

78-760 Porosity of Soils



Introduction: Soil porosity and permeability are by no means exact sciences. This is primarily due to the complex makeup of soil. While sand and clay are relatively simple to work with, they are just a small part of soil. Bits of weathered rock, gravel, organic material, sand, clay, and other materials all go into the make up of soil. Not all soils are the same either, further complicating the study of them. It is fair to say that no two soils will have the same properties, if they are from different regions.

However, that does not mean that soils cannot be studied and compared. Soils with different porosities are desirable for different applications. Sand is useful for filtration because it has small, well connected pores: these allow a great deal of water to pass through, but stop particulates. Soil for agricultural purposes needs to hold on to enough water for plants to use, but allow enough to pass through to fully saturate the soil. Clays are very useful for the bottom of ponds because they allow very little water to pass through. Silts are extremely undesirable for building because of their tendency to shift. Gravels are usually used for foundations and areas that need good drainage without erosion.

Examine the soils near your school and home. It is likely that within a fairly small area you can find different examples of soils. Good places to look are gardens, lawns, drainage areas, and areas that are usually wet. Soil from each of these places should exhibit different characteristics.

Operation: For the first experiment, we will focus on *porosity*. This will determine how much of a soil's volume is taken up by *pores*, or

air spaces.

For this experiment, you will need two graduated cylinders and two soil samples. Try to find samples that are different from each other in some fashion, like loam versus sandy soil. Save some of each sample for the next experiment.

- Fill the graduated cylinders with soil. 50ml worth is a good amount. Try to be as precise as possible. Make sure each cylinder has a separate sample!
- Take the syringes from this apparatus and fill them to the 60ml mark.
- Slowly inject water until the water level reaches the top of the soil sample.
- Subtract how much water was added from the initial 60ml.
- This value is the volume of open pores in your samples.
- To determine by percentage, divide the pore volume by the initial volume, and multiply by 100.

- Compare the percentage of open pores between the two samples. In general, soils with smaller grains, such as sands and clays, will have a lower percentage of open pores.

For the next experiment, we will determine permeability. Permeability is a measure of water's ability to flow through a substance. While you will want to use the same soils samples as before, they must be dry.

- Before starting, obtain a stopwatch for each tube. The rate of permeation will be different.
- Place 50ml of soil in each tube. You will need to measure the height of the soil, in centimeters.
- Position the apparatus near a sink or bucket so the water has somewhere to drain. Fill both syringes with water and inject them both into one tube, for a total of 120ml. Do the same for the other tube.
- The tubes are equipped with pinch cocks to hold water in; these should be opened when you are ready to begin.
- Open the pinch cocks and start timing. Your object is to see how long it takes the water to permeate through your soil.
- When the water level reaches the top of the soil, stop timing. Since you know the volume of the soil and water, and the porosity of the soil (determined in the first experiment), you can determine how much water permeated through the soil.
- Since you know how many centimeters of soil were initially present, it is possible to determine how long it takes 1cm of your sample to become fully permeated; that is, how long it takes for water to soak all the way through.

Once you have determined the permeability of a soil sample, compare it versus the other sample you have. How might the composition of the soil affect the permeability? What possible uses might each example of soil have? If you added more of one of the components, how might that affect the permeability? With enough knowledge, you will be able to estimate the permeability of almost any type of soil.

Warranty and Parts:

We replace all defective or missing parts free of charge. Additional replacement parts may be ordered toll-free. We accept MasterCard, Visa, checks and School P.O.s. All products warranted to be free from defect for 90 days. Does not apply to accident, misuse or normal wear and tear. Intended for children 13 years of age and up. This item is not a toy. It may contain small parts that can be choking hazards. Adult supervision is required.