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## Mechanical Analysis of Soils (Elutriation Method)

### SC T 34

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#### 1. Scope

This method covers a procedure for the quantitative determination of the distribution of particle sizes in soils.

#### 2. Referenced Documents

None

#### 3. Apparatus

- 3.1 Sieves (sizes 63-mm, 37.5-mm, 19-mm, 9.5-mm, 4.75-mm, 2-mm, 850- $\mu$ m, 425- $\mu$ m, 250- $\mu$ m, 150- $\mu$ m, 75- $\mu$ m)
- 3.2 Electronic scales or balance accurate to 0.1 grams
- 3.3 500-ml glass bottle
- 3.4 4% solution of hexametaphosphate (calgon)
- 3.5 Water
- 3.6 Timer
- 3.7 Siphon
- 3.8 Convection oven (optional)
- 3.9 Riffle splitter (optional)

#### 4. Test Specimens

Soil sample weighing approximately 500 grams, obtained by quartering or by the use of a riffle splitter. Soil should be thoroughly mixed, lumps pulverized.

#### 5. Procedure

- 5.1 The sample of soil shall be thoroughly mixed, lumps pulverized, and while the material is damp, reduced to approximately 500 grams by quartering or the use of a riffle splitter as outlined in SC T 3.
  - 5.2 The 500-gram portion shall be air dried or dried in an oven having a maximum temperature of 60°C so that it will pass the 2-mm sieve without clogging. All lumps of soil retained on the 2-mm sieve shall be pulverized until all particles smaller than the 2-mm sieve will pass the sieve. The portion passing the 2-mm sieve shall be weighed. The aggregate retained on this sieve shall be graded through the following sieves: 63 mm, 37.5 mm, 19 mm, 9.5 mm, and 4.75 mm. These fractions shall be weighed and calculations made based on a total percent passing basis.
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- 5.3 The portion passing the 2-mm sieve shall be reduced by quartering or splitting to a 50-gram sample. This sample is placed in a 500-ml bottle which has been premeasured and marked 4 cm and 12 cm from the bottom. It is then covered to a depth of approximately 25 mm with a 4% solution of hexametaphosphate (calgon) and allowed to stand for at least one hour. If the sample has been air dried for this test, another 50-gram sample should be taken from the remaining soil, dried to a constant weight, and the percent of hygroscopic moisture determined.
- 5.4 If water under pressure is available, the material in the bottle should then be agitated vigorously with a jet of water, care being taken not to splash any of the contents over the edge of the bottle. The bottle should be filled to the 12-cm mark. The material in the bottle is then allowed to settle for 30 minutes after which time the liquid is siphoned off, refilled to the 12-cm mark, and the material allowed to settle for 15 minutes; after which time the liquid is siphoned off, refilled to the 12-cm mark, and settlement time allowed for 8 minutes. If the liquid is siphoned off before the 30, 15, or 8 minute siphoning time, some of the silt will be siphoned off with the clay and incorrect results will be obtained. This operation of washing, settling, and siphoning is continued for the 8 minute time limit until the water above the 4-cm mark is clear at the end of the settling period. If water under pressure is not available, the bottle should be filled to the 12-cm mark, stoppered, and shaken vigorously for 3 minutes. The 30, 15, and 8 minute wash procedures are followed as when using water under pressure.
- 5.5 Carefully transfer the material remaining in the bottle to a pan and dry. Weigh the material remaining and determine the weight of material lost during the washing process. The soil that is siphoned off from the bottle is classified as clay and is reported as "Clay by Elutriation." Screen the material remaining through 850- $\mu$ m, 425- $\mu$ m, 250- $\mu$ m, 150- $\mu$ m, and 75- $\mu$ m sieves using a bottom pan under the 75- $\mu$ m sieve. Material passing the 75- $\mu$ m sieve is classified as silt. Calculate the percentage of each size based on the dry weight of the sample; however, if an air-dried sample has been used, dry weight should be determined before calculations are made. For example, an air-dried sample is used weighing 50 grams, hygroscopic moisture determined from the same sample is 2.5 grams. The dry weight of the sample to be used for calculation shall be 47.5 grams.

## 6. Calculations

- 6.1 The weight of material retained on each sieve is used to calculate the percentage of the sample retained on that sieve as follows:

Wt. of material retained on 75- $\mu$ m sieve = 3.7 grams

Dry wt. of sample = 49.3 grams

% retained on 75- $\mu$ m sieve = 3.7 grams/49.3 grams = 8%

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6.2 The percent of material lost during the washing process is calculated as follows:

wt. of material after drying = 45.3 grams

wt. of dry sample = 48.7 grams

% clay by elutriation =  $(48.7 \text{ g} - 45.3 \text{ g})/48.7 \text{ g} \times 100\% = 7\%$

## **7. Report**

Report the percentage of material passing each sieve to the nearest whole percent. Report the percentage of clay to the nearest whole percent as % Clay by Elutriation. The percentage of material passing the 75- $\mu\text{m}$  sieve is reported as % silt. The percentage of material passing the 2-mm sieve and retained on the 75- $\mu\text{m}$  sieve is reported as Total Sand. Use form titled "Determination of Clay Content by Elutriation with Correction for Hygroscopic Moisture" to record data and calculations. Test results are reported on Lab Form 930. Data and calculations are recorded on lab worksheets 930W, SO 101W, and SO 105W.

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