

Lab: Porosity and Permeability in Different Soil Types

Important note: Do not proceed until you have read and understand the procedures. Some of the procedures must be timed and can only be performed once without reloading the apparatus.

This is a team exercise. You should team with the people who share your table. Everyone must turn in an answer sheet.

Part 1. Grain size and sorting

There are three different buckets of sediment for you to examine in the front of the room. The colored sediment is sample 1. The coarser sand is sample 2, and the finer, light-colored sand is sample 3.

1. Send one of your team up to get a small sample of each. Use the small glass cylinders.
2. Pour out a small amount of each sediment sample on a separate sheet of paper and have your team examine it with a magnifier.
3. Use a ruler to estimate the size range in millimeters of the majority of grains for each sample.
4. Use the Grain Size Folders and Wentworth Scale to assign a name such as coarse sand, granules, etc. to each sample. Using the same folder, assign a sorting description (well sorted, poorly sorted, etc.) for each sample. Sorting is independent of grain size.
5. Record your results on the answer sheet provided.

Part 2. Porosity Measurement

1. Fill a glass cylinder with 50 ml of sediment. The black line on the cylinder is 50 ml. Do not try to pack the sediment, just let normal gravity do it. Start with the finest sediment sample.
2. Fill a graduated cylinder with 50 ml of water.
3. Slowly pour the water into the sediment cylinder until the sediment is saturated. You may have to wait for any less dense fluids present to escape as you pour the water (what fluids could these be?). Stop when the water just starts to rise over the top of the sediment. Do not try to shake or tap the sediment as you will change the packing and decrease the porosity. This may take longer than 10 minutes for some samples. In the end, the water level and the sand level should be equal.

4. Calculate the volume of water required to completely saturate the sediment by subtracting the volume of water left in the graduated cylinder from the starting 50 ml.
5. Record your results on the answer sheet provided.
6. Let the sediment sample stand undisturbed in a safe place so you can top it off later if necessary.
7. Repeat for each sediment sample.
8. Calculate the porosity for each sample by dividing the volume of water required to saturate the material by the total volume you had initially filled with dry sediment. Express these values as a percent by multiplying by 100.
9. Record your results on the answer sheet provided.
10. Complete the questions on the answer sheet.
11. Empty the wet sediment into the appropriate buckets and give the cylinders a quick rinse. Dry them with paper towels and place them in a safe place for the next lab session.

Phi Scale	Size (mm)	Wentworth Size Class	
-8	256 mm	Boulders	Sediment: Gravel Rock: Conglomerate, Breccia
-6	64 mm	Cobbles	
-2	4 mm	Pebbles	
-1	2 mm	Granules	
0	1 mm	Very Coarse Sand	Sediment: Sand Rock: Sandstone
1	½ mm	Coarse Sand	
2	¼ mm	Medium Sand	
3	1/8 mm	Fine Sand	
4	1/16 mm	Very Fine Sand	
8	1/256 mm	Silt	Sediment: Mud Rock: Mudstone
		Clay	

Wentworth Scale

Part 3. Measuring flow rate.

1. Have one team member familiarize themselves with the operation of the stopwatches.
2. Make sure you have three flow rate apparatuses, each filled with one of the three sediment samples. These should be placed in a 250 ml beaker with the cap/screen down.
3. You will be timing the relative rates at which water will flow through the sediment samples. Use the water bottle provided to pour the water into the first flow rate apparatus.
4. Start the timer when the water level in the beaker reaches the 25 ml mark and stop it when the water reaches the 50ml mark. You should not pour too much water into the apparatus, but there should be water standing above the sediment level during timing. You may find that one of the samples flows too quickly to permit this, but that's ok.
5. If you were to start with dry sand and measure the amount of water you poured in and the amount you get out, you would find that you may not get all the water to flow out. Why?
6. Record the time it takes for 25 ml to flow out. Repeat this until you are satisfied that your technique yielded a good measurement.
7. Use the dishpan to discard any excess water.
8. Calculate the flow rate in ml/sec and gallons/day. (1 gallon = 3.785 liters)
9. Repeat for each sample.
10. Answer the questions on the answer sheet.

Answer Sheet

Part 1. Grain size and sorting

Sample	Average size range in mm	Sediment size name	sorting

Part 2. Porosity Measurement

Sample	Sediment volume	Volume of water added	% Porosity
	50 ml		
	50 ml		
	50 ml		

Questions

1. How does sorting influence porosity?

2. How does grain size influence porosity?

3. Which will have the greater porosity, a jar of large marbles or a jar of tiny "BB" shot. Explain why.

