DEPARTMENT OF MINES
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RADIUM HILL PROJECT

RADIUM HILL MINE.

HYDRAULIC FILLING - PRELIMINARY INVESTIGATIONS

This report summarizes preliminary work done to date concerning availability and suitability of material for the hydraulic filling of stopes at Radium Hill.

Available Material

No appreciable quantities of suitable material will be available from milling or other operations at Radium Hill.

Two classes of material have been considered:

(1) Olary Creek sand.

(2) Alluvial material in creek flats near the mine.

(1) Olary Creek Sand

Large quantities of sand exist in the creek bed but availability is limited by distance from the mine and the presence of trees in the bed. The area considered is shown on a sketch plan accompanying this report. This is almost free of trees, is fairly wide, and the banks are not steep. The distance from the new main shaft varies approximately from 6,000 feet to 10,000 feet. Downstream the bed becomes narrower. Trees are more frequent and the banks steep. Upstream, waterholes and gravel appear and the creek swings away sharply.

The quantity of sand has been estimated roughly, the area being determined by plane-table survey and the depth by driving probes to bedrock. At the eastern end, auger-holes were bored to determine depth and obtain samples. However, this method proved very slow and in some places impossible, owing to caving of sand or obstruction by gravel layers, and was abandoned.

The fill depth was not reached in some cases owing to the difficulty of driving long probes through gravel layers so that the estimated area is somewhat conservative.

Using these figures the quantity has been estimated at 320,000 cubic yards. Perhaps 40 per cent of this would have to be rejected as oversize, leaving approximately 190,000 cubic yards, or four years' supply assuming that fill is required at 45 per cent of ore mined at the rate of 450 tons per day.

(2) Alluvium

Ample quantities are available fairly close to the shaft. An area 400 x 600 yards was marked out in the creek flats north of the new main shaft. The area was chosen as being close to the shaft, free of scrub and clear of any likely buildings, drills, etc. It is bounded by the N - S baseline and the 1,800 E, 8,000N, and 9,200 N grid lines. Auger holes were drilled to bedrock on a grid pattern at intervals of 300 feet N - S and 600 feet E - W, using a six inch auger. Cores from each hole were sampled and sized. The rejects were then combined for desliming and percolation tests.

Sizings are shown in table 1 attached.

The depths of the alluvium varied from one foot four inches to ten feet with an average of 6.7 feet. The volume of material in place is therefore 570,000 cubic yards. As discussed later, about 40 per cent by weight of this material would be recovered as usable sand. This area would therefore yield approximately 200,000 cubic yards or 4½ years' supply at the maximum filling rate. The area could be extended considerably grid east or west.

Suitability

(1) Creek Sand.

This material would be difficult to sample properly. The top layer is dry and caves rapidly, while the bottom layer is saturated with water and washes in. Layers of gravel make augering very difficult. Some Auger samples were taken at the southern end where there is little gravel, and another from the top two feet of a gravelly section at the northern end. Sizings have not been done on these samples, but from inspection it appears that there are insufficient extreme fines to give trouble with drainage. The main question would be the amount of plus ten mesh gravel that would have to be discarded.

(2) <u>Alluvium</u>

This must be deslimed before use. The material is generally very clayey and tough. Oversize om $\frac{1}{4}$" is mainly nodular limestone from the subsurface layer, while the $\frac{1}{4}$" to 44 mesh fraction is mainly quartz sand.

Desliming tests were done in a 3" cyclone, the material being first thoroughly puddled then screened wet at 10 mesh, with a rejection of 15 per cent of the material is oversize. The pulp was then pumped through the cyclone, the products being recirculated. Timed samples for tonnage and sizing determinations were taken simultaneously. Four tests were done and details given below. The included angle of the cyclone was 22$\frac{1}{2}$ degrees, and apex and overflow diameter 7/16" and $\frac{5}{8}$" respectively in all tests.

Test (1)

Feed 30 per cent solids. 36 lbs. per square inch pressure

	Feed	Underflow	Overflow
Throughput lbs. per second (dry)	1.445	0.823	0.622
Per cent weight	100	57.0	43.0
Per cent solids	30.9	79.2	17.1
Sizings B.S.S. + 10	trace	trace	-
18	10.9	19.2	-
30	9.0	15.8	-
52	11.6	20.2	-
100	13.1	22.3	0.6
150	4.5	6.9	1.5
200	2.4	3.2	1.3
270	5.5	4.2	7.2
-270	43.1	8.1	89.4

In this test the sand appeared quite suitable. There was little loss of material coarser than 200 mesh in the overflow. The sand comprises 57.0 per cent of the cyclone feed or 48.5 per cent of the original material.

Test (2)

Feed 30 per solids. 25 lbs. per square inch pressure.

	Feed	Underflow	Overflow
Throughput lbs. per second (dry)	1.11	0.74	0.44
Per cent weight	100	60.1	39.9
Per cent solids	28.2	79.0	14.3
Sizing B.S.S. + 10		Trace	
18		15.5	
30		16.1	
52		21.4	
100		24.9	
150		7.2	
200		3.3	
270		4.4	
-270		7.2	

Sizings of feed and overflow are not available at the time of writing.

Compared with Test 1, a somewhat higher yield of underflow was produced with a similar sizings, but capacity was lower at the reduced pressure.

Test 3

25 per cent solids. 35 lbs per square inch pressure.

		Feed	Underflow	Overflow
Throughout lbs. per second		0.90	0.62	0.28
Per cent weight		100	69.2	30.8
Per cent solids		26.3	68.3	11.0
Sizing B.S.S. +	18	9.5	13.6	-
	30	10.2	14.8	-
	52	12.3	17.8	-
	100	14.2	20.6	-
	150	4.4	6.4	-
	200	2.4	3.6	-
	270	5.0	7.2	trace
	-270	41.9	16.0	100.0

The lower feed density resulted in a marked deterioration in quality of sand, owing to an increase in the proportion of material underflowed.

Test 4

25 per cent solids. 25 lbs. per square inch pressure

Throughput lbs. per second (dry)		0.61	0.41	0.20
Per cent weight		100.0	66.4	33.6
Per cent solids		23.3	56.1	10.8
Sizing B.S.S. +	18	4.1	6.1	-
	30	7.2	10.9	-
	52	11.7	17.5	-
	100	15.7	23.7	-
	150	4.9	7.4	-
	200	2.6	3.9	-
	270	6.4	9.7	trace
	-270	47.4	20.8	100.0

In this test the feed sizing was apparently finer than in Test (3), and despite the smaller portion underflowing, the sand sizing was also finer; this was probably due to unstable conditions as the pressure was fluctuating during the test.

Drainage Tests

A short run was made, attempting to hold the conditions of Test (1). However, after filling a portion of the drainage box it was obvious that the sand was unsatisfactory and the test was abandoned. The reasons for the failure of the test are believed to be:

(1) In the first two or three batches, a feed pressure higher than 25 lbs. per square inch could not be obtained, for some unknown reason.

(2) A suitable large agitator not being available, the material was fed in batches of approximately 100 lbs. At the beginning and end of each run (i.e.

when the control valve was being opened or closed) the pressure varied from zero to operating pressure and during these periods the sand was dilute and slimy.

It is considered that suitable sand can be produced in the cyclone, by using a slightly smaller apex nozzle. This would make a separation at a coarser sizing, but as the percentages of material between 100 and 270 mesh are small, this would not cause a serious loss in weight of sand. On the basis of Test (1[illegible] it could be assumed that the sand recovery would be approximately 40 per cent of the original material, given complete disintegration of the clay material.

<u>Feasibility of Materials</u>

A detailed discussion of ways and means is notwarranted at this stage; however, it may be mentioned that the clay is extremely difficult to wet and break up. In the test work it was found desirable to soak the material for several hours, followed by vigorous agitation.

The scheme envisaged at present for large scale work consists of excavating and transporting to field plant, as by tractor-drawn scraper; ground storage; feeding to small hopper by scraper hoist; flushing to washing trommel with ½" openings; pumping to desliming in cyclone; underflow to shaft.

It is doubtful whether the clay could be disintegrated on a trommel unless preliminary wetting and agitation is resorted to. Addition of an agitator for this purpose would add greatly to the cost of plant and treatment. If the clay is not broken up, large losses of sand will result as the two are intimately mixed.

With regard to the creek sand, excavation would be easier and preparation limited to screening. Transport would be more expensive than for alluvium because of the greater distance and necessity of using trucks.

18/1/54 <u>METALLURGICAL ENGINEER R/H/P</u>

TABLE 1.

Hole No.	Mesh B.S.S.							Depth ft.
	$+\frac{1}{4}$"	12	22	44	100	200	-200	
77/12	1.3	9.1	10.3	12.8	14.8	8.3	43.5	10.0
77/18	1.1	2.0	3.1	5.6	9.6	7.6	71.0	5.5
80/0	5.6	3.5	5.6	8.2	14.4	10.0	52.7	5.5
80/6	12.7	5.1	4.8	7.3	12.7	10.8	46.6	2.0
80/12	31.5	7.5	6.9	7.3	9.7	6.7	30.4	2.0
80/18	1.7	3.9	5.0	9.3	16.5	8.6	55.0	8.0
83/0	21.7	11.5	6.4	6.9	10.1	8.6	34.8	4.0
83/6	14.2	10.4	6.5	7.8	11.1	8.6	41.4	2.5
83/12	17.0	15.4	7.0	8.0	10.9	7.9	33.8	4.0
83/18	1.8	5.7	7.1	11.8	17.5	10.1	45.9	9.5
86/0	1.7	9.4	7.0	9.3	14.5	8.4	49.7	8.0
86/6	4.7	5.9	7.3	12.1	22.9	13.3	33.8	8.0
86/12	-	3.6	5.9	13.1	23.4	12.6	41.4	9.0
86/18	5.9	13.3	8.3	10.6	14.6	6.5	40.8	8.0
89/0	1.7	10.1	10.3	15.1	17.0	6.5	39.3	8.0
89/6	0.6	4.5	7.5	15.4	21.5	8.7	41.8	7.0
89/12	1.1	3.3	6.0	12.0	19.8	10.0	47.8	6.0
89/18	trace	4.8	7.3	12.5	15.6	7.5	52.3	7.5
92/0	2.3	9.7	8.7	11.6	13.4	7.3	47.0	10.0
92/6	0.5	9.1	7.0	10.3	14.2	8.6	50.3	10.0
92/12	1.7	11.0	8.3	10.0	13.3	7.4	48.3	7.5
92/18	7.1	8.9	7.1	9.1	12.6	8.0	47.2	1.3
Average	3.7	7.6	7.3	11.0	15.9	8.8	45.9	6.5