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MINES BRANCH INVESTIGATION REPORT IR 63-97

PRELIMINARY EVALUATION OF A CARBONATE ROCK FROM PRESTON, ONTARIO

by

F. E. HANES

MINERAL PROCESSING DIVISION

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SUMMARY OF RESULTS

Carbonate rock underlying sand and gravel deposits at the Preston Sand and Gravel Company's plant at Preston, Ontario was found to be amenable to quarrying for the production of crushed-stone products.

Physical acceptance test results indicate that the rock is acceptable for the production of highway aggregate, although it has a borderline Los Angeles abrasion value, according to an Ontario Highway Specification. However, the results are all well within allowable limits by ASTM Standards for the use of this material as a concrete aggregate.

The rock was identified as a dolostone.

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INTRODUCTION

Mr. T.J. McGovern, manager of the Preston Sand and Gravel Company Limited plant at Preston, Ontario, requested the assistance of the Mines Branch to assess the value of bedded carbonate rock underlying the sand and gravel deposits on the company's property for its suitability as a concrete, highway or other aggregate.

Approximately 200 lb of the rock were received during the early part of June, 1963. It consisted of broken fragments (4 to 6 in. in size) of a dense, massive, buff to buff-grey and mottled grey dolomitic limestone. The rock is of the Lockport formation of mid-Silurian age. Twenty-five acres of this property previously overlain by gravel deposits have been cleared and are available for immediate quarrying should tests indicate that the deposit is amenable to economic production.

SAMPLING AND PREPARATION

The rock, as submitted, was inspected megascopically for structural and textural features. A fragment which contained examples of both light and dark phases of the rock was selected for thin section preparation. A small representative fragment of the sample was finely ground to supply a sample for an X-ray analysis.

The remainder of the rock was passed through a jaw crusher with plates set at 2 in. Oversize from this first crushing was choke-fed through the same plate setting. The product from these crusher-runs was then passed through the same crushing machine with plates set at 1 1/2 in. Twenty-two lb of the -1 1/2 + 1 in. product were cut out to supply an appropriate amount in this size required for necessary acceptance tests. The remainder of the rock was reduced to a minus 3/4-in. size using the same jaw crusher.

The minus 4 mesh material was removed after each crushing operation and bulked in one lot to make up the fine material.

EXAMINATION AND TESTS

The following examination and tests were made on the rock and aggregate products:

1. Thin section petrographic study and X-ray diffraction analysis.
2. Grading analysis on the coarse and fine aggregate products.
3. Specific gravity and absorption.
4. Los Angeles abrasion.
5. Sulphate soundness.
6. Unit weight.

MINERALOGICAL EXAMINATION AND TEST RESULTS

1. Petrographic Description and X-Ray Analysis*

The rock is fine-grained, tan to medium-grey and fossiliferous. Larger (0.2-1.5mm) crystals have developed in the vicinity of fossil molds.

From the thin section (TS-83-63), both tan and grey phases of the rock consist predominantly (95+ per cent) of dolomite. The tan phase has an even, sacchoroidal texture with grain size ranging from 0.1 to 0.4mm, while the grey phase is composed of 50 per cent translucent fine-grains (<0.1mm) interspersed with coarser crystals ranging in size from 0.1 to 0.5mm.

The rock is a fossiliferous dolostone.

An X-ray diffractogram shows peaks characteristic of the material being tested. By comparing the peaks obtained during a test with standards obtained from tests made on known minerals, a determination of the mineral composition of crystalline materials is possible with high accuracy. The analysis of the specimen sample, representative of the Preston rock, showed it to be essentially dolomite.

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*J.A. Soles and R.S. Dean

2. Grading Analyses

The following grading of the coarse aggregate was obtained on all the products from the combined crushing operations as described under Sampling and Preparation. The results of the grading appear in Table 1.

TABLE 1

Grading (Coarse Aggregate)

Sieve Size	Weight Retained, lb	Retained, %
-1 1/2 in. + 1 in.	22.0*	12.8
-1 in. + 3/4 in.	35.0	20.4
-3/4 in. + 1/2 in.	32.25	18.7
-1/2 in. + 3/8 in.	17.50	10.3
-3/8 in. + 4 mesh	26.50	15.4
-4 mesh	38.50	22.4
Total	171.75	100.0

*This amount of the -1 1/2 + 1 in. material was removed after the first crushing stage.

The grading results of the crusher fines material appears in Table 2.

TABLE 2

Grading (Fine Aggregate)

Sieve Size, mesh	Weight Retained, g	Retained, %	Cumulative Passing, %	Cumulative Retained, %
-4 + 8	158.0	29.4	70.6	29.4
-8 + 14	110.0	20.4	50.2	49.8
-14 + 28	65.5	12.2	38.0	62.0
-28 + 48	39.5	7.2	30.8	69.2
-48 + 100	42.0	7.8	23.0	77.0
-100	124.0	23.0		
Total	539.0	100.0		F.M.* 2.87

*F.M. (Fineness Modulus) = 2.87

3. Specific Gravity and Absorption

Results of these tests were obtained in accordance with the Standard Method of Test for Specific Gravity and Absorption of Coarse Aggregate, ASTM Designation: C 127-42.

The following values were obtained:

Specific Gravity (saturated surface dry)

Bulk	=	2.76
Absorption	=	0.76 per cent

4. Los Angeles Abrasion Test

The abrasion test was made in accordance with the Standard Method of Test for Abrasion of Coarse Aggregate by Use of the Los Angeles Machine, ASTM Designation: C 131-51.

The result of testing by an 'A' grading is as follows:

Abrasion loss per cent ('A' grading)

= 31.4 per cent

5. Soundness of Aggregate by Magnesium Sulphate

The following losses were obtained by immersing samples in a $MgSo_4$ solution in accordance with the Tentative Method of Test for Soundness of Aggregates, ASTM Designation: C 88-56T.

Table 3 shows the individual losses prorated to the grading as obtained for the total crusher product excluding the minus 4-mesh material.

TABLE 3

Sulphate Soundness, Per Cent Loss

Sieve Size	Original Grading, %	Weight of Fraction, g	Weight after Test, g	Loss %	
				Actual	Corrected
-1 1/2 in. + 1 in.	16.5	1500	1500	0.0	0.0
-1 in. + 3/4 in.	26.3	1000	991	0.9	0.24
-3/4 in. + 1/2 in.	24.1	750	750	0.0	0.0
-1/2 in. + 3/8 in.	13.2	500	498	0.4	0.07
-3/8 in. + 4 mesh	19.9	300	295	1.67	0.33
Total	100.0	4050			0.64

The corrected total per cent loss by sulphate soundness solution (magnesium) amounts to 0.64 per cent.

6. Unit Weight

Unit weight of this aggregate was obtained in accordance with The Standard Test For Unit Weight of Aggregate, ASTM Designation: C 29-42 using the rodding method:

Unit Weight = 102.8 lb/cu ft

DISCUSSION

The rock submitted by the Preston Sand and Gravel Company for the investigation was defined as a dolostone by the mineralogical examination. Although it is fossiliferous and vugular (porous) around dolomitized fossil molds, absorption of the aggregate fractions is very low -- 0.76 percent, a value which will meet any specification requirement.

The crushing process employed in this investigation and knowledge of previous crushing tests on this type of rock are sufficient to indicate that the rock should be amenable to crushing processes for the production of most grading requirements.

The value of the loss as determined by the Los Angeles abrasion test method was borderline by Ontario Highway Standards for coarse aggregate, which specifies a maximum 30 per cent loss. It would be advisable to have this property of the rock tested elsewhere and preferrably by the Ontario Department of Highways before considering the material as unsound. The ASTM Specification for coarse concrete aggregate abrasion loss is 50 per cent.

The loss during five cycles of immersion and drying of samples in a $MgSO_4$ solution, by Ontario Highway Standards is not to exceed 12 per cent while the ASTM maximum allowable loss for coarse concrete aggregate is 18 per cent. The Preston rock with a value of 0.64 per cent is exceptionally resistant to loss by this standard.

CONCLUSIONS

The results of the physical acceptance tests indicate that, with one exception, the rock is acceptable as an aggregate for use in concrete and road construction. The one exception, a borderline value for abrasion loss by Ontario Highway Standards, is not too serious in view of the aggregate's acceptance by ASTM Standards for concrete use. As discussed above, the loss by abrasion should be thoroughly investigated, both by repeating the test on the aggregate by the Los Angeles method and by actual performance tests in the field.

The sample received is a hard, fossiliferous dolostone with no deleterious constituents.

The low absorption value and the very low soundness loss indicate weather-resistant qualities that attest to the amenability of the rock to resist deterioration by changes in temperature and moisture content.

Graded products of aggregates were efficiently obtained for test purposes. The crushing characteristics of the rock appear suitable for the production of most types of aggregate materials.

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