Porosity and Permeability of Soil

Background: Although rock, sand, and soil are solid, there are spaces between the grains of the material called pores. Water may flow into these pores. The measure of how much open space there is in a solid is called its "porosity."

Another important measure is permeability, which is the rate at which fluid can flow through the pores of a solid.

Porosity:
Materials: Two paper cups, graduated cylinder, large jar or beaker, soil samples, spoon/scraper

Procedure

1. Pour 100 mL of water into your cup and draw a line where the water comes up to. Write 100 mL in the total volume column on your data sheet. Dump out the water.
2. Fill the cup with the first soil sample up to the line you drew.
3. Using your graduated cylinder, slowly and carefully pour water into the cup until the water reaches the top of your sample. Write the volume of water remaining in the graduated cylinder on your data sheet.
4. Subtract the volume remaining from the total volume. This is the amount of water you added to your sample. Write the volume of water added to the sample on your data sheet – this is the pore space.
5. To determine the porosity of the sample, divide the pore space volume by the total volume and multiply the result by 100. Write the porosity on your data sheet. (Note: % pore space = pore space / total volume x 100)
6. Repeat procedure with another type of soil (sand, silt, clay) and compare results.

Permeability:
Materials: A fruit or vegetable juice can (50 oz. size) with both ends removed, a hammer, a wooden board, a ruler, a bucket or jar to hold 2 quarts of water, a watch, electrical or masking tape, pencil and paper.

Procedure:

1. Before disturbing the soil in any way, describe it. Write down your observations.
    a. Location (pasture, grassy field, riverbank, desert, etc.)
    b. Plant material present (grass, dead leaves, etc.)
    c. Soil condition (dry, moist, sandy, hard, soft, etc.)
2. Set the can on the ground and place the board on top. By hitting the board with the hammer, drive the can about 5 cm into the ground.
3. Put the piece of tape on the inside of the can near the top so that it is parallel with the top edge.
4. Measure the distance from the bottom of the tape in centimeters to the ground and write this down.
5. Pour water into the can until it reaches the level of the bottom of the tape. Record the time.
6. As the water permeates through the soil, the water level will drop. You can measure how many centimeters of water are permeating through the soil by measuring the distance between the starting height (bottom of the tape) and the

surface of the water. Using a ruler, measure this distance 30 minutes and 60 minutes from the time you first poured the water into the can. (Take lots of water for sandy soil!)

7. Record your measurements.
8. If the water runs out during the course of the experiment, immediately fill it up to the tape marker again. Make sure to add these centimeters of water to the ending total.
9. Divide the amount of water absorbed in one hour by 60 to get the permeability of centimeters per minute for the entire hour. cm/minute
10. Divide the amount of water absorbed in 30 minutes by 30 to get the permeability of centimeters per minute for the first half hour. Is this the same rate as for the entire hour?