EWCE 342

GEOTECHNICAL ENGINEERING SESSIONAL

Determination of Specific Gravity of Soil

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Introduction

- Specific gravity, Gs of a material represents the ratio of the mass of a given volume of that material at a temperature to the mass of an equal volume of distilled water at the same temperature.

$$G_s(\text{at } T^0C) = \frac{\text{Wt. of a given volume of the material at } T^0C}{\text{Wt. of the same volume of water at } T^0C}$$

- However, for geotechnical Engineering purpose, the Sp. Gr. of soils are usually reported for water temperature at 20°C

Introduction

- If the specific gravity of soil for water temperature T°C is known then it can be converted to the specific gravity for water temperature 20°C as follows :

$$G_s\,(\text{at } 20^0\text{C}) = \frac{\text{Wt. of unit volume of soil at } T^0\text{C}}{\text{Wt. of unit volume of water at } 20^0\text{C}}$$

$$= \frac{\text{Wt. of unit volume of soil at } T^0\text{C}}{\text{Wt. of unit volume of water at } T^0\text{C}} \text{ X } \frac{\text{Wt. of unit volume of water at } T^0\text{C}}{\text{Wt. of unit volume of water at } 20^0\text{C}}$$

$$= G_s\ (\text{at } T^0\text{C}) \text{ X } \frac{(\gamma_w)_{\text{at } T^0\text{C}}}{(\gamma_w)_{\text{at } 20^0\text{C}}}$$

$$= G_s\ (\text{at } T^0\text{C}) \text{ X } \frac{(G_w)_{\text{at } T^0\text{C}}}{(G_w)_{\text{at } 20^0\text{C}}}$$

Significance

- Test is performed to determine specific gravity of soil passing 4.75 mm sieve.
- Used in the phase relationship (Porosity, void ratio, degree of saturation) and density calculation.
- Can be associated with the soil’s mineral composition and weathering .

Typical Value of Specific Gravity

Table 3.1 Typical Values of Specific Gravity or Soil

SOIL TYPE	SPECIFIC GRAVITY
Sand	2.65 – 2.67
Silty Sand	2.67 – 2.70
Inorganic clay	2.70 – 2.80
Soils with mica or iron	2.75 – 3.00
Organic soils	Quite variable, as low as 2.0

Apparatus

- Volumetric flask
- Wash bottle
- Funnel
- Pippet
- Can
- Balance
- Burner/ gas stove
- Vacuum pump
- Oven
- Thermometer

Procedure

1. Weigh the volumetric flask in dry state. Record this weight in the data sheet.
2. Weigh about 50 gm of soil in a can, put it in the dry volumetric flask by use of a funnel and take weight of "flask+soil" and record it in the data sheet.
3. Now fill about two thirds of the flask (as shown in figure) with water and boil the flask with its contents for about 10 minutes applying agitation and partial vaccum.

Procedure

4. Cool the bottle and suspension to room temperature. (You have to keep it overnight to be cooled to room temperature, so put it in a secured place according to the instruction of the laboratory staff).

(You will do steps 5 to 11 on the following day)

5. Put water at room temperature into the flask by use of wash bottle or pipette to bring the bottom of the meniscus to the calibration mark. Add water slowly and drop by drop when the water level comes near the graduation mark so that you do not need to pippet out water.

Procedure

6. Dry the outside of the bottle and the inside of the neck above the meniscus by cloth / filter paper / blotting paper/ tissue paper.
7. Weigh the bottle with water and soil in it nearest to 0.01 g. Record this weight.
8. Remove the soil water mixture from the volumetric flask, wash and clean it, then fill it with water only (up to the graduaton mark).
9. Wipe the outer surface and the portion above the meniscus.

Procedure

10. Take weight of the bottle with water and record it in the data sheet.
11. Record the room temperature T0C from the thermometer kept in a jar filled with water.

Sample Data Sheet

Specimen No:			
Mass of flask (gm)			
Mass of flask + Mass of dry soil (gm)			
Mass of dry soil, M_o (gm)			
Mass of flask filled with water, M_a (gm)			
Mass of flask filled with soil and water, M_b (gm)			
Specific gravity of soil solids, G_s			
Room temperature, T (^{0}C)			
Specific gravity of water at 20^{o}C, G_{w20}			
Specific gravity of water at T^{o}C, G_{wT}			
Correction factor, K			
Specific gravity of soil solids at 20^{o}C, G_{s20}			

Calculation: $G_s = \dfrac{M_o}{M_o + (M_a - M_b)} \times 100\%$

$$G_{20} = G_s K$$

Table-2 Specific Gravity of water at different temperature (from T.W.Lambe, Soil testing for Engineers)

0^0C	0	1	2	3	4	5	6	7	8	9
	0.9999	0.9999	1.0000	1.0000	1.0000	1.0000	1.0000	0.9999	0.9999	0.9998
10	0.9997	0.9996	0.9995	0.9994	0.9993	0.9991	0.9990	0.9988	0.9986	0.9984
20	0.9982	0.9980	0.9978	0.9976	0.9973	0.9971	0.9968	0.9965	0.9963	0.9960
30	0.9957	0.9954	0.9951	0.9947	0.9944	0.9941	0.9937	0.9934	0.9930	0.9926
40	0.9922	0.9919	0.9915	0.9911	0.9907	0.9902	0.9898	0.9894	0.9890	0.9885
50	0.9881	0.9876	0.9872	0.9867	0.9862	0.9857	0.9852	0.9848	0.9842	0.9838
60	0.9832	0.9827	0.9822	0.9817	0.9811	0.9806	0.9800	0.9795	0.9789	0.9784
70	0.9778	0.9772	0.9767	0.9761	0.9755	0.9749	0.9743	0.9737	0.9731	0.9724
80	0.9718	0.9712	0.9706	0.9699	0.9693	0.9686	0.9680	0.9673	0.9667	0.9660
90	0.9653	0.9647	0.9640	0.9633	0.9626	0.9619	0.9612	0.9605	0.9598	0.9591

THANK YOU