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Bulking Measurement of Surface Area

New Method of Determining Surface Area of Sands or Mixtures of Sand and Gravel is Based on Volume-Moisture Relation—Requires No Mechanical Analyses—Paper Presented to American Society for Testing Materials

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WE are all more or less familiar with the fact that the space occupied by a given weight of fine aggregate is related in some way to the moisture contained by that aggregate. A sand ordinarily occupies more space when moist than when dry. In the course of an investigation undertaken to ascertain the bearing that this might have on the problems of proportioning concrete mixtures, it was discovered that this phenomenon was related to the "surface area" of the aggregates involved.

Perhaps it would be well to define the terms, "surface area," "bulking," "sand" and "silt," as used in this paper. The "surface area" of an aggregate is the summation of the surface areas of its individual particles—these particles

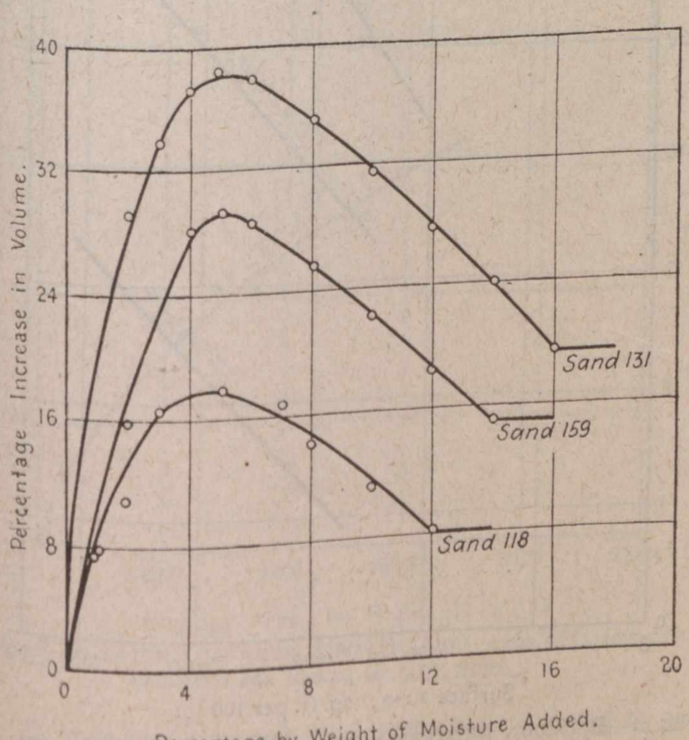

FIG. 1—RELATION BETWEEN MOISTURE CONTENT AND BULKING IN SAND

being considered spheres equal in volume to that of the actual particles. The investigations of Edwards* and others have shown that both the strength and water requirements of a concrete mixture are related rather definitely to the "surface area" of the aggregates used. Surface area is, therefore, used in proportioning concrete mixtures as a measure of the cement requirement of an aggregate.

When a sand increases in volume because of an increase in its moisture content, it may be said to "bulk." Bulking is expressed quantitatively as a percentage or ratio.

"Sand" is used in its commonly accepted sense: namely, a fine aggregate derived from a natural source, all of which

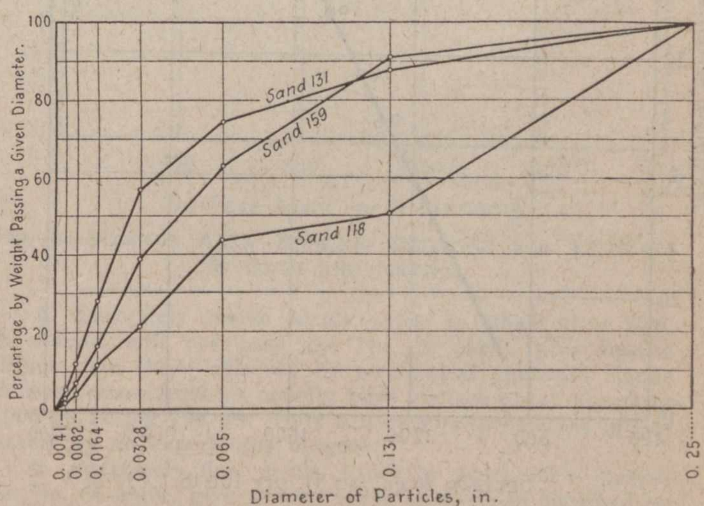

FIG. 2—MECHANICAL ANALYSES SHOWING RANGE OF SAND USED IN THE INVESTIGATION

will pass, when dry, a screen having circular openings ¼ in. in diameter.

"Silt" as here used means that very fine material in a sand which will pass a No. 150 sieve.

The tests described in this paper were carried out by the authors in the laboratory of the Hydro-Electric Power Commission of Ontario as a part of an extended research being conducted there into the problem of concrete proportioning.

The materials used in these tests were sands which had been submitted to the laboratory in the course of its routine examination of aggregates. They came from sundry localities in Ontario and elsewhere—localities quite dissimilar geologically. Most, though not all, would be classed as good concrete sands.

Mechanical analyses were made of each sand from carefully prepared samples taken by the method of quartering. The sieves used were a perforated plate having ¼-in.-diameter openings and Tyler's Nos. 6, 10, 20, 35, 65 and 150. Grain counts were carried out on each size of separation for a representative sand from each locality, and from these

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