

Nov. 10, 2024

Project Question:

Porosity & Permeability of Sediments:
How much water can it hold?

Nov. 11, 2024

Key words

Porosity - It's the amount of open space in a substance as compared to its total volume.

Permeability - It's a measure of how easily fluids can flow through a porous substance.

Sediment - It's a solid material that is moved & deposited in a new location through the process of erosion. It can be as small as a grain of sand or as large as a boulder. It can be made up of a variety of materials; sand, clay, gravel, rocks,

minerals, plants, & animal remains.

Nov. 12, 2024

Background Research

Porosity is the proportion of empty space in a sediment.

Permeability is a measure of the ease with which liquids & gases can pass through a rock. All rocks have pore space & fractures, the

greater the percentage of pores or fractures, the greater the porosity.

It's not enough to have pore space, the pores must also be connected so the liquid/gas can flow. Clay, Shale,

& Slate have pores that aren't connected, so it's difficult for water to enter or leave these rocks. For

groundwater to be able to get into a rock with good porosity, it must also have good permeability. Aquifer is a type of soil or rock that can

hold & transfer water that is completely saturated with water. for e.g. glacial till & sandy soils. Understanding porosity & permeability of sediments is crucial to find out groundwater resources. This concept also to finding oil resources. Groundwater exists everywhere there is porosity. However, whether that groundwater is able to flow in significant quantities. Materials like gravel, sand, & even silt make good aquifers.

Nov. 13, 2024

Hypothesis

I think that clay will have the highest porosity because it has less space in between the particles & I think that gravel will have the highest permeability because it has more space in between the particles.

Nov. 13, 2024

Materials

for Porosity Test:

- 3 clear cups
- 1 Measuring cup
- 200ml of dry gravel, sand, clay
- 200ml of water

for Permeability Test:

- 1 funnel
- 3 clear cups
- 3 filter papers
- 1 stop watch
- 100ml of dry gravel, sand, clay
- 1 Marker
- 100ml of water

Nov. 14, 2024 Variables

Constant Variables

for Porosity Test:

- Room Temperature
- Amount of water

for Permeability Test:

- Type of filter paper
- Room Temperature
- Amount of water

Test Variables

for Porosity Test:

- Type of Sediment

for Permeability

- Type of Sediment

Responding Variables

for Porosity Test:

- Amount of water soaked by each sediment

for Permeability Test:

- Time it took for water to pass through each sediment.

Nov. 15, 2024

Procedure for Porosity Test

1. Gather all materials.
2. Measure 200ml of gravel into a cup & gently shake the container so that the surface of gravel is flat.
3. Measure 200ml of water.
4. Pour water little by little into the gravel until the water level reaches the surface of the gravel. As it takes some time for water to go to the bottom of the beaker, make sure to pour little water at a time & then wait before pouring some more.
5. Record the volume of water poured into the gravel. Calculate porosity using the formula, $\text{Porosity} =$

$\text{Pore Space} / \text{Total Volume} \times 100\%$

6. Repeat experiment 2 more times for accuracy

7. Repeat experiment using sand & clay.

Nov. 15, 2024

Procedure for Permeability Test

1. Place a filter paper inside the funnel & place the funnel on top of a clear glass cup.

2. Fill the funnel with 100ml of gravel.

3. Tap the funnel lightly to make surface of gravel flat.

4. Use a marker to mark 20ml, 40ml, 60ml, 80ml, & 100ml on the cup.

5. Take 100ml of water in a cup.

6. Start the stopwatch as you start to pour the water over the gravel.

7. At regular intervals, record the time & volume of water in the cup.

8. Repeat experiment 2 more times.

for accuracy.

9. Repeat experiment using sand & clay.

DEC. 27, 2024

Data

Sediment	Trial 1	Trial 2	Trial 3	Avg.
Gravel	25%	26%	24%	25%
Sand	39%	37%	41%	39%
Clay	50%	52%	53%	52%

DEC. 28, 2024 Results

To test porosity, we'll take 200ml of sediment into a clear glass & pour water until sediments is completely saturated with water. In the first trial, clay had consumed almost half of the water followed by sand & then gravel. Then second & third trial had similar results. The average of all the trials showed that clay has the highest porosity meaning that it has more pore space. Sand has moderate porosity. Gravel has low porosity.

To test permeability, we'll pour water over the sediment & see how much time it takes for the water to pass through. Also, we'll see the amount of water that actually passes through the sediment. In the first trial, we see that water passes through gravel very quickly, it took less than 20 seconds for the 100ml to pass through. Also, the entire amount of water passed through gravel. For sand, it took about 23 minutes on average across all three trials for the water to pass through. However, only 80ml of water passed through sand. For clay, not all the water passed through. Across all 3 trials, water came out very slowly, it took 18 minutes for 60 ml of water to pass through.

Jan. 1, 2025

Conclusions

Gravel has the lowest porosity. It has large particles which creates larger pore space. However, due to large particle size, it's unable to hold water. Gravel has the highest permeability. Due to large pore space, water easily flows through, making it highly permeable. Sand has moderate porosity. Particle size is smaller than gravel, but there is still enough voids to hold water. Sand has moderate porosity. Pores are large enough for water to flow through fairly easily, but the rate is slower than gravel. Clay has high porosity. It has very fine particles & the pores are extremely small. While it holds lots of water, the water doesn't drain easily due to small size of

pore space. Clay has the lowest permeability. It has very fine particles that create small pore spaces restricting water flow.

Jan. 5, 2024

If I were to conduct this experiment again, what changes would I make? How would I improve this experiment?

If I were to conduct this experiment again, I would add different rock types & different sediments. Also, the sediments that were used in this experiment came in different varieties. I'll improve this experiment by using different types of liquids & rocks.

Jan. 5, 2024

Sources of Error

The rocks used in this experiment comes in different varieties. So, if this experiment was to be done again with different varieties, the results may vary.

Jan. 7, 2024

Abstract

I was intrigued by how scientists determine which place has probability of finding water/oil resources. The concept of porosity & permeability is applied. I wanted to learn more about this topic, so I chose this topic.

Three easily available were used: gravel, sand, & clay. To test porosity, put each sediment in a clear glass cup. Then take 200ml of water in the measuring cup & pour it over gravel until it reaches surface level. Amount of water that was poured into the container is the measure of pore space. The amount of water the sediment can hold is directly related to the porosity since water will try & fill

the empty space in the sediment. All 3 trials show the same results. that clay has the highest porosity, followed by sand, & then gravel.

To test permeability, take a funnel & place a filter paper inside it. Next, put 100ml of sediment into the funnel & place the funnel over a clear glass cup. Measure 100ml of water & pour into it into the funnel. The aim of this experiment was to see how long it takes for the water to pass through the sediment & how much water actually passes through the sediment. All 3 trials showed that the entire amount of water was able to pass through very quickly, in less than 20 seconds. for sand, only 80ml of water passed through in average

of 24 minutes. However, water took the longest to pass through clay, it took 18 minutes for 60 ml of water to pass through.