NORANDA MINES LTD.

REPORT ON

AUTOGENOUS GRINDING OF

GRUM ORE

A.R. MacPHERSON
CANADIAN BECHTEL LTD.

November 1977

NORANDA MINES LTD.
GRUM DEPOSIT

Two samples of ore from the Grum Lead-Zinc deposit in the Yukon Territory were received by Aerofall Mills for ginding tests in the 18" Aerofall Mill. Mr. Dick Coleman of Noranda Mines requested that autogenous work indices be obtained with the object to determining the possible application of autogenous grinding to this ore.

The ore was crushed to a nominal top size of 1¼ inches before feeding into the 18" Aerofall Mill. A sample of the feed was screened in order to determine 80% passing size.

Sample No. 1 was run by two different methods in the 18" Mill - one making a relatively coarse grind (top size - 8 mesh) and the other somewhat finer (top size minus 35 mesh). Sample No. 2 was ground producing only a fine grind (top size 28 mesh). Results of these grinding tests are given in the attached Data Sheets supplied by Aerofall Mills.

The results of this work indicated the following Autogenous Work Indices:

Sample #1 Coarse Grind - 5.80
Sample #1 Fine Grind - 5.79
Sample #2 Fine Grind - 11.2

This type of Autogenous Work Index indicates that even the hardest ore is very friable and easy to grind. Sample #1 indicates it is somewhat harder than the granular Labrador ores and Sample #2 is somewhat softer than the normal LORNEX ore. In either case the ore is ideal for full autogenous grinding. It is evident from the test results that the ore is granular and the grain structure is in the order of all minus 100 mesh particles.

It would appear that a grind of 80% passing 100 microns, more or less, as attained in the second grinding test would be suitable for feed to a flotation process.

Assuming that this grind would be suitable for concentration processes and that the ore would be a blend of the two types, 5000 tons per day would require a fully autogenous wet grinding mill of 26' x 10' drawing 2200 KW. This mill would be a single stage grinding plant and would have an availability of just over 90% when grinding minus 8 inch ore to 80% minus 100 microns. The liner consumption is expected to be less than 0.15 lbs per ton including scrap loss.

Recently Palabora Mining Co. in South Africa put in fully autogenous mills to grind a copper ore from primary crusher discharge size to a finished size suitable to feed a flotation concentration process. The Grum ore appears to have somewhat similar favorable grinding characteristics compared to the South African ore.

If this type of grinding appears to offer promise when compared to conventional grinding, I would recommend that a sample should be sent to a commercial laboratory such as O.R.F. or LAKEFIELD where a suitable autogenous mill is available to carry out confirmatory tests. The sample should be a minimum of 30 tons and should be blended to represent expected amounts of Samples 1 and 2 in the probable feed to a commercial plant. Such a grinding test could be tied in with flotation and thus supply complete data for plant design.

AEROFALL MILLS LIMITED
for
NORANDA MINES, LTD.

TEST DATA
Test No. 2

7714

Ore Type: Sample 1, Run "B"

Size or Mesh	Feed	Mill Charge	Vert. Class +28 mesh	Vert. Class -28 mesh		Cyclone	Filter	Total
% Weight	-	-	(1.75)	44.14		53.51	1.75	100.00
1¼inch	—	—						
1	7.45	6.74						
3/4	23.14	35.10						
½	27.06	21.17						
3/8	7.65	8.64	—					
¼	10.20	9.34	6.26					
+4 mesh	1.47	2.67	1.69					
6	1.77	3.25	2.61					
8	0.73	2.49	4.30					
10	3.22	1.72	6.13					
14	1.70	1.15	5.08					
20	1.55	1.29	11.08					
28	1.42	1.03	22.16	—				—
35	0.96	0.37	19.18	trace				trace
48	0.83	1.34	17.48	0.08		—	—	0.04
65	2.34	0.88	1.17	6.49		0.08	0.09	2.95
100	1.25	1.17	0.78	10.11		0.56	—	4.82
150	1.45	0.74	0.52	22.84		2.00	0.09	11.29
200	1.05	0.52	0.39	22.35		6.64	0.09	13.55
270	1.20	0.18	—	21.86		8.80	0.09	14.49
325	0.44	0.10	0.52	5.26		8.56	—	6.93
-325 mesh	3.12	0.11	0.65	11.01		73.36	99.64	45.93
Total	100.00	100.00	100.00	100.00		100.00	100.00	100.00

( ) Circulating Load

Ore Charge, lb. 58.59
, cu. ft. 0.350
, lb./cu. ft. 167.40

Total Charge, lb. 98.59
, cu. ft. 0.437
, lb./cu. ft. 225.61

Output, lb./hr. 39.32
Net kw. hr./ton* 5.40
d80 Feed 21900 microns
d80 Products 100 microns
Wi 5.79
*Estimated Mill Watts = 106.17

AEROFALL MILLS LIMITED

TEST DATA for Noranda Mines Ltd. 7714

Test No. 1

Ore Type: Sample No. 4, Run "A"

Size or Mesh	Feed	Mill Charge	Per. Dis. & Vert. - Class +8 mesh	- 8 mesh		Cyclone	Filter	Total
% Weight	-	-	(65.97)	46.98		51.40	1.62	100.00
1½ inch	-	-						
1	7.45	4.84						
3/4	23.14	31.88						
½	27.06	21.49	—					
3/8	7.65	9.02	4.95					
¼	10.20	10.51	26.04					
+4 mesh	1.47	3.84	27.21					
6	1.77	3.69	21.22					
8	0.73	2.60	14.26	—				—
10	3.22	2.40	6.11	4.74				2.23
14	1.70	1.53	0.07	5.46				2.57
20	1.55	1.50	—	4.50				2.11
28	1.42	1.13	-	2.41				1.13
35	0.96	0.56	-	0.88		—		0.42
48	0.82	1.30	-	3.13		0.09		1.52
65	2.34	0.88	0.07	4.18		0.09		2.01
100	1.25	1.15	—	12.77		0.60	0.11	6.31
150	1.45	0.73	—	16.95		1.96	—	8.97
200	1.05	0.49	—	21.37		6.46	0.11	13.33
270	1.20	0.20	—	10.52		9.05	—	9.60
325	0.44	0.12	—	5.46		9.22	0.23	7.31
-325 mesh	3.12	0.14	0.07	7.63		72.59	99.55	42.49
Total	100.00	100.00	100.00	100.00		100.00	100.00	100.00

( ) Circulating Load

Ore Charge, lb. 49.41
, cu. ft. 0.3241
, lb./cu. ft. 153.92

Total Charge, lb. 89.41
, cu. ft. 0.4221
, lb./cu. ft. 212.38

Output, lb./hr. 43.85
Net kw. hr./ton* 4.56
d80 Feed 21900 microns
d80 Products 137 microns
Wi 5.80
*Estimated Mill Watts = 99.94

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TEST DATA

Test No. Morenci, Ampex II :

Size or Mesh	Feed	Mill Charge	Vert. Cone +8 mesh	Vert. Cone -28 mesh		Cyclone	Filter	Total
% Weight	-	-	(6.54)	46.38		47.60	6.02	100.00
1¼ inch								
1	16.19	6.22						
3/4	25.94	24.81						
½	13.75	16.29						
3/8	5.76	9.08						
¼	9.98	6.95	0.93					
+4 mesh	4.91	12.67	1.94					
6	4.10	9.80	3.20					
8	4.01	5.37	4.72					
10	2.73	2.80	3.60					
14	1.21	1.62	8.43					
20	2.16	1.62	12.73					
28	1.45	1.15	25.30					
35	0.64	0.34	24.37	0.97				0.45
48	1.42	0.88	9.36	10.15		0.18	Tr	4.80
65	0.95	0.14	0.08	33.20		0.61	0.1	15.68
100	1.16	0.10	-	21.58		2.54	Tr	11.22
150	0.76	Tr	-	13.02		5.25	0.1	10.87
200	0.69	0.03	-	8.12		10.60	0.1	8.83
270	0.50	Tr	0.01	4.71		9.81	0.1	6.86
325	0.33	0.03	0.08	0.73		8.93	0.1	4.59
-325 mesh	1.36	-	0.20	2.52		62.08	99.5	36.70
Total								

( ) Circulating Load

Ore Charge, lb. 41.415
, cu. ft. 0.340
, lb./cu. ft. 121.81

Total Charge, lb. 81.415
, cu. ft. 0.422
, lb./cu. ft. 192.93

Output, lb./hr. 25.85
Net kw. hr./ton* 7.02
d_{80} Feed 26000 microns
d_{80} Products 210 microns
Wi 11.20

*Estimated Mill Watts = 90.79

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John Carrington

KILBORN

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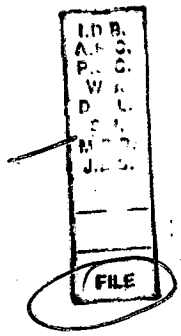
November 11, 1977



Noranda Mines Limited
P.O. Box 45
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Toronto, Ontario
M5L 1B6

Attention: Mr. R.L. Coleman

Dear Dick:

I have been out to Aerofall Mills Ltd. three times recently to observe their dry grinding tests on your two Grum samples, as requested. As a result of these visits and talks with Bob Turner, Bob Heath and Alan Clarke, I would make the following comments.

1. This test at Aerofall in their 18" x 10" dry grinder mill is essentially a "Work Index" type of test. Your ore is crushed then screened through a 1¼" x 1¼" screen. The mill is charged with 40 pounds of 2½ rationed ball load. The ore is fed in continuously and a constant load volume maintained. Part of the load consists of the bigger pieces of your ore, which round up somewhat like pebbles. As the mill is run dry in closed circuit with an 8 mesh Sweco screen, two air cyclones and a final dust filter, it is easy to shut the mill down and check the load. The operation of the test equipment was excellent and they produce a final grind with known proven input. Thus a "Work Index" can be calculated and the power to grind to a given mesh is known. The mill is lined with the Aerofall steel deflector plates and has heavy impact bars on the shell. The mill is run at 83% of critical speed with the result that the balls and bigger pebbles are well "keyed" to the shell.

2. The first sample was the softer one and contained much fine grained pyrite. The ore was relatively soft but was quite competent and formed good looking pebbles. During the final sample period the mill feed rate was 39.3 lbs per hour and power was 5.4 KWH/ton giving Wi of 5.8 while grinding to 8% passing 100 microns.

3. The second sample was harder and did not contain as much pyrite. This ore was also competent but ground at a lower rate.

4. Both the Aerofall staff and Kilborn staff feel that this ore could be ground autogenously but we would both wish to have a test in a 5½ ft. or 6 ft. mill to determine the proper amount of power to put into the first of two stages of grinding or if the entire grind can be considered in one stage. It would seem that the total power requirements might be 11-13 KWH/ton. This can sometimes be accomplished in a single stage "Run of Mine" mill. Only a pilot run can establish this. Also the metallurgy of the ore may dictate that we should attempt to use a two stage grinding circuit.

SUMMARY TABLE OF TESTS

Mesh	Products	
	#1	#2
+35		0.45
+48	.004	4.8
+65	2.95	15.68
+100	4.82	11.22
+150	11.29	10.87
+200	13.55	8.83
+270	14.49	6.86
+325	6.93	4.59
-325	45.93	36.70
	100.00	100.00
Ore lb. per cu. ft.	167.40	121.81
Output lb/hr	39.3	25.8
Net KWH/ton *	5.40	7.02
d 80 Feed	21,900	25,000
d 80 Product	100	210
Wi	5.8	11.2
Operating KWH/ton	5.8	7.6

* This is net power and 8% should be added to this to allow for power drive losses etc. This figure is shown above under operating KWH/ton.

Yours sincerely

B. S. Crocker/mw

B.S. Crocker, P. Eng.
Consultant

BSC/jt
Encl.