

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

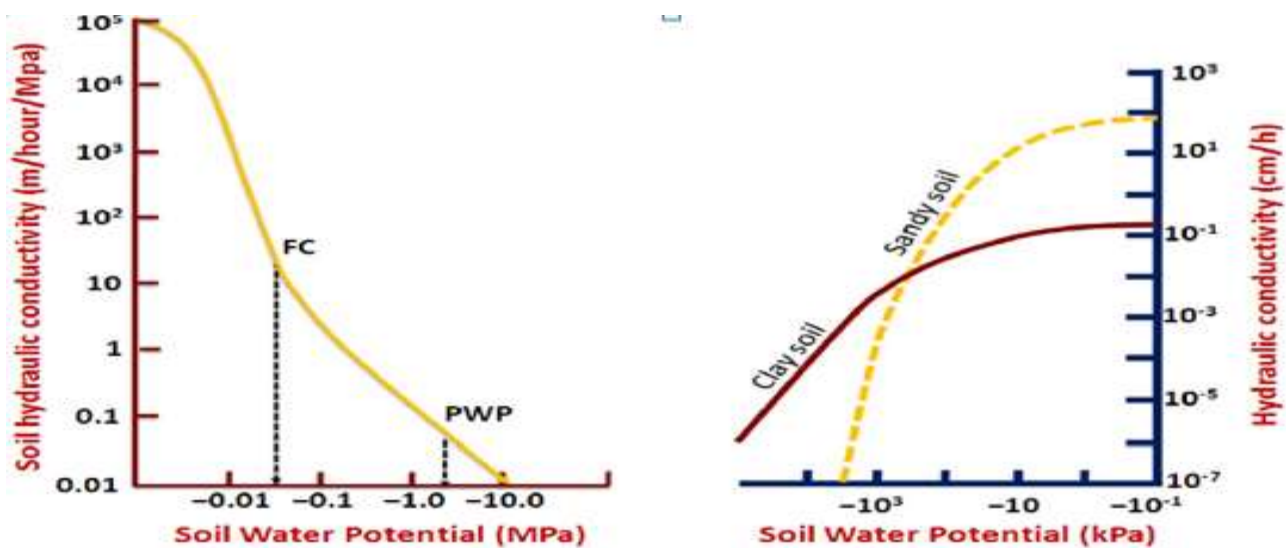


Figure: Soil hydraulic conductivity

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