.3% recovery of the cobalt.

Test #7

In this test the reagent Flotagen was used for the flotation of the cobalt minerals.

3000 grams of the ore -14 mesh was ground for 30 minutes in the ball mill with 2000 grams of water. This gave a grind of about 80% through 200 mesh. Reagents as listed below were added. After grinding it was floated in a mechanically agitated machine at a dilution of 3:1. First froth was removed for 5 minutes when copper sulphate was added and a further froth removed for 2 minutes. The rougher froth was cleaned.

Reagents.

To Ball Mill

To Flotation Machine

Soda ash - 7 lb. per ton.
Flotagen - .05 lb. per ton.

Flotagen - 0.10 lb. per ton
Pine Oil - 0.25 lb. per ton
Copper Sulphate - 1.0 lb. per ton

Product	% Wt.	Assay		% Values	
		Co %	Ag	Co	Ag
Concentrate	11.93	17.76	83.67		
Middling	10.16	1.54	6.18		
Tailing	77.91	0.33	10.15		
Heads (calculated)	100.0	2.53	100.00		

The use of flotagen results in much better recoveries of cobalt than reagents used in preceding tests.

The results secured in these tests indicate that much higher recoveries can be obtained by concentration by flotation than by table concentration as practiced at the property.

Additional investigations are being carried on by D.S. Halford, Canadian Industries Limited.