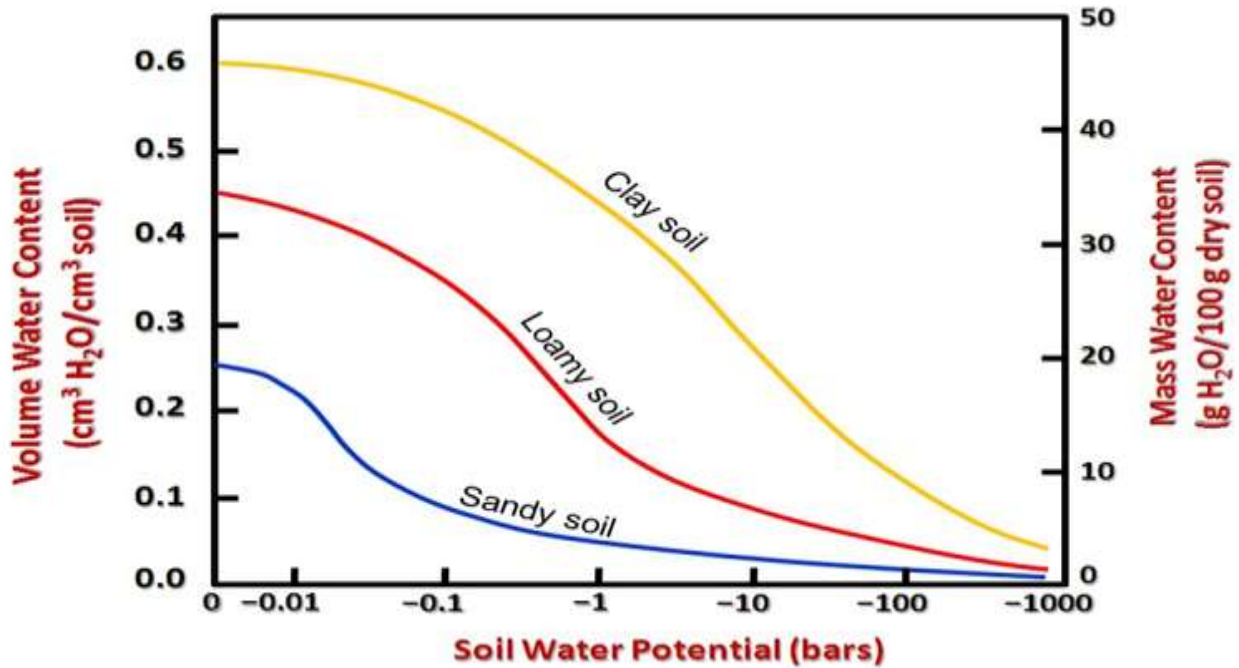


Soil Moisture Characteristic Curve

Aim: To determine Soil Moisture Characteristic Curve

Soil Moisture Characteristic Curve

Soil moisture characteristic curve is the relationship between the water content and the soil water potential (Ψ). It describes the functional relationship between soil water content and its energy status in terms of its matric potential under equilibrium conditions. This curve is characteristic for different types of soil. It is also called the Water retention curve. A soil water characteristic (SWC) curve describes the amount of water retained in a soil (expressed as mass or volume water content, Θ_m or Θ_v) under equilibrium at a given matric potential. A SWC is an important hydraulic property related to size and connectedness of pore spaces. It is strongly affected by soil texture and structure, and by other constituents including organic matter. Modeling water distribution and flow in partially-saturated soils requires knowledge of the SWC. It plays a critical role in water management and in prediction of solute and contaminant transport in the environment. The SWC function is highly nonlinear and relatively difficult to obtain accurately. The matric potential extends over several orders of magnitude for the range of water contents commonly encountered in practical applications, it is often plotted on a logarithmic scale. The SWC is a primary hydraulic property required for modelling water flow in porous materials. It is used to predict the soil water storage, water supply to the plants (field capacity) and soil aggregate stability. Due to the hysteretic effect of water filling and draining the pores, different wetting and drying curves may be distinguished. At potentials close to zero, a soil is close to saturation, and water is held in the soil primarily by capillary forces. As Θ decreases, binding of the water becomes stronger, and at small potentials (more negative, approaching wilting point) water is strongly bound in the smallest of pores, at contact points between grains and as films bound by adsorptive forces around particles. Early conceptual models for SWC curve were based on the "bundle of cylindrical capillaries" (BCC) representation of pore space geometry (Millington and Quirk, 1961). The BCC representation postulates that at a given matric potential a portion of interconnected cylindrical pores is completely liquid filled, whereas larger pores are completely empty.



Factors influencing soil water retention

1. Soil structure (pb, aggregate size distribution)
 - a) Important at low suctions, 0 to 50 kPa
 - b) Capillary effects
2. Clay content
 - a) Positively related to surface area of soil particles
 - b) Positively related to water adsorption
 - c) Dominant factors at high suctions

Practical Significance

Conclusion

Signature of Faculty In-charge

Determination of saturated hydraulic conductivity by constant and falling head method**Aim:**

Determine the coefficient of permeability of a re-moulded coarse grained soil sample with a constant head permeameter.

Materials required

1. Permeameter mould with or without collar
3. Tot cap with water inlet nozzle, air release valve
4. Perforated top and bottom plates
5. Constant head tank
6. Bottom tank
7. Tamping rod
8. Stop watch, scale, measuring cylinder, spanner, grease, thermometer, etc.

Introduction

The coefficient of permeability (k) of a soil is defined as the rate of discharge of water through a unit cross sectional area of a soil under unit hydraulic gradient for a laminar flow condition. This can be determined in the laboratory by constant head permeability test for coarse grained soil with k value greater than 10^{-3} cm/sec.

Working principle

The hydraulic conductivity of a soil is a measure of the soil's ability to transmit water when submitted to a hydraulic gradient. Hydraulic conductivity is defined by Darcy's law, which, for one-dimensional vertical flow, can be written as follows:

Field method with falling head permeameter

$$Q = K \frac{A\Delta H}{L}$$

Where, Q = volume of water flow per unit time (cm^3/s)

V = Darcy's velocity (cm/s)

$\Delta H = h_1$ and h_2 are hydraulic heads, and L is the vertical distance in the soil through which

flow takes place.

K = The coefficient of proportionality, in the equation is called the hydraulic conductivity

L = length of flow

Field method with variable head permeameter

$$K = \frac{2.3aL}{A} \log_{10} \frac{h_1}{h_2}$$

Where, L = flow length (cm)

A = cross-sectional area of glass tube (cm^2)

A = cross-sectional area of soil core (cm^2)

t = time interval (s)

$\Delta H = h_1$ and h_2 are hydraulic heads,

K = The coefficient of proportionality, in the equation is called the hydraulic conductivity

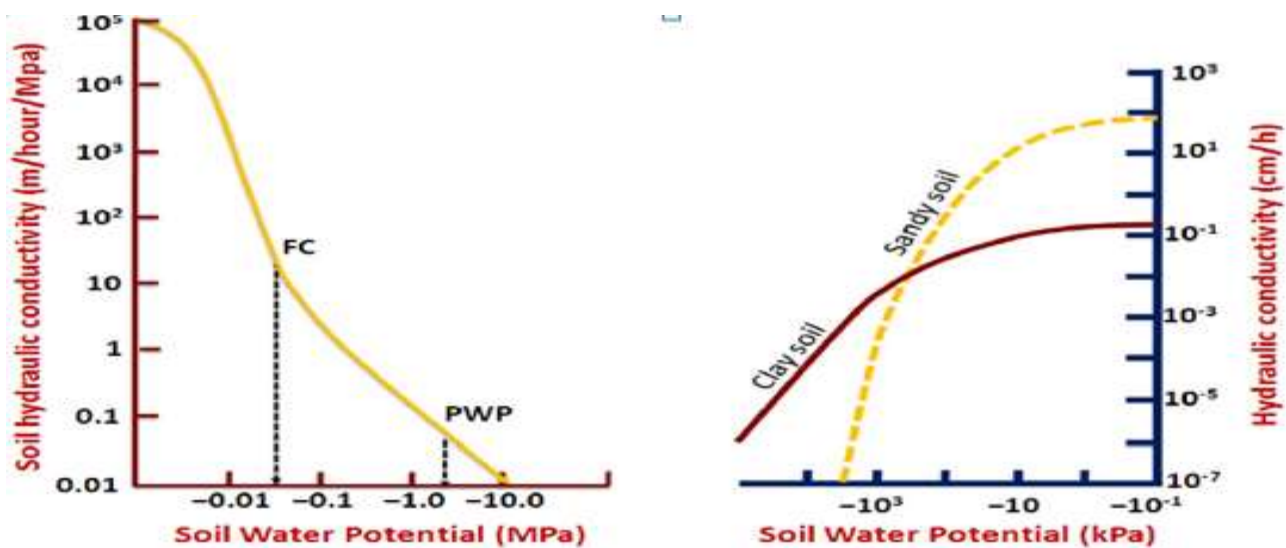


Figure: Soil hydraulic conductivity

Diagram sketch of hydraulic conductivity



Procedure

1. Remove the oversize a particle by sieving the soil specimen through IS 20 mm sieve and determine its percentage (%).
2. Note the dimensions of the permeameter and calculate its volume.
3. For testing re-moulded soil sample, first calculate the amount of dry soil and water required to achieve a particular density and moisture content.
4. Mark the height of mould into three equal parts and also divide the soil into three equal parts.
5. Compact the soil into the mould in layers after fixing the mould to its base plate containing porous stone and placing the collar on top.
6. Put the porous stone on the top of the soil and fix the top plate which is provided with an inlet valve and air cock. Secure both the base plate and the top plate to mould with suitable clamps and rubber gasket to make the entire assembly water tight.
7. Place the assembly in a shallow metal tray with an out-let .Fill the tray with water submerge the base plate completely. All the heads of water must be measured with respect to the tail water level corresponding to the centre of the out-let pipe or crest of the outlet in tray.
8. Attach the constant head water tank with the sliding bracket to a vertical stand. This tank has three opening connect one of them to water supply source, the second to the overflow

tube and the third to the inlet valve provided on the cap of the permeameter. Remove all the air bubbles with the help of the air cock, provided on the top plate. Allow the soil sample to saturate. Check this by obtaining constant values of discharge collected over a given time under a given head.

9. When steady state flow is attained, collect sufficient quantity of water (about 250cc) and note the time interval. Take two to three observations.
10. Note the total head loss and the length of specimen and note the temperature of water.
11. Repeat the test for three different hydraulic heads covering the full range of head in the apparatus.

Tabulation Variable Head or Fall Head Permeability Test

Observations

flow length (cm) (L)	Head (h1) cm	Head (h2) cm	cross-sectional area of glass tube (cm²) (a)	Time (sec) (T)

Calculation

The permeability at the test temperature can be found at by the following formula

Precautions

- This apparatus is for research applications only and needs to be operated by qualified operators.
- Other use than intended purposes should be avoided.
- Take care for personal hygiene and environmental precautions in case of operating contaminated samples.
- Apparatus is rated for indoor lab locations only.

Practical significance

The reports of permeability test shall include the following information:

- (a) Grain size analysis, maximum particle size, and percentage of any over-size material not used
- (b) Dry unit weight, void ratio,
- (c) Average value of permeability obtained.

Conclusion

Signature of Faculty In-charge