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THE EVALUATION OF EVAN'S QUARRY FREESTONE AS A SOURCE OF BUILDING SANDS.

by

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THE EVALUATION OF EVAN'S QUARRY FREESTONE AS A SOURCE OF BUILDING SANDS.

-Abstract-

Three samples of waste freestone were evaluated as a source of building aggregate and fine clay. Washed sand produced from each sample appears unsuitable as building aggregate because of the high percentage of composite particles present. The fine clay present in the stone may be of use in the ceramic or brick making industries.

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1. SUMMARY.

Three samples of waste freestone were obtained from the management of Evan's Quarry, Loftia Park for testing. The samples were crushed and washed to produce a washed sand which represented approximately 75 percent of the feed and a fine clay portion.

The washed sand conforms or can be made to conform to most sizing specifications for building aggregate but contains a high percentage of composite particles which would probably make it unsuitable for most requirements.

The fine clay fractions represent approximately 15 percent of the feed and warrant further investigation as ceramic or brick making clays, if a suitable market can be found for the sand.

2. INTRODUCTION.

Three samples of freestone were obtained from the management of Evan's Quarry, Loftia Park for testing.

The samples were to be crushed and treated, to determine whether a sand capable of meeting building specifications could be produced from the stone. The fine clay which would have to be removed from the crushed rock to produce a clean sand, was to be examined to ascertain whether it had any commercial value.

There is a large area of land adjacent to the quarries suitable for the storage of waste material.

3. MATERIAL EXAMINED.

The samples represented reject stone from three quarries. This waste material which is approximately 60 percent of the present total production, consists mainly of broken pieces of freestone up to four inches in diameter. The main constituent of the freestone is fine quartz particles bonded together by a clay layer.

The samples were taken from the following localities.

Sample 1.

Dump material from sand sorting in Quarry.

Sample 2.

Waste material from stone dressing sheds.

Sample 3.

Dump material from hand sorting in northern Quarry.

4. EQUIPMENT USED.

Jaw crusher.

Rolls.

500 grams Laboratory flotation cell.

1 ml Glass cyclone.

5. EXPERIMENTAL PROCEDURE & RESULTS.

5.1 Sand Washing.

Each sample was crushed to 100 percent minus one inch in a jaw breaker. Slaking tests were carried out on a portion of each sample at this size with one pound of sodium silicate per ton of dry solids added as a dispersant. Practically all the particles of stone over ¼ inch in diameter remained at their original size, even after prolonged soaking and agitation.

One half of each sample was crushed to 100 percent minus 3/16 of an inch. This size was chosen because it is the maximum particle size allowed in sand for most building purposes.

A 500 gram charge from each sample was washed in a 500 gram laboratory flotation cell at approximately 20 percent solids, and violently agitated for 10 minutes to break down any soft particles present. The pulp was allowed to settle for half a minute and then syphoned off to a depth of five inches. This procedure was repeated, with an agitation period of one minute until the liquor being syphoned off was perfectly clear.

Because the larger particles of sand were obviously composities, a second series of tests was carried out on the three samples, with one pound of sodium silicate per ton added during the initial period of agitation. The addition of the dispersant was to aid in the disintergration of the composites.

The weight of slime liberated, and the number of washes needed during each series, are shown in Tables 1 and 2.

TABLE 1.

Washing Tests using Water Only.

Sample No.	Weight of sand %	Weight of Slime %	Number of Washes required.
1.	73.4	26.6	17
2.	75.2	24.8	15
3.	76.6	23.2	20.

TABLE 2.

Washing Tests Using Sodium Silicate as a Dispersant.

Sample No.	Weight of Sand %	Weight of Slime %.	Number of Washes Required.
1.	73.0	27.0	16
2.	75.4	24.6	14
3.	76.2	23.8	19

The sizing of the washed sand from each test is shown in Table 3.

TABLE 3.

Sizing of Washed Sand.

Screen Fraction.	Water Washed.			Water washed with sodium silicate.		
	Sample 1. % Wt.	Sample 2. % Wt.	Sample 3. % Wt.	Sample 1. % Wt.	Sample 2. % Wt.	Sample 3 % Wt.
+3/16	-	-	-	-	-	-
-3/16 + 7	-	0.2	0.1	0.3	0.3	0.1
- 7 + 14	0.1	0.7	1.1	0.8	1.4	1.4
-14 + 25	17.2	26.1	33.5	17.1	25.9	28.9
-25 + 52	39.4	38.7	36.8	39.7	38.6	37.8
-52 +100	30.8	23.9	19.1	29.5	24.1	22.4
-100	12.5	10.4	9.4	12.6	9.7	9.4
Total	100.0	100.0	100.0	100.0	100.0	100.0

A sample of each of the water washed sands was assayed for free silica. The results are shown in Table 4.

TABLE 4.

Analysis of Washed Sands.

Sample No.	True Silica %.
1.	96.9
2.	96.2
3.	96.3

5.2 Treatment of Clay Fraction.

The clay liberated from the water washed sands was treated at four percent solids in a one inch glass laboratory cyclone. The feed pressure was approximately nine pounds per square inch.

The results of the cyclone tests are shown in Table 5, where the cyclone fractions are expressed both as a percentage of the clay fraction and as a percentage of the original unwashed sand.

TABLE 5.

Cyclone Tests on Clay Fraction.

Sample No.	% Wt. of Clay Fraction.		% Wt. of Unwashed Sand.	
	Fine Fraction.	Coarse Fraction.	Fine Fraction.	Coarse Fraction.
1.	72.2	27.8	19.2	7.4
2.	69.4	30.6	17.2	7.6
3.	65.3	34.7	15.3	8.1

The main minerals present in the fine fractions were kaolin and illite in an approximate ratio of 1:1. There were minor amounts of quartz and feldspar present. A detailed report on the X-ray analysis is shown in Appendix 1.

Fusion tests were carried out on the fine portions at temperatures of 1000, 1100, 1200, 1250, and 1300 degrees centigrade. The clay from each sample fired hard with little or no surface cracking. The colour of the clay briquettes at each firing temperature is shown in Table 6.

TABLE 6.

Colour of Fired Clays.

Sample No.	Firing Temperature	Colour.
1.	Oven Dried.	Off White.
	1000	Fawn.
	1100.	Light-Fawn.
	1200.	Dark Grey.
	1250.	Grey.
	1300	Light-Grey.
2.	Oven Dried.	Off-White.
	1000.	Off-White.
	1100.	Off-White.
	1200.	Dark Grey.
	1250.	Grey.
	1300.	Light Grey.
3.	Oven Dried.	Light Brown.
	1000.	Pink.
	1100.	Pink.
	1200.	Red-Brown.
	1250.	Dark-Grey.
	1300.	Grey.

6. DISCUSSION.

A washed sand can be produced from each sample submitted to conform with the sizing specifications for most building aggregat The sand however, contains a high percentage of composites which cannot be eliminated except by finer crushing. This finer crushing would in turn make the sand unsuitable.

The high strength and purity demanded of building materials would disqualify the sand for most purposes although there may be instances where it could be used. Sized portions of the sand were submitted to the management of the quarry to enable them to test the reaction of the building trade to this material.

A fine clay product can be produced from the sand which because of its mineral composition and firing characteristics looks promising as a ceramic or brick making clay. The clay can be evaluated further when and if the washed sand is found to have a suitable application.

6.1 Possible Uses of Washed Sand.

The sizing of the washed sands meets the specification for the following building sands.

1. Fine Aggregates Class B.
2. Plastering Sand, Class B Undercoat.
3. Plastering Sand Class B Finishing.
4. Rendering Sand Class B.
5. Mortar Sand for Plain Brickwork.

The washed sands could probably be made to conform to the specifications for the following building sands by further crushing or more vigorous washing:-

1. Fine Aggregate Class A.
2. Plastering Sand Class A, Undercoat.
3. Plastering Sand Class A, Finishing.
4. Rendering Sand Class A.
5. Fine Aggregate for granolithic concrete.

A microscopic examination showed that the greater proportion of particles coarser than 100 mesh, are composites. This explains the relatively low true silica content of the sand.

APPENDIX 1.

MINERAL X-RAY REPORT.

Qualitative Analysis.

Diffractographs were taken using Fe K alpha radiation over the range $88^\circ - 3^\circ\ 2\theta$. From these charts all three samples were found to contain the following crystalline minerals:-

/Kaolin (fireclay) - large amounts.

Illite (includes sericite, hydro muscovite etc.) large amounts.

Quartz - small amount.

Felspar? - trace.

/ The presence of kaolin was confirmed by the X-ray pattern after treatment of 2 portions of each sample by the following.

(1) heating in air at 550°C the pattern due to this mineral disappeared.

(2) warming in approximately 15 percent HCl the pattern remained.

Quantitative Analysis.

Because of the nature and association of the minerals present an absolute quantitative determination of the various minerals present could not be made by internal standard technique.

An endeavour was made to find in the three samples the following variations: illite, kaolin and the ration $\frac{\text{kaolin}}{\text{illite}}$.

This was done by comparing the heights of the strong peaks of these two minerals, it being assumed that the samples are closely related, i.e. from the same locality, similarly treated etc.

Sample 1 is taken as a base in each case.

	Sample 1.	Sample 2.	Sample 3.
Kaolin	1.0	1.1	1.2
Illite.	1.0	0.85	1.4
$\frac{\text{Kaolin}}{\text{Illite.}}$	1.0	1.3	0.85

The percentage of quartz, and felspar, although undetermined, is small in each case.

From this table it is noted that illite and kaolin, the major crystalline minerals in each sample, have apparently both increased in percentage in Sample 3. Thus some amorphous material must be present in Sample 1, and absent in Sample 3 for this to be possible.