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## **Determining the Specific Gravity of a Fine Grain Soil**

The specific gravity of soil grain is the mass ratio of the volume of dry soil in the pressure of air to the mass of the water of equal volume. Water is taken to be reference with a specific gravity of  $1\text{g/cm}^3$ .

The specific gravity of soil sample helps us to determine the void ratio, density and water content.

Below are the different types of soil and there specific gravity, the specific gravity of soil varies with the type or grade of soil.

- Coarse Grained – 2.6-2.7
- Fine Grained – 2.7-2.8
- Organic soil – 2.3-2.5

Fine grained particle have more specific gravity than coarse grained because they have less void or pore space. The volume occupied by unit weight of coarse particles is more than the unit weight of fine grained particles which decrease the density {density is inversely proportional to volume}. So, fine particles have more density.

$$\text{Specific density} = \frac{(M2-M1)GL}{(M4-M3)-(M3-M2)}$$

M1 = mass of density bottle (g)

M2 = mass of bottle + dry soil (g)

M3 = mass of bottle + soil + water (g)

M4 = mass of bottle + water only (g)

### **Procedure**

To carry out the specific gravity operation, the followings are the procedures use:

- The density bottle with its stopper should be dry and weigh to the nearest 0.001g which is then recorded as M1.
- The original sample is quarter down to 50-100g and should be dry.

- The specimen should be divided into three equal parts and one part should be placed into the density bottle, the stopper should be placed on the bottle and the weight should be recorded as M2 to the nearest 0.001g.
- De-aired distilled water should be added to the specimen in the density bottle carefully to fill it completely.
- The bottle should be shaken thoroughly and the stopper should be removed to allow the air bubble to escape then the stopper should be placed back.
- The body of the density bottle should be wiped dry then weighed with its content (bottle + water + fine sand) which should be recorded as M3 (to the nearest 0.001g).
- The density bottle should be empty and the procedures stated above should be repeated for the two parts of the sample left with the weights M1, M2, M3 of each recorded to the nearest 0.001g.
- The density bottle should be empty thereafter filled with distilled water. The weight of the bottle with the distilled water should be measured and recorded as M4.

## Apparatus

The following are the apparatus used during specific gravity operation.

- Washed bottle.
- Chattaway spatula 150mmX3mm.
- Analytical balance reading (to 0.001g).
- Density bottle (50ml) with stopper, numbered and calibrated.
- Absorbent cotton.
- Constant temperature water bath.

## Data and Calculation

$$\text{Specific density} = \frac{(M2 - M1)GL}{(M4 - M3) - (M3 - M2)}$$

M1 = mass of density bottle (g)

M2 = mass of bottle + dry soil (g)

M3 = mass of bottle + soil + water (g)

M4 = mass of bottle + water only (g)

## **Precaution**

1. Ensure that the density bottle is kept dry before filling it with the specimen.
2. Accurate measurement of weight with the stopper should be place for each of the measurement.
3. Ensure that all the apparatus being used is clean and free from dirt before use.
4. Utmost care should be taken in handling the appatus.

## **Possible Errors**

- Natural Error: This include uneven distribution of air and humidity in the practical lab.
- Systematic Error: This can occur due to old age and inefficiency of the apparatus being used
- Human Error: This may be in form of parallax or as a result of the inexperience of the group members.

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