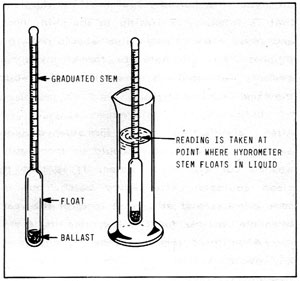
|  |  |
| --- | --- |
| **Course No.:** CE 363 | **Date of** **Testing:**28.10.2011 |
| **No and Title of Test:** Sml 7(a) Determination of particle size distribution of fine-grained soils by the hydrometer | |
| **Year and Section:** 2011, 5 | **Lab. Group:** 3 |
| **SURNAME, Other Names of Student:** | |

**OBJECT OF EXPERIMENT:**

To determine quantitatively the particle size distribution in a soil from largest to the smallest. The test is possible when at least 10% of the sample passes the 63 micron sieve.

**APPARATUS:**

1. A hydrometer calibrated to read density (g / ml) at 20˚C, (e.g. ASTM 151 H).
2. Two 1000ml graduated glass measuring cylinders about 7cm in diameter and 33cm high, marked at 1000ml volume.
3. A thermometer to cover the range 0-50˚C.
4. An electrically driven stirrer.
5. Test sieve sizes 2.5mm, 630µm, 200µm, 63µm (ASTM No. 8, 30, 70, and 200 respectively), and a receiver.
6. A balance readable and accurate to 0.01g.
7. A thermostatically controlled drying oven, capable of maintaining a temperature of 105-110˚C.
8. A stop watch.
9. A desiccators containing anhydrous silica gel.

**THEORY:**

Stoke’s Law:

When a sphere falls freely through a liquid of infinite extent, its acceleration will increase rapidly to a certain maximum velocity and it will continue at that velocity as long as conditions remain the same. As applied to soil particles falling through water, there might be some inaccurate results caused by the idealized theorem. Sample particles may not hold the conditions of being perfect sphere, having infinite fluid extent, differing specific gravity, and having different fall speed because of turbulence.

Using the proper sample may ensure idealized conditions. The shape of soil particles will vary from cubes to flakes with each of the shapes between these limits having different influence. Indeed, the hydrometer test includes different sizes of the materials; assumption will be made of equivalent grain diameter rather than actual grain diameter.On the other hand, an agent solution is used to separate the soil particles into the possibly small size so it will not act as a coarser particle.

**TEST PROCEDURE**:

1. Obtain by riffling two sub samples weighing 50-100g approximately. Weigh the other accurately to the nearest 0.01g (ma), and place in an evaporating dish.
2. Add 100ml of sodium hexametaphodphate solution into the soil, and warm for about 10 minutes.
3. Pour the mixture into the dispersing cup of the mixer, by means of a jet of distilled water from a wash-bottle. Then stir the soil suspension for 15 minutes by means of the mechanical mixer.
4. Wash the soil on the sieve to the 63 micron test sieve placed on the receiver. Do not use more than 500ml of water for this operation. Transfer the suspension that has passed through the sieve to the 1000ml measuring cylinder and make up to exactly 1000ml with distilled water.
5. Put the material retained on the 63 micron sieve to an evaporating dish, and dry in the oven at 105-110˚C. After drying, sieve this material on the 2.5mm, 630µm, 200µm, 63µm test sieves. Weigh the material retained on each sieve.
6. Shake the cylinder vigorously until a uniform suspension is formed. Immediately the shaking has ceased, allow the measuring cylinder to stand, and start the stop watch. Immerse the hydrometer to a depth slightly below its floating position, and then allow it to float freely.
7. Read and record the temperature of the suspension once during the first 15 minutes and then after every subsequent reading, with an accuracy of at least ± 0.5˚C.
8. Place exactly 50ml of the dispersing agent solution in a weighed beaker, and place this in the oven at 105-110˚C until the water evaporates. Hence calculate the mass (Md) of dispersing agent. Calculate the dispersing agent correction (x) from the formula:

X = 2Md

**CALCULATIONS:**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Temp C** | **Elapsed Time** | **Hydrometer Reading R'h** | **Corrected hydrometer reading Rh=R'h+Cm** | **Hr** | **Equivalent particle diameter D (mm)** | **Temperature Correction Mt** | **Rh+ Mt-x** | **percentage finer than D = K (%)** |
| 24 | 1/2 min | 19 | 19.5 | 14.008 | 0,0730 | 0,35 | 15.85 | 71.80 |
| 24 | 1 min | 18 | 18,5 | 14.25 | 0,0500 | 0,35 | 14.85 | 67.27 |
| 24 | 2 min | 17 | 17,5 | 14.50 | 0,0360 | 0,35 | 13.85 | 62.74 |
| 24 | 4 min | 16.5 | 17 | 14.63 | 0,0260 | 0,35 | 13,35 | 40.47 |
| 24 | 8 min | 15.5 | 16 | 14.87 | 0,0180 | 0,35 | 12.35 | 55.94 |
| 24 | 15 min | 14.5 | 15 | 15.12 | 0,0130 | 0,35 | 11.35 | 51.41 |
| 24 | 30 min | - | - | - | - | - | - | - |
| 24 | 24 hr | 8 | 8.5 | 16.73 | 0,0013 | 0,35 | 4.85 | 21.97 |

Meniscus Correction = (Cm) = 0,5 gr/lt

Total dry mass of sample, Mb= 35 gr

Gs (measured/assumed) = 2.7

100 Gs

K= ---------------- (Rh + Mt - x) (%)

Mb (Gs-1)

**DISCUSSION OF RESULTS:**

Size distribution of the fine-grained soils experimented in this test. Stokes law introduces the velocity of particles in the sedimentation and the distribution of the particles.

Errors of human factor and environmental factors possibly occurred in the test. The performer of the test behaves the hydrometer very carefully while moving it and while reading the values from the hydrometer. Another factor is the environmental factors. The fracture of particle while stirring by the mixer and sticking together of the hydrometer, soil particles and the glass tube are the possibilities.

Although we use Mb as 50 gr , it s not air dried rather it is oven dried. Instead of pure water, tap water poured in the experiment that may affect the results, too.

**CONCLUSION:**

As the Stoke’s Theorem states that the amount of clays and silts distinguishes by the use of hydrometer test method. The sedimentation velocity of particles principle is used. The line of the size distribution graph shows that the soil sample is silt. More than 50 % of the fine soil sample stays in the range of the silt.

**REFERENCES:**

\* Craig R.F. (1997), *Soil Mechanics*, London

\* Mathew, L. (2008, September 21). *Soil compaction*. Retrieved from http://www.eoearth.org/article/Soil\_compaction

\* Mirata T. (1997), *Laboratory Instructions for Soil Mechanics Students,* METU, Ankara 2001

\* Lecture Notes