Mechanical Analysis of Soils (Colloid Test)

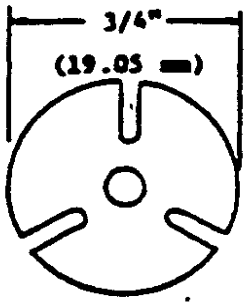
1. Scope:

This test for the quantitative determination of the distribution of particle sizes in soil.

2. Apparatus:

2.1 Scale or balance having the capacity to weigh any sample which may be tested utilizing this procedure and readable to the nearest 0.1 gram.

2.2 Stirring apparatus. A mechanically operated stirring apparatus consisting of an electric motor suitably mounted to turn a vertical shaft at a speed not less than 10,000 revolutions per minute without load, with a replaceable stirring paddle made of rubber similar to the design shown below:



2.3 Hydrometer identified as 152H conforming to AASHTO T88.

2.4 Glass graduate 18" in height, 2 1/2" in diameter and graduated for a volume of 1000 mL.

2.5 Thermometer accurate to 1°F.

2.6 Sieves. A #40 and #200 sieve conforming to ASTM E11. 18

2.7 Beaker with a minimum capacity of 400 mL.

2.8 Evaporating dish with a minimum capacity of 70 mL.

2.9 Drying oven capable of maintaining a temperature of 230° ± 9°F.

2.10 Stock solution containing 18.5 g of sodium tripolyphosphate per liter of distilled water.

3. Procedure:

3.1 Obtain a 50 g soil sample prepared in accordance with SD 101.

3.2 Place the sample in the glass beaker and add 100 mL of the stock solution. Stir the mixture and allow it to soak for a minimum of 12 hours.

3.3 Transfer the mixture to the stirring apparatus cups, add distilled water to fill the cups approximately 1/2 full and mix for 1 minute.

3.4 Transfer the mixture to the glass graduate, add distilled water to bring the volume to 1000 mL.

3.5 Cover the mouth of the graduate and shake for 1 minute.

3.6 Record the time on the worksheet and following a 90 minute sedimentation period, make hydrometer and temperature readings and record. Record the reading to the nearest 0.5 g per liter and the temperature to the nearest 1°F.

NOTE: The hydrometer is read at the top of the meniscus.

3.7 Wash the material in the glass graduate over a #200 sieve and dry the material retained in an evaporating dish in an oven at a temperature of 230° ± 9°F.

3.8 Sieve the dry material on the #40 and #200 and record the weights retained on each sieve to the nearest 0.1 gram.

4. Report:

4.1 Calculations.

A. Sieve Analysis.

(1) Compute the sieve analysis in accordance with SD 202.

B. Percentage of Soil in Suspension.

(1) Determination of Composite Correction for Hydrometer Reading:

a. Equations for percentages of soil remaining in suspension are based on the use of distilled or demineralized water. A dispersing agent is used in the water, however, and the specific gravity of the resulting liquid is appreciably greater than that of distilled or demineralized water.

b. Both soil hydrometers are calibrated at 68°F, and variations in temperature from this standard temperature produce inaccuracies in the actual hydrometer readings. The

amount of the inaccuracy increases as the variation from the standard temperature increases.

c. Hydrometers are graduated by the manufacturer to be read at the bottom of the meniscus formed by the liquid on the stem. Since it is not possible to secure readings of soil suspensions at the bottom of the meniscus, readings must be taken at the top and a correction applied.

d. The net amount of the corrections for the three items enumerated is designated as the composite correction, and may be determined experimentally.

e. For convenience, a graph or table of composite corrections for a series of 1^{o} temperature differences for the range of expected test temperatures may be prepared and used as needed. Measurement of the composite corrections may be made at two temperatures spanning the range of expected test temperatures, and corrections for the intermediate temperatures calculated assuming a straight-line relationship between the two observed values.

f. Prepare 1000 mL of liquid composed of distilled or demineralized water and dispersing agent in the same proportion as will prevail in the sedimentation (Hydrometer) test. Place the liquid in a sedimentation cylinder and the cylinder in the constant temperature water bath, set for one of the two temperatures to be used. When the temperature of the liquid becomes constant, insert the hydrometer, and, after a short interval to permit the hydrometer to come to the temperature of the liquid, read the hydrometer at the top of the meniscus formed on the stem. For hydrometer 152H the composite correction is the difference between the reading and zero. Bring the liquid and the hydrometer to the other temperature to be used, and secure the composite correction as before.

(2) The percentage of the dispersed soil in suspension represented by different corrected hydrometer readings depends upon the amount of soil dispersed. The percentage as dispersed soil remaining in suspension is calculated as follows:

P = Percentage of originally dispersed soil remaining in suspension.

R = Corrected hydrometer reading.

W = Weight in grams of soil originally dispersed.

For hydrometer 152H;

$$P = \frac{R}{W} \times 100$$

If the sample is 50 g, the percentage of dispersed soil in the suspension is twice the corrected hydrometer reading.

To convert the percentages of soil in suspension to percentages of the total test sample including the fraction retained on the #10 sieve, the percentage of originally dispersed soil remaining in suspension is multiplied by the expression:

$$\frac{100\% - \text{retained on \#10 sieve}}{100}$$

C. Report the total percentages passing each sieve size and the percentage of material in suspension at the designated sedimentation time to the nearest 0.1.

5. References:

AASHTO T 88
ASTM E11
SD 101
SD 202

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