Determine The Specific Gravity Of Soil

This test is done to determine the specific gravity of fine-grained soil by density bottle method as per IS: 2720 (Part III/Sec 1) – 1980. Specific gravity is the ratio of the weight in air of a given volume
of a material at a standard temperature to the weight in air of an equal volume of distilled water at the same stated temperature.

The apparatus used:

i) Two density bottles of approximately 50ml capacity along with stoppers

ii) Constant temperature water bath (27.0 + 0.2^{o}C)

iii) Vacuum desiccator

iv) Oven, capable of maintaining a temperature of 105 to 110^{o}C

v) Weighing balance, with an accuracy of 0.001g

vi) Spatula

PREPARATION OF SAMPLE

The soil sample (50g) should if necessary be ground to pass through a 2mm IS Sieve. A 5 to 10g sub-sample should be obtained by riffling and oven-dried at a temperature of 105 to 110^{o}C.

Procedure to Determine the Specific Gravity of Fine-Grained Soil

i) The density bottle along with the stopper, should be dried at a temperature of 105 to 110^{o}C, cooled in the desiccator and weighed to the nearest 0.001g (W_1).

ii) The sub-sample, which had been oven-dried should be transferred to the density bottle directly from the desiccator in which it was cooled. The bottles and contents together with the stopper should be weighed to the nearest 0.001g (W_2).

iii) Cover the soil with air-free distilled water from the glass wash bottle and leave for a period of 2 to 3hrs. for soaking. Add water to fill the bottle to about half.

iv) Entrapped air can be removed by heating the density bottle on a water bath or a sand bath.

v) Keep the bottle without the stopper in a vacuum desiccator for about 1 to 2hrs. until there is no further loss of air.

vi) Gently stir the soil in the density bottle with a clean glass rod, carefully wash off the adhering particles from the rod with some drops of distilled water and see that no more soil particles are lost.

vii) Repeat the process till no more air bubbles are observed in the soil-water mixture.

viii) Observe the constant temperature in the bottle and record.

ix) Insert the stopper in the density bottle, wipe and weigh(W_3).
x) Now empty the bottle, clean thoroughly and fill the density bottle with distilled water at the same temperature. Insert the stopper in the bottle, wipe dry from the outside and weigh (W_4).
xi) Take at least two such observations for the same soil.

REPORTING OF RESULTS

The specific gravity G of the soil = $(W_2 - W_1) / [(W_4\text{-}_1)\text{-}(W_3\text{-}W_2)]$
The specific gravity should be calculated at a temperature of 27°C and reported to the nearest 0.01. If the room temperature is different from 27°C, the following correction should be done:-
G' = kG
where,
G' = Corrected specific gravity at 27°C
k = [Relative density of water at room temperature]/ Relative density of water at 27°C.
A sample proforma for the record of the test results is given below. Relative density of water at various temperatures is taken from table here. **Relative Density Water**

SPECIFIC GRAVITY OF SOIL

S. No.	Description	Determination No.		
		I	II	III
1	Temperature in °C	31	31	31
2	Weight of bottle (W_1) in g	18.57	18.50	18.62
3	Weight of bottle + Dry soil (W_2) in g	28.57	28.50	28.62
4	Weight of bottle + Soil + Water (W_3) in g	90.88	90.20	91.02
5	Weight of bottle + Water (W_4) in g	84.74	84.00	84.83
	CALCULATION:			
1	Specific gravity $G = \frac{W_2 - W_1}{(W_4 - W_1) - (W_3 - W_2)}$	2.59	2.63	2.62
2	Average G (at 31°C)		2.61	
3	Corrected G (at 27°C), $G' = G \times \frac{\text{Relative density of water at room temperature}}{\text{Relative density of water at 27°C}}$ $= 2.61 \times \frac{0.995369}{0.996542} = 2.6069$, say 2.61			

Note: *The figures given in the above table are for illustration purpose only.*

Source: http://www.engineeringcivil.com/determine-the-specific-gravity-of-soil.html