SAMPLING DEPOSITS OF ROAD STONE AND GRAVEL IN THE FIELD

FOR a knowledge of the roadmaking values of natural deposits of stone and gravel, the engineer is dependent very largely upon the results of laboratory tests. The tests are made upon small samples taken from much larger deposits and the value of the laboratory tests, therefore, depends directly upon the degree to which the samples represent the deposits. A series of studies is being made by L. Reinecke and K. A. Clark, of the Geological Survey of Canada, upon variations in the roadmaking qualities of deposits of bedrock, boulder aggregates and gravel. In *The Canadian Engineer* for May 3rd, 1917, was published an illustrated article by Mr. Reinecke on "Methods of Determining the Roadmaking Qualities of Deposits of Stone and Gravel." Messrs. Reinecke and Clark have now prepared for the American Society for Testing Materials a brief paper giving the results of a number of tests in respect to the sampling of deposits of road stone and gravel. The authors say that the field is very wide and that their paper covers only a small part of it. In regard to bedrock, they came to the following conclusions:—

Bedrock

1. The results of an abrasion test is liable to an error of 0.2 per cent. due to variations caused by laboratory procedure.

2. No additional error is introduced into the results of abrasion tests by the process of sampling when samples are collected in the manner outlined below.

3. Results of abrasion tests on rock in place in a deposit represent, within a probable difference of 0.4 per cent., the percentage of wear that will be shown by a crushed product produced from the deposit.

4. In the case of deposits consisting of stone of a very uniform character and appearance, the results of abrasion tests on samples taken at one point in the deposit can be regarded as representing within the probable error due to laboratory manipulation, the percentage of wear of the stone over quite a considerable area, at least a quarter of a square mile.

5. It is possible to assign average values and fairly narrow limits of variation of this value for the percentage of wear and the toughness of the material occurring in a limestone formation covering areas up to 50 and 60 square miles, and with thicknesses up to 500 ft., even though stone of quite different character is included in the formation. These values and limits will apply to the majority of results of tests made on samples collected throughout the formation and its various horizons. These limits should define the maximum variation of the results of abrasion and toughness tests made on samples collected from a quarry in a limestone formation to represent the material produced from the quarry as operations are extended from year to year. They should assist in determining at what intervals apart vertically and horizontally it is necessary to sample formations consisting mainly of limestone or dolomite in order to arrive at their average percentage of wear and toughness values, and variations from such values.

6. The results of abrasion and toughness tests over a series of diabase dykes of the same age and structure reveal very uniform results in deposits of the same grain. A change in grain affects the toughness value slightly. The number of samples taken in dykes of this character need therefore not be great even though they cover large areas, if structural conditions and the texture and degree of alteration of the stone remain the same.

Boulder Aggregates or Field Stone

The authors state that the following conclusions may be drawn from their investigation of boulder aggregates:

1. Boulder deposits in any one area consist of many combinations of three or four rock types of fairly uniform durability, and the percentage of wear of any combination of the rock types found in deposits of boulder aggregates can be calculated by the following formula if the percentages of wear of each of the rock types are known:

$$W_m = \frac{\Sigma\, C\, W}{100},$$

in which W_1, W_2 .... Wn = percentages of wear of the various rock types, and C_1, C_2 .... Cn = percentage proportions in which the rock types are present in the combinations.

2. A large variation was found between the results of duplicate granulometric laboratory analyses on the same sack of gravel. The variation in texture over one deposit of gravel of 80 acres was found to be large.

Method of Collecting Samples

In collecting samples of bedrock for the abrasion test, care was taken to secure samples which fairly represented the entire face of the deposit being sampled. Equal numbers of pieces were broken from equal units of height of face. Fifty-five pieces, the right size or a little larger, for the abrasion test constituted a sample. In a good many cases 110 pieces were uniformly collected from the face and separated in the laboratory by quartering into duplicate samples. In other cases two samples of 55 pieces were separately collected over the same face and at the same place. If there was reason to suspect that any definite section of a deposit contained material that possessed somewhat different qualities than stone from the other parts of the deposit, samples were taken to detect any such difference. Corresponding to each abrasion sample, toughness blocks representing each important lithological phase of the stone in the deposit were collected. In sampling crushed stone, material was taken from the stock pile of large sizes so that pieces with fresh edges could be prepared for the abrasion test.

At a joint meeting of the Point Grey, Richmond and South Vancouver boards of trade, held recently, a desire was expressed by one of the members from Point Grey to obtain a site for an up-to-date smelter for the purpose of making grey pig iron from British Columbia ores. It was agreed that the committees should see what sites are available.

The new policy of concentrating the work of the engineering department of the city of Montreal has led to the assignment of defined positions to divisional engineers. F. E. Field, engineer of the filtration plant, has been appointed assistant to the head of the waterworks department. E. Blanchard, of the Eastern division, has been appointed assistant engineer of the road department. T. Langlois is assistant engineer of the sewers department. J. H. Valiquette, of the Western division, is now assistant designer in the sewers department.

It has been definitely determined by laboratory tests that the maximum safe working internal temperature of an 11,000-volt cable is 150 deg. Fah. 65.6 deg. Cent.), says the "Electrical World." Beyond that temperature a peculiar phenomenon is manifested. By reason of the high voltage, a hysteresis effect occurs in the insulation that generates heat. Up to 150 deg. Fah. this loss increases directly with the temperature, but after 150 deg. Fah. is reached the curve takes a very sharp upward turn and quickly reaches the failure point. Safe operation depends, therefore, upon the ability to keep the internal cable temperature below 150 deg. Fah.