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GRINDING INVESTIGATION ON A HIGH GRADE COPPER-ZINC ORE FROM CONSOLIDATED VAUZE MINES LIMITED, NORANDA, QUEBEC

by

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MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

The work index, W_i, for the high grade copper-zinc ore from Consolidated Vauze Mines Limited, at a grind of 81.4% -200 M, when compared with two ores, the work indices of which were known, was:

	Ore A	Ore B	Consolidated Vauze
Work index, W_i, kwh/short ton	19.5		14.5
		13.4	14.7

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INTRODUCTION

The Consolidated Vauze Mines Limited is a copper-zinc mine under development, located in the Noranda mining area of northwestern Quebec.

On January 24, 1961, at the conclusion of the pilot mill testing of a high grade copper-zinc ore from the mine, Mr. Ken Rawling, the company metallurgist, suggested that a valuable service would be rendered the company if the Mines Branch in Ottawa would undertake the necessary test work to determine a work index on the high grade ore.

DETAILS OF INVESTIGATION

Approximately 150 lb of high grade copper-zinc ore rejects from the pilot mill run was crushed to all -10 M and carefully riffled until ten 2000 g samples were obtained. These were retained for the necessary test work. A head sample was riffled out of the crushed ore for a screen test, and the remainder of the ore was bagged.

Since it was desirable that a grind of between 80.0% and 83.0% -200 M be obtained, a series of timed grinding tests was carried out in a steel grinding mill which had been set aside for the grindability tests. It was determined from these tests that a grind of 21 min would give a product falling within the desired range.

In order to determine the work index on the Consolidated Vauze ore, it was necessary to grind the same weight of one or two known ores, (ie. the work indices of which were known), for the same time in the same ball mill. In this investigation two known ores were used for comparison and these shall hereafter be designated "Ore A" and "Ore B".

Accordingly, approximately 4000 g of Ore A and Ore B were crushed to -10 M and a 2000 g sample was carefully riffled out of each for the comparison grinding tests. Head samples of Ore A and Ore B were retained for screen tests.

Screen tests and infrasizer tests were done on each test grind.

The tables which follow show the results of these tests.

TABLE 1

Results of Screen Tests on Feeds

Mesh Size	Con. Vauze		Ore A		Ore B	
	Wt, %	%, Pass	Wt, %	%, Pass	Wt, %	%, Pass
+10 M	0.5	100.0	-	-	-	-
-10 +14 "	11.2	99.5	13.2	100.0	13.5	100.0
-14 +20 "	13.4	88.3	16.2	86.8	15.4	86.5
-20 +28 "	10.4	74.9	12.1	70.6	10.8	71.1
-28 +35 "	9.8	64.5	10.7	58.5	9.2	60.3
-35 +48 "	7.9	54.7	7.8	47.8	6.6	51.1
-48 +65 "	5.9	46.8	6.8	40.0	5.9	44.5
-65 +100 M	6.6	40.9	5.7	33.2	5.1	38.6
-100 +150 "	6.2	34.3	5.0	27.5	4.4	33.5
-150 +200 "	5.6	28.1	3.8	22.5	3.5	29.1
-200 "	22.5	22.5	18.7	18.7	25.6	25.6
Total	100.0		100.0		100.0	

TABLE 2

Results of Screen Tests on Products

Mesh Size	Con. Vauze		Ore A		Ore B	
	Wt, %	%, Pass	Wt, %	%, Pass	Wt, %	%, Pass
+48 M	-	-	0.2	100.0	-	-
-48 +65 "	0.4	100.0	1.3	99.8	0.4	100.0
-65 +100 M	1.6	99.6	6.6	98.5	1.8	99.6
-100 +150 "	5.6	98.0	13.4	91.9	6.2	97.8
-150 +200 "	11.0	92.4	14.5	78.5	9.5	91.6
-200 M + 56 microns	10.6	81.4	4.7	64.0	3.8	82.1
-56 " + 40 "	16.3	70.8	11.2	59.3	13.2	78.3
-40 " + 28 "	13.7	54.5	8.3	48.1	13.5	65.1
-28 " + 20 "	11.3	40.8	7.0	39.8	12.9	51.6
-20 " + 14 "	7.1	29.5	5.6	32.8	9.0	38.7
-14 " + 10 "	4.7	22.4	4.8	27.2	7.5	29.7
-10 microns	17.7	17.7	22.4	22.4	22.2	22.2
Total	100.0		100.0		100.0	

The power required in each test was the same since the same conditions prevailed in each test and thus, the power formula

$$W = W_i \left(10/\sqrt{P} - 10/\sqrt{F}\right)$$

used by F. C. Bond in the development of his Third Theory of Comminution can be used to calculate the work index of the Consolidated Vauze ore.

The terms which are shown in the formula are defined as follows:

F = 80 per cent passing size in the feed, expressed in microns;

P = 80 per cent passing size in the product, expressed in microns;

W = work required in kwh per short ton, to reduce a material from F to P,

W_i = work index. The amount of work required in kwh/short ton to reduce a material from infinite size to 80 per cent passing 100 microns.

Thus, $W_i (10/\sqrt{P} - 10/\sqrt{F})$ for Consolidated Vauze ore may be equated to $W_i (10/\sqrt{P} - 10/\sqrt{F})$ for Ore A or Ore B.

The infrasizer used in the tests was calibrated for an ore having a density of 2.43. The densities of the ores under test were determined and the true separating size for each infrasizer cone was calculated. When the two per cent passing curves were plotted using the nominal micron sizes and the new Stokes diameters, the difference at the 80 per cent passing size in microns was extremely small. Thus, the nominal micron sizes of the infrasizer were used.

The following table gives the conditions which prevailed during the test work and shows the results achieved and the work index which was calculated for the Consolidated Vauze ore using Bond's power formula.

TABLE 3

Results of Test Work

	Consolidated Vauze	Ore A	Ore B
Grind time, min	21	21	21
Weight of charge, g	2000	2000	2000
% Solids	57	57	57
Feed, % -200 M	22.5	18.7	25.6
Product, % -200 M	81.4	64.0	82.1
Feed, F, 80% Passing, Microns	900	1030	1060
Product, P, 80% Passing, Microns	70	110	64
Work Index, W_i, from Ore A	14.5	19.5	
" " " " Ore B	14.7		13.4

CONCLUSIONS

The calculated work index, W_i, for the ore from Consolidated Vauze Mines Limited, when compared with Ore A was 14.5 kwh/short ton and when compared with Ore B was 14.7 kwh/short ton.

TFB:EBM