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CANADA

DEPARTMENT OF MINES AND TECHNICAL SURVEYS

OTTAWA

MINES BRANCH INVESTIGATION REPORT IR 63-17

**GRINDING INVESTIGATION ON THREE
SAMPLES OF SANDSTONE FROM CANADA
CEMENT COMPANY LIMITED,
EXSHAW, ALBERTA**

by

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MINERAL PROCESSING DIVISION

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Mines Branch Investigation Report IR 63-17
GRINDING INVESTIGATION ON THREE SAMPLES OF SANDSTONE
FROM CANADA CEMENT COMPANY LIMITED, EXSHAW, ALBERTA.

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SUMMARY OF RESULTS

The grinding characteristics of the three samples of sandstone were very similar although Sample S was slightly harder to grind than the other two. The results of screen tests plotted in Figure 2 and the calculated work indices of 17.2, 17.0 and 19.7 kwh/short ton for Samples C, H and S respectively, show the similarity in grinding characteristics of Samples C and H and the slight difference in grindability of Sample S.

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INTRODUCTION

In a letter dated October 5, 1962, Mr. W.S. Weaver, Manager of Research and Chief Chemist, Canada Cement Company Limited, Canada Cement Building, Phillips Square, Montreal 2, Quebec, informed the Mines Branch in Ottawa of a crushing and grinding problem encountered at the company's plant in Ershaw, Alberta. The Mines Branch was asked to do an investigation to determine the grindability of three samples of sandstone.

Location of Property

The samples received were from the Canada Cement Company plant at Ershaw, which is located between Calgary and Banff in Alberta.

Shipment

On November 6, 1962 three samples of - $\frac{1}{2}$ in. sandstone were received at the Mines Branch. They were designated as follows:

Sample C - 50 lb

" H - 50 "

" S - 50 "

DETAILS OF INVESTIGATION

The three sandstone samples were reduced separately to - 10 m and a head sample representative of each was obtained by riffing. Also from each sample of sandstone crushed to - 10 m, 5 - 2000 g test samples were riffled out. The test samples were ground for 5, 10, 15, 20 and 30 min intervals and screen tests were determined in the ground pulps and on the head samples.

A comparison ore of known work index was crushed to - 10 m and a head sample and 2 - 2000 g test samples were obtained by riffing. These test samples were ground for 20 and 30 min intervals and screen tests were determined on the ground pulps and on the head sample.

In the case of the 20 and 30 min grinds an infrasizer test was done in addition to the screen test.

The results of all of this work may be seen in the following tables and a graphical presentation of the results is shown in Figures 1 and 2.

TABLE 1

Screen Tests on Head Samples

Mesh Size	Comparison Ore		Sample C		Sample H		Sample S	
	% Ret	% Pass	% Ret	% Pass	% Ret	% Pass	% Ret	% Pass
+ 14 mesh	16.8	83.2	22.7	77.3	19.5	80.7	15.2	84.8
+ 20 "	17.6	82.4	19.1	80.9	15.7	84.3	14.2	85.8
+ 28 "	11.5	88.5	10.2	89.8	10.4	89.6	8.5	91.5
+ 35 "	11.8	88.2	9.6	90.4	10.5	89.5	10.1	89.9
+ 48 "	8.1	91.9	6.5	93.5	7.2	92.8	6.5	93.5
+ 65 "	6.7	93.3	5.2	94.8	5.9	94.1	9.4	90.6
+ 100 "	5.9	94.1	4.9	95.1	6.0	94.0	9.7	90.3
+ 150 "	4.2	95.8	4.5	95.5	5.6	94.4	7.2	92.8
+ 200 "	2.7	97.3	3.7	96.3	4.5	95.5	4.0	96.0
- 200 "	14.7	-	15.3	-	15.5	-	15.4	-
Total	100.0	-	100.0	-	100.0	-	100.0	-

TABLE 2

Screen Tests after 5 min Grind

Mesh Size	Sample C		Sample H		Sample S	
	% Ret	% Pass	% Ret	% Pass	% Ret	% Pass
+ 14 mesh	4.1	95.9	5.8	94.2	-	-
+ 20 "	5.0	95.0	4.2	95.8	-	100.0
+ 28 "	4.4	95.6	5.2	94.8	0.4	99.6
+ 35 "	9.5	90.5	9.2	90.8	2.0	98.0
+ 48 "	9.7	90.3	9.6	90.4	6.6	93.4
+ 65 "	11.2	88.8	11.0	89.0	17.5	82.5
+ 100 "	10.9	89.1	12.2	87.8	22.1	77.9
+ 150 "	10.1	89.9	11.4	88.6	16.4	83.6
+ 200 "	7.8	92.2	9.4	90.6	10.2	89.8
- 200 "	27.3	-	26.0	-	24.8	-
Total	100.0	-	100.0	-	100.0	-

TABLE 3

Screen Tests after 10 min Grind

Mesh Size	Sample C		Sample H		Sample S	
	% Ret	% Pass	% Ret	% Pass	% Ret	% Pass
+ 14 mesh	-	-	-	-	-	-
+ 20 "	-	100.0	-	100.0	-	-
+ 28 "	0.7	99.3	0.1	99.9	-	-
+ 35 "	0.6	98.7	0.2	98.7	-	100.0
+ 48 "	2.2	96.5	0.8	98.9	0.6	99.4
+ 65 "	7.4	89.1	4.0	94.9	5.6	93.8
+ 100 "	14.3	74.8	12.8	82.1	18.7	75.1
+ 150 "	16.4	58.4	19.0	63.1	21.6	53.5
+ 200 "	13.4	45.0	17.0	46.1	12.9	40.6
- 200 "	45.0	-	46.1	-	40.6	-
Total	100.0	-	100.0	-	100.0	-

TABLE 4

Screen Tests after 15 min Grind

Mesh Size	Sample C		Sample H		Sample S	
	% Ret	% Pass	% Ret	% Pass	% Ret	% Pass
+ 14 mesh	-	-	-	-	-	-
+ 20 "	-	-	-	-	-	-
+ 28 "	-	-	-	-	-	-
+ 35 "	-	-	-	-	-	100.0
+ 48 "	-	100.0	-	100.0	0.2	99.8
+ 65 "	2.4	97.6	1.0	99.0	1.3	98.5
+ 100 "	9.2	88.4	6.2	92.8	10.6	87.9
+ 150 "	16.0	72.4	16.1	76.7	20.2	67.7
+ 200 "	15.6	56.8	17.8	58.9	14.6	53.1
- 200 "	56.8	-	58.9	-	53.1	-
Total	100.0	-	100.0	-	100.0	-

TABLE 5

Screen Tests after 20 min Grind

Mesh Size	Comparison Ore		Sample O		Sample H		Sample S	
	% Ret	% Pass	% Ret	% Pass	% Ret	% Pass	% Ret	% Pass
+ 35 mesh	-	100.0	-	-	-	-	-	-
+ 48 "	1.0	99.0	-	100.0	-	100.0	-	100.0
+ 65 "	5.8	93.2	0.6	99.4	0.5	99.7	0.4	99.6
+ 100 "	16.2	77.0	4.6	94.8	5.8	95.9	6.1	98.5
+ 150 "	15.8	61.8	13.2	81.6	12.9	85.0	18.6	76.9
+ 200 "	9.6	51.6	15.3	66.3	17.2	65.8	16.6	60.5
- 200 "	51.6	-	66.3	-	65.8	-	60.3	-
Total	100.0	-	100.0	-	100.0	-	100.0	-

TABLE 6

Screen & Infrasiser Tests after 30 min Grind

Mesh Size	Comparison Ore		Sample C		Sample H		Sample S	
	% Ret	% Pass	% Ret	% Pass	% Ret	% Pass	% Ret	% Pass
+ 35 mesh	-	-	-	-	-	-	-	-
+ 48 "	-	100.0	-	-	-	100.0	-	100.0
+ 65 "	0.2	99.8	-	100.0	0.1	99.9	0.2	99.8
+ 100 "	5.0	94.8	1.4	98.6	1.1	98.8	2.2	97.6
+ 150 "	13.5	81.5	8.6	90.0	8.3	90.5	10.9	86.7
+ 200 "	13.7	67.6	14.6	75.4	15.5	75.0	15.4	71.3
+ 56 microns	4.5	63.1	9.6	65.8	7.4	67.6	6.6	64.7
+ 40 "	13.0	50.1	23.1	42.7	19.8	47.8	19.2	45.5
+ 28 "	9.5	40.6	11.4	31.3	14.9	32.9	15.5	32.2
+ 20 "	8.1	32.5	8.8	23.1	10.6	22.3	9.7	22.5
+ 14 "	6.6	25.9	5.5	17.6	6.6	18.7	6.0	16.5
+ 10 "	5.1	20.8	5.5	12.1	4.0	11.7	3.8	12.7
- 10 "	20.8	-	12.1	-	11.7	-	12.7	-
Total	100.0	-	100.0	-	100.0	-	100.0	-

Work Index Calculations

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

$$W = W_i \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}}$$

- where: F = 80% passing size of the feed in microns
- P = " " " " " product in microns
- W = work done in kwh per short ton in reducing F to P
- and W_i = work index - the work in kwh per short ton to reduce a material from infinite size to 80% passing 100 microns.

Since the grinding tests were done under identical conditions for the sandstone and the comparison ore samples then:

$$W_i \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} = W_i \frac{10}{\sqrt{P}} - \frac{10}{\sqrt{F}} \quad \text{and inserting}$$

the work index of the comparison ore on one side of the equation the work indices of the unknown sandstone ores were calculated.

Thus for the 30 min grind, values for P and F were obtained from the graph (figure 1) and values for W_i were calculated.

Results

	Comparison Ore	Sample C	Sample H	Sample S
F (microns)	1150	1500	1150	1040
P (")	95	82	78	90
W _i kwh/short ton	19.5	17.2	17.0	19.8

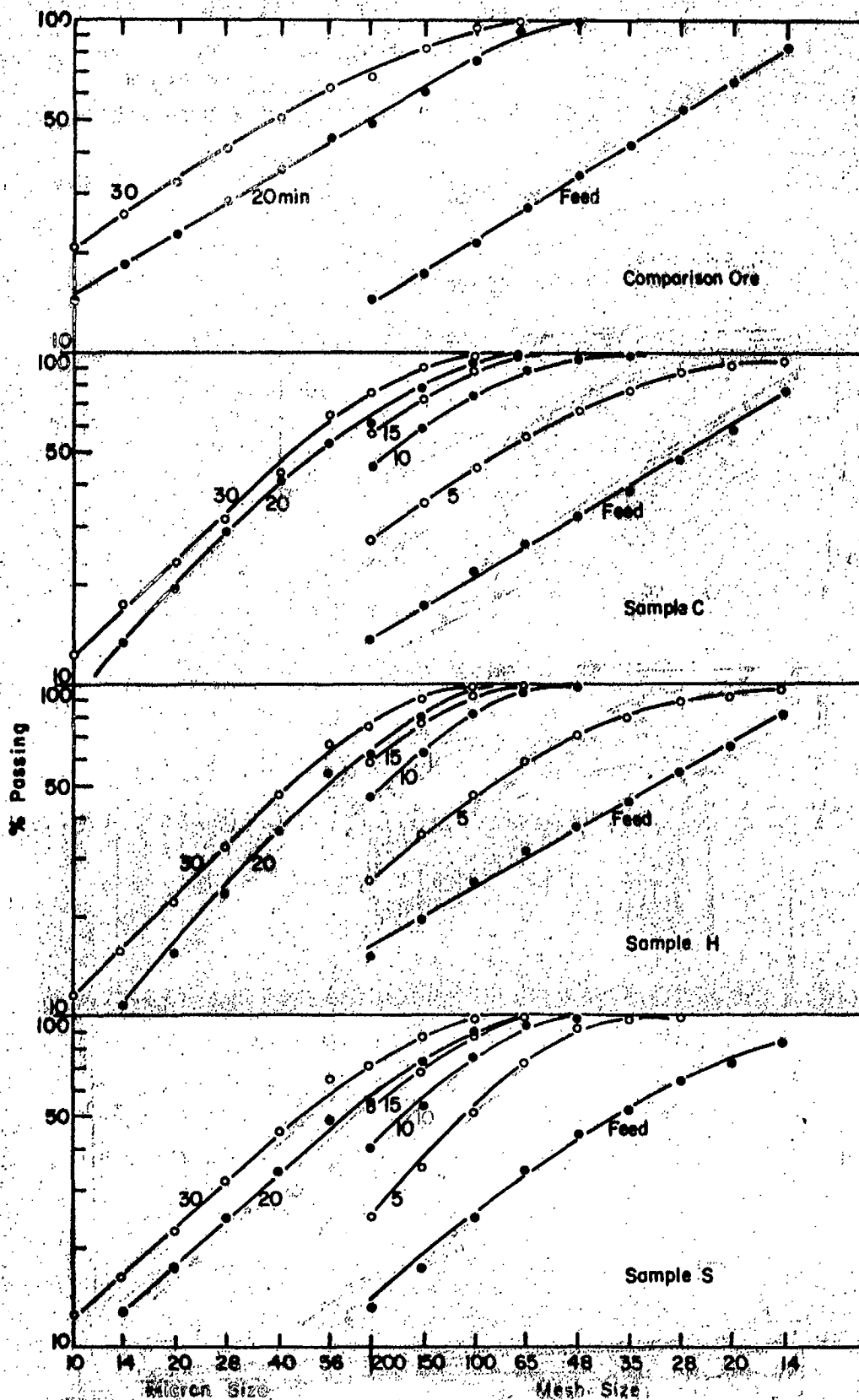


Figure 1: Relationship between size distribution and grinding time

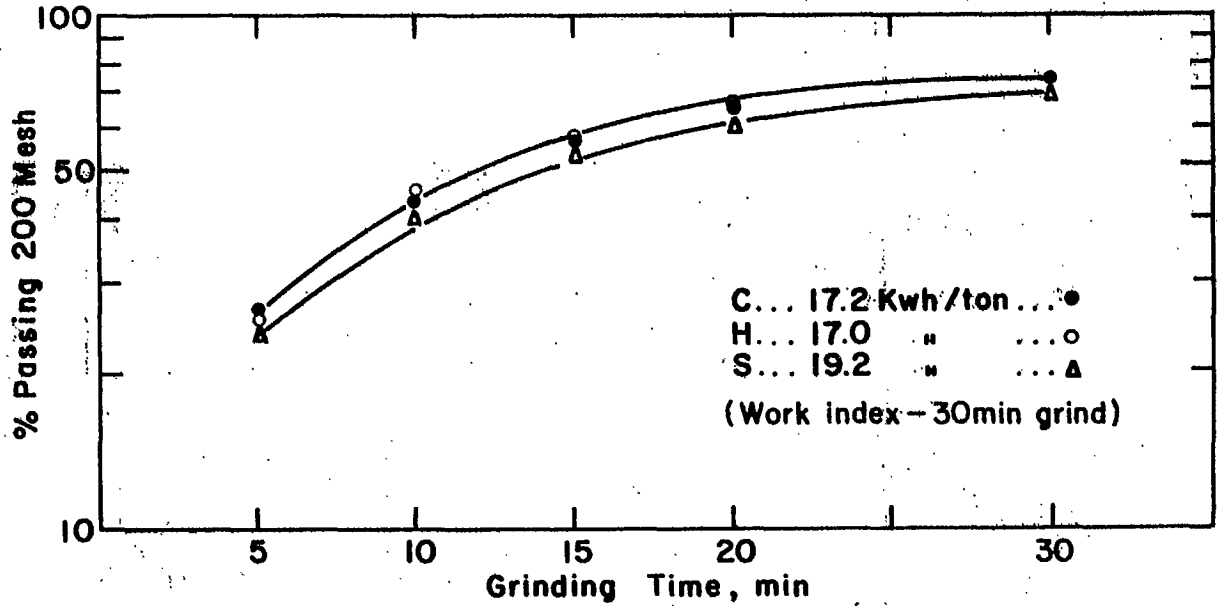


Figure 2: Comparison of the Grinding Characteristics between Three Samples of Sandstone.

CONCLUSIONS

The three samples of sandstone have very similar grinding characteristics but as may be seen in Figure 2, Sample S was slightly harder to grind than the other two samples.