Lesson 05

Title of the Experiment: Determination of water percentage of a soil sample at field capacity
(Activity number of the GCE Advanced Level practical Guide - 05)

Name and affiliation of the author:
Dr W A P J Premaratne
Department of Chemistry, University of Kelaniya

Introduction:

Soils hold different amounts of water depending on their texture and structure. The upper limit of water holding capacity is often called “field capacity” (FC) while the lower limit is called the “permanent wilting point” (PWP). For example, following an irrigation event that saturates the soil, there will be a continuous rapid downward movement (drainage) of some soil water due to the gravitational force. During the drainage process, soil moisture decreases continuously. The velocity of the drainage is related to the hydraulic conductivity of the soil, in other words, drainage is faster for sandy soils compared to clay soils. After some time, the rapid drainage becomes negligible and at that point, the soil moisture content is called “field capacity”

Learning outcomes:

At the end of the experiment, students will be able to

- develop skills in soil sampling
- develop skills to measure soil samples and crucibles accurately using an electronic balance
- calculate the percentage of water in a soil sample at field capacity

Materials/Equipment:

Galvanized metal cylinder about 10 cm of height

Petri dish (10 cm of diameter)

A piece of polythene

Rubber bands

Filter paper

A piece of wood

Electronic balance

Desiccator

Crucible

Hammer

A piece of wood

Sharpen blade

Methodology/Procedure:

1. Measure the mass of the galvanized tube of 10 cm of height. (M_1 g)
2. Keep the sharpen edge of the cylinder on the ground and leave a piece of wood on the other edge. Then tap it by a hammer.
3. Take the cylinder out when it is filled with soil and remove any excess soil in the outside of the cylinder with a blade and flatten the top and bottom sides with a knife.
4. Wrap the cylinder containing the soil sample by a piece of polythene and bring it to the laboratory.
5. Prepare a wetting column from the galvanized tube as shown in figure 1 given below. Secure a screen over one end of the column with a polythene cover and a rubber band.

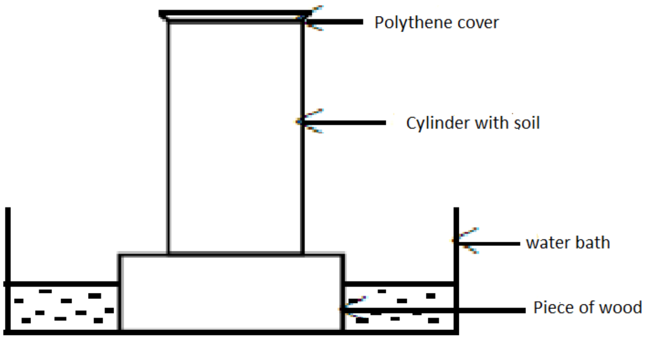

Figure 1: Wetting column

6. Keep the other end of the tube on a piece of wood and put it in a petri dish filled with water. Keep this until the top soil is fully wet.
7. Leave the cylinder in the petri dish with water and weigh until a constant weight is obtained. (M_2 g)
8. Weigh an empty crucible. (W_1 g)
9. Add the soil sample to the crucible. Heat the sample in the crucible at 105°C until a constant weight is obtained. Measure and record the combined mass of the crucible and soil. (W_2 g)

Readings/Observations:

Mass of the cylinder	= (M_1 g)
Mass at the field capacity cylinder + the soil sample	= (M_2 g)
Mass of the crucible	= (W_1 g)
Mass of the crucible + dried soil	= (W_2 g)

Calculations:

Field capacity $= \frac{weight\ of\ the\ soil\ saturated\ with\ water\ by\ capillary\ effect}{mass\ of the\ dry\ soil} \times 100$

Weight of the soil sample saturated by capillary effect = $(M_2\text{-}M_1)$ g

Weight of the dry soil sample = $(W_2\text{-}W_1)$ g

Field capacity $= \frac{(M_2 - M_1)g - (W_2 - W_1)g}{(W_2 - W_1)g} \times 100$

Discussions:

1. Keep the water level in the petri dish below the piece of wood.
2. It might take nearly 3 days for soil to reach the field capacity.

References:

Soil Sampling and Methods of Analysis *(Second Edition)* 2006, Edited by M.R. Carter and E.G. Gregorich, Canadian Society of Soil Science, Taylor & Francis Group