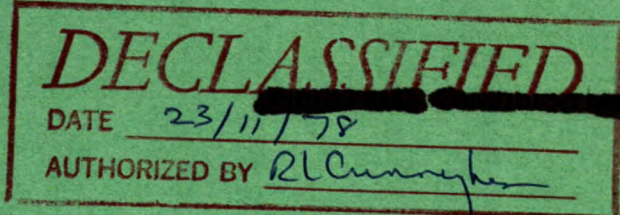


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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 62-68

# GRINDING INVESTIGATION OF THREE SAMPLES OF ORE FROM EAST MALARTIC MINES LIMITED, NORRIE, QUEBEC

by

M. J. WALKER & T. F. BERRY

MINERAL PROCESSING DIVISION

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COPY NO. 19

SEPTEMBER 6, 1962



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GRINDING INVESTIGATION OF THREE SAMPLES OF ORE FROM  
EAST MALARTIC MINES LIMITED, NORRIE, QUEBEC

by

M. J. Walker\* and T. F. Berry\*\*

SUMMARY OF RESULTS

The average indices of the three East Malartic ores compared with two ores whose work indices were known was found to be as follows:

	<u>Comparison Ores</u>		<u>East Malartic Ores</u>		
	<u>A</u>	<u>B</u>	<u>No.1</u>	<u>No.2</u>	<u>No.3</u>
Work Index (Kwh per short ton)	19.5	13.4	16.8	13.5	17.6

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## INTRODUCTION

Following a survey of the mill of East Malartic Mines, Limited, performed by the Extraction Metallurgy Division, Mines Branch, Ottawa, in April, 1962, Mr. J. W. Keys, Mill Superintendent, East Malartic Mines, Limited, submitted samples of three different types of ore which were said to be materially reducing the tonnage in their grinding circuit. The Mineral Processing Division was asked to carry out a grinding investigation on the ores in question.

### Location of Property

East Malartic Mines, Limited, is a gold producer situated in the Malartic area of northwestern Quebec.

### Shipment

On July 27, 1962, a shipment of approximately 175 pounds of ore was received by the Mines Branch in Ottawa. The shipment comprised the following:

Mines Branch Designation	Company Designation and Description	Gross Weight (lbs)
Ore No. 1	4/62-7-1 surface greywacke	57
Ore No. 2	4/62-7-2 amphibdite carbonate schist	63
Ore No. 3	4/62-7-3 silicified greywacke with calcite stringers	55

## DETAILS OF INVESTIGATION

The samples of East Malartic ore and the samples of two comparison ores of known work indices were crushed separately to all -10 mesh. A head sample and three 2000 g samples were carefully riffled from each ore. Screen tests were run on the five head samples. The other 15 - 2000 g samples were retained for investigative tests. The two comparison ores whose work indices are known will be hereafter designated as Ore A and Ore B.

In order to obtain the work index of each of the East Malartic ore samples it was necessary to grind the three samples for 15, 25, and 35 minutes at 57% solids in the same mill to ensure identical power requirements. In some cases infrasizer analyses were carried out on the ground pulps to obtain more accurate screen analysis curves.

Screen and infrasizer test results on the feeds and ground pulps are tabulated in the following tables.

TABLE 1

Screen Tests on Feeds

Mesh Size	COMPARISON ORES				EAST MALARTIC ORES					
	Ore A		Ore B		Ore No 1		Ore No 2		Ore No 3	
	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass
+14m	18.9	81.1	15.8	84.2	19.6	80.4	17.3	82.7	20.3	79.7
-14m+20m	19.5	61.6	17.9	66.3	20.1	60.3	16.5	66.2	20.9	58.8
-20m+28m	12.8	48.8	12.3	54.0	12.6	47.7	10.4	55.8	12.6	46.2
-28m+35m	11.2	37.6	10.9	43.1	11.0	36.7	9.0	46.8	10.4	35.8
-35m+48m	7.2	30.4	7.2	35.9	6.8	29.9	5.8	41.0	6.5	29.3
-48m+65m	6.0	24.4	5.7	30.2	5.4	24.5	4.8	36.2	5.2	24.1
-65m+100m	5.2	19.2	4.8	25.4	4.6	19.9	4.6	31.6	4.4	19.7
-100m+150m	3.6	15.6	3.3	22.1	3.3	16.6	4.6	27.0	3.3	16.4
-150m+200m	2.2	13.4	2.5	19.6	2.6	14.0	4.8	22.2	2.4	14.0
-200m	13.4	-	19.6	-	14.0	-	22.2	-	14.0	-
TOTALS	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-

TABLE 2

Screen Tests on Products - 15 min Grind

Mesh Size	COMPARISON ORES				EAST MALARTIC ORES					
	Ore A		Ore B		Ore No 1		Ore No 2		Ore No 3	
	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass
+35m	1.2	98.8	-	-	0.4	99.6	-	-	1.1	98.9
-35m+48m	3.9	94.9	0.2	99.8	1.2	98.4	0.1	99.9	3.0	95.9
-48m+65m	13.1	81.8	2.0	97.8	7.8	90.6	0.8	99.1	11.0	84.9
-65m+100m	18.2	63.6	9.4	88.4	16.8	73.8	5.8	93.3	16.8	68.1
-100m+150m	13.9	49.7	13.1	75.3	14.0	59.8	10.8	82.5	12.5	55.6
-150m+200m	9.2	40.5	11.3	64.0	10.4	49.4	14.4	68.1	9.5	46.1
-200m	40.5	-	64.0	-	49.4	-	68.1	-	46.1	-
TOTALS	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-

TABLE 3

Screen Tests on Products - 25 min Grind

Mesh Size	COMPARISON ORES				EAST MALARTIC ORES					
	Ore A		Ore B		Ore No 1		Ore No 2		Ore No 3	
	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass
+48m	0.2	99.8	0.2	99.8	0.1	99.9	0.1	99.9	0.1	99.9
-48m+65m	1.8	98.0	0.4	99.4	0.8	99.1	0.2	99.7	1.4	98.5
-65m+100m	10.8	87.2	3.4	96.0	6.3	92.8	2.2	97.5	8.2	90.3
-100m+150m	16.1	71.1	8.8	87.2	12.6	80.2	7.3	90.2	13.2	77.1
-150m+200m	13.6	57.5	11.0	76.2	12.6	67.6	12.2	78.0	12.1	65.0
-200m	57.5	-	76.2	-	67.6	-	78.0	-	65.0	-
TOTALS	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-

TABLE 4

Screen Tests on Products - 35 min Grind

Mesh Size	COMPARISON ORES				EAST MALARTIC ORES					
	Ore A		Ore B		Ore No 1		Ore No 2		Ore No 3	
	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass	Wt %	% Pass
+65m	0.5	99.5	0.2	99.8	0.3	99.7	0.2	99.8	0.4	99.6
-65m+100m	4.8	94.7	1.4	98.4	2.7	97.0	1.0	98.8	3.2	96.4
-100m+150m	12.1	82.6	5.4	93.0	9.0	88.0	4.8	94.0	9.2	87.2
-150m+200m	13.6	69.0	9.1	83.9	12.0	76.0	10.3	83.7	11.6	75.6
-200m+56 $\mu$	69.0	-	4.8	79.1	4.3	71.7	9.5	74.2	4.2	71.4
-56 $\mu$ +40 $\mu$		-	12.1	67.0	14.3	57.4	34.0	40.2	14.1	57.3
-40 $\mu$ +28 $\mu$		-	11.9	55.1	12.0	45.4	15.1	25.1	11.4	45.9
-28 $\mu$ +20 $\mu$		-	12.5	42.6	10.5	34.9	8.0	17.1	10.5	35.4
-20 $\mu$ +14 $\mu$		-	9.5	33.1	8.9	26.0	4.4	12.7	9.0	26.4
-14 $\mu$ +10 $\mu$		-	7.8	25.3	6.5	19.5	3.0	9.7	7.2	19.2
-10 $\mu$		-	25.3	-	19.5	-	9.7	-	19.2	-
TOTALS	100.0	-	100.0	-	100.0	-	100.0	-	100.0	-

The work indices of the three samples of East Malartic ore were calculated using the following formula developed by F. C. Bond in his Third Theory of Comminution

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

where  $F$  = 80% passing size of feed in microns  
 $P$  = 80% passing size of product in microns  
 $W$  = work done in kwh per short ton in reducing from  $F$  to  $P$   
 $W_i$  = work index. Work in kwh per short ton to reduce material from infinite size to 80% passing 100 microns.

Since the grinding of the known and unknown ores was done under identical conditions,  $W_i \left( \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right)$  for the known ore may be equated to

$W_i \left( \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \right)$  for the unknown ore. Hence the unknown work index may be calculated.

The infrasizer used in the tests was calibrated for an ore having a specific gravity of 2.43. The specific gravities of the ores tested was close enough to 2.43 that nothing was to be gained by determining the true separating size of each cone and thus the nominal sizes were used in the calculation of results.

The work indices of the three samples of East Malartic ore were calculated by comparison with each of the two known ores, A and B. The 80 percent passing sizes of all feeds and products, the work indices of the two known ores, and the calculated work indices of the three East Malartic ores are shown in Table 5.

To further illustrate the relative grindability of the three East Malartic ores and the two comparison ores a graph of the percent passing 200m vs. grinding time was drawn up and is shown in Figure 1.

TABLE 5

Test Results and Calculated Work Indices

GRIND TIME (min)	COMPARISON ORES						EAST MALARTIC ORES									
	ORE A			ORE B			ORE NO 1			ORE NO 2			ORE NO 3			
	F (microns)	P (microns)	Wi (Kwh/ton)	F (microns)	P (microns)	Wi (Kwh/ton)	F (microns)	P (microns)	Wi (Kwh/ton)	F (microns)	P (microns)	Wi (Kwh/ton)	F (microns)	P (microns)	Wi (Kwh/ton)	
15	1200 -	200 -	19.5 -	- 1150	- 115	- 13.4	1180 1180	168 168	16.6 17.4	1190 1190	99 99	11.6 12.1	1280 1280	190 190	18.2 19.1	
25	1200 -	120 -	19.5 -	- 1150	- 84	- 13.4	1180 1180	104 104	17.6 15.5	1190 1190	79 79	14.6 12.8	1280 1280	112 112	18.3 16.0	
35	1200 -	94 -	19.5 -	- 1150	- 66	- 13.4	1180 1180	84 84	18.1 15.7	1190 1190	70 70	16.0 13.9	1280 1280	84 84	17.8 15.5	
AVERAGE									16.8				13.5			17.6

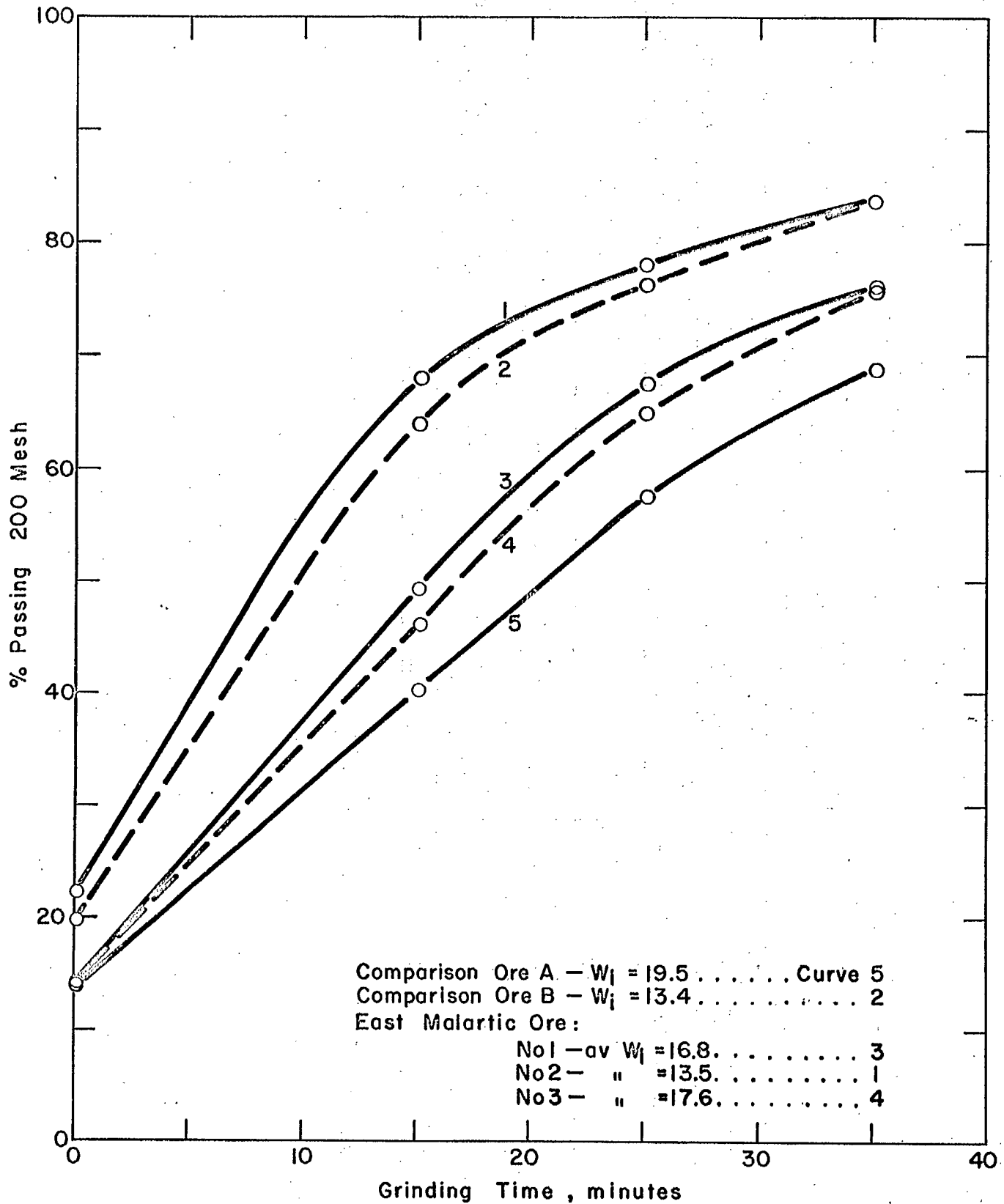


Figure 1 - Comparison of Grinding Characteristics Between Three East Malartic Ores and Two Comparison Ores



### CONCLUSIONS

The average work indices of the three East Malartic ores, Nos 1, 2 and 3, as compared to two known ores, were found to be 16.8, 13.5 and 17.6 respectively. From the above work indices and the curves shown in Figure 1 it can be seen that East Malartic ores No. 1 and No. 3 have comparable hardnesses, while ore No. 2 is considerably softer.