October 12, 1921

REPORT
of the
ORE DRESSING AND METALLURGICAL LABORATORIES.
Test No.149

Two shipments of asbestos rock were received at the Ore Dressing and Metallurgical Laboratories, from the Asbestos Mines Ltd., East Broughton, Quebec. The rock was from the Boston Mine, was received crushed to about three inch size, the product of their secondary crushers, and represented the feed to the Jumbo and Cyclone crushers or fiberizers.

The rock from the Boston mine is of the "Slip Fibre" type, representative of the East Broughton deposits, which contain no crude but is a straight milling rock. In this respect it is dissimilar to the Thetford Mines, and Black Lake deposits. The rock is also much softer than that from the other districts.

The first shipment of three tons was received on March 30, 1921, and the second shipment of ten tons on May 16, 1921.

In the company's milling operations, the Jumbo and Cyclone crushers or fiberizers are used to separate the fibre from the rock. These machines, while being good fiberizers, are costly to operate, as to power consumed and repairs required. Moreover, the action is so violent that the fibre is more or less broken up, resulting in an excessive amount of fines. The object of the experimental work was to determine what results could be obtained from the Hardinge mill in comparison with the Jumbo and Cyclone crushers or fiberizers, as to amount and grade of fibre

149

produced, and also as to power consumption and repairs. As no data was available or could be secured as to the efficiency of the crushers and fiberizers in use, the only course to pursue was to perform the tests and leave the operators to draw their own conclusions and comparisons of results.

The first shipment of three tons was used up in making adjustments to the Hardinge mill, to suit the crushing of this type of rock. Tests were run using pebbles and balls as the grinding or breaking media, increasing the speed of the mill, increasing the inclination of the mill, and the removal of the fibre from the mill, on being freed from the rock, by suction.

In the crushing of asbestos rock, the main point to consider is the separation of the fibre from the rock to obtain the maximum amount of long fibre, The objective is, therefore, to crush or break the rock in such a manner so as to remove the fibre without grinding, and with as little damage to it as possible, and to remove it as soon as it is free, so that it will not be damaged by further crushing or breaking action. Up to the present, on account of its universal use as a grinding mill, it was considered that the Hardinge mill would not be adaptible to this class of work, in fact it was claimed that asbestos rock, due to its nature, would grind quite freely for a time and then would pack on the lining until crushing action would cease almost entirely. Our tests on this first shipment proved this not to be the case. By elevating the feed end of the mill to obtain quick discharge; by using large balls to obtain coarse grinding; by increasing the speed of the mill to obtain a breaking and not a grinding action; and by connecting the discharge end of the mill with a suction to remove the fibre as it was freed, favourable results could be obtained. It was also determined that the rate of feed to the 4'-6" x 13" mill should be around three tons per hour.

Having obtained this data, a new fibre collector was built, with connections to the discharge end of the mill and to a shaking screen, and also to an exhauster which exhausted into

another collector and to the air. With this arrangement there was practically no loss of fibre. The ball mill was adjusted to what had been proven the most desirable setting from the runs on the first shipment. It was also decided not to feed three inch material to the mill, but to crush the rock in a jaw crusher and rolls to one inch size before feeding to the ball mill, as this was the practice that was contemplated in the revised lay out of the Boston mill. By crushing to one inch size before feeding to the ball mill a large percentage of the fibre would be freed, and removed by suction.

Run No. 1

Nine tons of the rock from shipment #2 were weighed, crushed in a jaw crusher to 1½", and reduced to 1" in rolls. This operation gave the following:

Product	Weight lbs.	Percent of Heads
- 1"	17874.5	99.30
Dust loss	125.5	0.70
Total	18000.0	100.00

Run No. 2

The rock reduced to 1" was sampled by an automatic Vezin sampler, the main flow passing over a shaking screen, fitted with a blank screen for the first half and with a 1/16" slot screen for the second half at the discharge end. Two suction pipes into a main header to the collector were placed over the screen for the removal of the fibre. An exhauster was placed between the first collector and discharged into a second collector from which a second exhauster discharged into the air. Any fibre not collected in the first collector was deposited in the second one. With this arrangement there was practically no loss of fibre. This operation gave the following:

Product	Weight lbs.	Percent of Heads	Test
+1/16"	12,150.0	68.24	
-1/16"	3,312.0	18.60	
Fibre, 1st Collector	2,070.0	11.65	0 - 0.5 - 4.7 -10.8 (Large percent rock)
Fibre, 2nd Collector	21.0	0.12	
Dust Loss	123.5	0.69	
Sample	194.0		
Feed	17,874.5	99.30	

Run No. 3 - First Ball Mill Run

The +1/16" material from Run No. 2 was sampled by an automatic Vezin sampler and fed to a Hardinge mill at the rate of 2.75 tons per hour. The 4'-6" x 13" mill was run at 36 r.p.m. and carried a load of 2900 pounds of 4" steel balls. The feed end of the mill was raised three inches from the horizontal. The discharge end was fitted with a suction pipe to the first collector, with a T pipe close to the discharge, permitting of the regular discharge and also of the fibre being sucked over into the collectors. This first ball mill run gave the following:

Product	Weight lbs.	Percent of Heads
Fibre, 1st Coll.	6163	35.04
Dust, 2nd Coll.	113	0.64
Rock, discharged	5540	31.49
Rock, in mill	188	1.07
Sample	146	
Feed	12150	68.24

Run No. 4 - Second Ball Mill Run:

The rock discharged from the first run of the ball mill was sampled by an automatic Vezin sampler and fed back to the mill, which contained some rock from the preceding operation. The mill was run under the same conditions. After the completion of the run the mill was dumped. This operation gave the following:

Product	Weight lbs.	Percent of Heads
Fibre, 1st Coll.	1377.0	8.04
Dust, 2nd Coll.	38.5	0.22
Tailing, discharged	3476.0	20.30
Tailing, from mill	553.0	3.23
Dust Loss	131.0	0.77
Sample	137.5	
Feed	5713.0	32.56

Run No. 5 - Fibre from First Ball Mill Run

After sampling the fibre from Run No. 3, or the first ball mill run, it was run over the shaking screen to remove the rock and dust. This gave the following products:

Product	Weight lbs.	Percent of Heads	Test
Fibre, 1st Coll.	940	5.41	0-0 - 3.2 - 12.8
Dust, 2nd Coll.	14	0.08	(Fairly clean)
+1/16" rock	2678	15.40	
-1/16"	2360	13.57	
Dust Loss	101	0.58	
Sample	70		
Feed	6163	35.04	

The +1/16" rock contained considerable unfiberized material and should have been returned to the circuit.

The -1/16" material contains some fibre that would produce a marketable grade as shown in a following table, under Run No. 12.

Runs Nos. 6, 7, & 8 - Fibre From Second Ball Mill Run.

The fibre from Run No. 4, or the 2nd. ball mill run, was used in these three runs, an attempt being made to remove the rock and bring the fibre up to a suitable grade. In run No. 6, the fibre from Run No. 4 was run over the shaking screen, using a 12 x 12 mesh screen, and with the suction at the end of the screen near the discharge, so as to allow the fines to screen out from the fibre before it was sucked up into the collectors. In Run No. 7, the fibre from Run No. 6 was rerun, and in Run No. 8 the fibre from Run No. 7 was rerun. The second collector was not cleaned out until the finish of Run No. 8. The following are the products obtained:

Product	Weight lbs.	Percent of Heads	Test
Fibre, 1st Coll.	180.0	1.05	0 - 0 - 2.8 - 13.2
Dust, 2nd. Coll.	100.0	0.58	
+12, Run 6	443.5	2.60	
+12, Run 7	25.0	0.15	
+12, Run 8	29.0	0.17	
-12, Run 6	230.0	1.35	
-12, Run 7	109.0	0.64	
-12, Run 8	194.0	1.14	
Dust Loss	61.5	0.36	
Feed	1372.0	8.04	

The +12 product from Run No. 8 contained considerable unfiberized material. A test was made on this product, the results of which is shown in the table of fibre recovered following..

Run No. 9 - on Fibre from Initial Crushing in Jaw Crusher and Rolls to One Inch.

The fibre from Run No. 2 was run over the shaking screen fitted with a 12 x 12 mesh screen, as in Run No. 8. The object of this run was to improve the grade. The following products were made:

Product	Weight lbs.	Percent of Heads	Test
Fibre, 1st Coll.	900	5.09	0 - 0.5 - 4.5 - 11.0
Dust, 2nd Coll.	5	.03	(fairly clean)
+12	376	2.12	
-12	746	4.22	
Dust Loss	34	0.19	
Feed	2061	11.65	0 - 0.5 - 4.7 - 10.8 (large percent rock)

Run No. 10 - on -1/16" Material From Initial Crushing

The -1/16" material from Run No. 2 was rerun over the shaking screen fitted with a 12 x 12 mesh screen to recover any fibre which passed through this screen. This run would not have been necessary if the square mesh screen had been used instead of the 1/16" slotted screen. The results were as follows:

Product	Weight lbs.	Percent of Heads	Test
Fibre, 1st Coll.	204	1.15	0 - 0 - 1.9 - 14.1
Dust, 2nd Coll.	2	.02	(clean)
+12	1098	6.17	
-12	1957	10.98	
Dust Loss	49	.28	
Feed	3312	18.60	

Run No. 11 - Rerun of fibre from 1st. Ball Mill Run

The fibre from Run No. 5 was rerun over the shaking screen to remove any further rock and dust from it. The 12x12 mesh screen was used. The products from this run were as follow:

Product	Weight lbs.	Percent of Heads	Test
Fibre, 1st Coll.	475	2.75	0 - 0 - 4.1 - 11.9 (clean)
Dust, 2nd Coll.	6	.03	
+12	21	.12	
-12	417	2.41	
Dust Loss	17	.10	
Feed	936	5.41	0 - 0 - 3.2 - 12.8 (fairly clean)

Run No. 12 - on -1/16" material from 1st. Ball Mill Run:

The - 1/16" material from Run No. 5, was run over the shaking screen fitted with a 12 x 12 mesh screen to recover any coarse fibre which passed through the -1/16" slotted screen. Had the square mesh screen been used in Run No. 5, this run would not have been necessary. The following products were obtained:

Product	Weight lbs.	Percent of Heads	Test
Fibre, 1st Coll.	134	0.77	0.-0 - 1.5 - 14.5 (Clean)
Dust, 2nd Coll.	4	0.02	
+12	492	2.81	
-12	1737	9.96	
Dust Loss	1	0.01	
Feed	2368	13.57	

Runs Nos. 13 & 14 : Rerun of Fibre from Initial Crushing:

These two runs were made on the fibre from Run No. 9, to remove any dust and rock remaining in it. Both runs were made over the shaking screen using a 12 x 12 mesh screen, Run No. 13, did not remove sufficient of the rock, so the fibre was rerun over the screen a second time. The products were as follows:

Product	Weight lbs.	Percent of Heads	Test
Fibre, 1st Coll. Run #14	366	2.07	0 - 1.8 - 5.6 - 8.6 (clean)
Dust, 2nd Coll. Runs #13 & 14	11	0.06	
+12, Run #13	114	0.64	
+12, Run #14	21	0.12	
-12, Run #13	257	1.45	
-12, Run #14	114	0.65	
Dust Loss, Runs #13 & 14	17	0.10	
Feed	900	5.09	0 - 0.5 - 4.5 - 11.0 (fairly clean)
Fibre, 1st Coll. Run #13	509		0 - 0.9 - 4.9 - 10.2 (fairly clean)

The +12 material from Runs Nos. 13 & 14 contained a

considerable amount of unfiberised material. These products should have been returned to milling operations. Test runs were made on these, the results of which are given in the table of fibre recovered.

Runs Nos. 15 & 16 : on Fibre from Run No. 14:

These two short runs were made on a portion of the fibre from Run No. 14, to determine if it would be possible to bring some of the fibre up to a high grade, and also to determine if it was possible to figure out fairly accurately what grades of fibre could be produced from a given lot of fibre

The two runs were made by passing the fibre over a ½" shaking screen, the screen being used as a grader. Run No. 16, is on the +½" fibre from Run No. 15.

Products Run #15	Weight lbs.	Percent Heads	Test
+½" Fibre	6.00	0.36	0.5+5.0+5.2+5.3 (clean)
-½" Fibre, 2nd Hopper	13.25	0.79	0.0+1.0+7.1+7.9 (clean)
-½" Fibre, 1st Hopper	15.50	0.92	0.0+0.3+6.9+9.7 (clean)
Feed, Run #15	34.75	2.07	0.0+1.8+5.6+8.6 (clean)

Products Run #16	Weight lbs.	Percent Heads	Test
+½" Fibre	1.60	0.10	2.2+7.6+8.8+3.4 (clean)
-½" Fibre	4.40	0.26	0.0+3.8+5.6+6.6 (clean)
Feed, Run #16	6.00	0.36	0.5+5.0+5.2+5.3 (clean)

It is here demonstrated that it is possible to produce a high grade fibre by grading. If in each of these runs the figures given in the fibre test on the products are multiplied by the weight of the product, and corresponding terms added, and the sum divided by the weight of the feed, it will be found to give very nearly the fibre test of the feed. Hence, we may conclude that it is possible to figure fairly accurately what grades can be produced from a certain fibre, and also that it is correct in

figuring recovery, to sum up from the different fibre products the percentage of heads on the same testing screen.

The following table shows the different fibres recovered from all the different runs, etc., In the list will be noticed some +12 products. These are really middlings which would be returned to the circuit in regular mill work. Small tests have been conducted on these products, and whatever fibre was found possible to recover from them, has been tabulated

Product	% of Heads	% Fibre	% Recovd.	Testing +2	+4	+10	-10	% Heads Recovered +2	+4	+10	-10	
Fibre Run 8			1.05			2.8	13.2			.184	.866	x
" " 10			1.15			1.9	14.1			.137	1.013	
" " 11			2.75			4.1	11.9			.705	2.045	x
" " 12			.77			1.5	14.5			.072	.698	x
" " 14			2.07		1.8	5.6	8.6		.253	.725	1.112	
+12 Run 8	.17	17.5	.03		.1	2.2	13.7			.004	.026	x
" " 9	2.12	12.9	.27		.3	3.6	12.1		.005	.061	.204	
" " 11	.12	37.9	.05		.2	5.8	10.0		.001	.018	.031	x
" " 13	.64	60.0	.38		.2	5.8	10.0		.005	.138	.237	
" " 14	112	80.0	.10		.2	5.8	10.0		.001	.036	.063	
Total Fibre			8.62		.5	3.8	11.7		.245	2.080	6.295	

Note: Products marked "x" are from ball milling.

A small sample of the feed to the first ball mill run, Run No. 3, was separated by screening into a number of different sizes. As much fibre as possible was picked out of the larger sizes, and sucked out of the smaller ones. The sizes were all mixed and ground in a small ball mill, and the product screened, picked, and sucked, as before. This milling, screening, picking, and sucking was continued until the rock was clean of fibre. The fibre obtained was tested in the usual manner, and the following table shows the results of this small test compared with what was obtained from the large runs:

Product	% of Heads	% Fibre	% Recovd	Testing +2	+4	+10	-10	% Heads Recovered. +2	+4	+10	-10
Feed Run 3	68.24	12.87	8.78		.1	.9	15.0		.055	.494	8.231
Fibre from Mill (Large run)			4.65			3.4	12.6		.001	.983	3.666

In this table of comparison, it is noticed that the small test recivered much more +4 than the large runs. This was to be expected, as in hand picking in the small test, a knife was used to cut off the fibre from the rock, and much unfiberized asbestos was put with the picked material.

It will also be noticed that the large runs give the largest amount of total fibre, +10. This would indicate that the Hardinge ball mill, with suction, is a very effective machine for the work upon which it was employed in the larger runs.

We are unable to make a comparison of the efficiency of the Hardinge ball mill with the Cyclone or Jumbo fiberizers, as no data is available on the work of the latter machines.

From the results given above, however, the mill operator may be able to draw some conclusions on the relative efficiency of the two types of mills.

.....
Chief, Division of Ore Dressing
and Metallurgy.

WBS/FH.