Name_____

Lab Report Template

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4.2.3 Soil Buffers

Problem

Which soil texture has a high buffering capacity?

Hypothesis

If we add a base solution to sand, silt, and clay soil samples, then clay will be the most resistant to change, meaning it has a higher buffering capacity, because it has a smaller particle size and higher density than silt or sand.

Materials

Per pair of students:
• LabQuest2
• Vernier pH sensor
• Buffer solution
• 2 250ml beaker
• 2 50ml beaker
• Permanent marker
• Laboratory tape
• 3 plastic spoons
• Distilled water
• Rinse bottle
• HCL dropper
• NaOH dropper
• Stir rod
• 3 soil samples
• 4 9-oz plastic cups

Per student:
• Disposable gloves
• Safety glasses
• Lab apron
• Pencil
• Agriscience Notebook
• Lab Report Template
• Lab Report Evaluation Rubric

Procedures

Procedure
1. Use marker and masking tape to label one cup “sand”, a second “silt”, and a third “clay”.
2. Place four spoonfuls of sand into your cup labeled sand. Keep the spoon used to transfer the soil to the cup inside the cup for mixing later.
3. Repeat this process for silt and clay.

4. For each sample measure 100ml of distilled water and add the water to each cup.
5. Stir each sample with a stir rod for two minutes.
6. As the samples settle, develop your own procedure for testing the buffering capabilities of each soil solution.
Note: Samples should settle for 2 – 3 minutes before measuring pH with pH sensor.
Obtain a 250ml beaker with 100ml of buffer solution.
7. Using tape and a permanent marker label the 250ml beaker buffer solution.
8. Label the second 250ml beaker rinse beaker.
9. Set up the LabQuest2 for data collection.
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• Attach the pH sensor to Channel 1.
• On the Meter screen, tap Mode. Change the data-collection mode to Events with Entry.
10. Enter the Entry Label as drops and leave the Units field blank.
11. Use a permanent marker pen and tape to label a 50ml beaker acidic.
12. Place 20ml of distilled water in the beaker.
13. Rinse the pH sensor thoroughly with distilled water over the rinse beaker.
14. Place the sensor into the 50ml beaker of distilled water.
15. Start data collection. Monitor the pH readings displayed to the right of the graph. When the readings are stable, tap Keep.
16. Using the numerical keyboard displayed on the screen, Enter 0 as the number of drops you have added. Select OK to store the first data set for this experiment.
17. Rinse the pH sensor thoroughly with distilled water and place the sensor into the beaker of buffer solution.
18. Add 5 drops of NaOH (base) to the beaker. Stir the solution thoroughly with a stirring rod after adding the acid.
19. Place the pH sensor in the solution.
20. When the LabQuest2 readings are stable, tap Keep. Enter the total number of drops of NaOH added to the water in the beaker and select “OK”.
21. Rinse the pH sensor thoroughly with distilled water and place the sensor into the beaker of buffer solution.
22. Repeat Steps 13 – 16 adding 5 drops of NaOH each time until you have added a total of 20 drops.
23. Stop data collection by tapping on the red square on the screen.
24. To examine the data on the displayed graph, select any data point. As you select each data point, the pH and drop number values are displayed to the right of the graph. Tap each point and record the pH values in Table 1.

Data Collection

Table 1: Soil Buffering for Base

Drops of NaOH	0	5	10	15	20	Change in pH
Sand	7.72	9.97	10.34	10.49	10.75	2.91
Silt	7.77	8.02	8.17	8.26	8.34	.57
Clay	8.26	8.44	8.45	8.76	8.64	.38

Analysis of Results

Sand, silt, and clay were all tested for buffering capacity. Both sand and silt started with lower pH levels closer to neutral, while clay started with a higher pH level, in the slightly basic range. Sand had the highest change in pH. Silt and clay had similar changes in pH, with clay having the smallest change in pH. At 15 drops the pH of clay increased higher than the reading at 20 drops. It was determined that the clay mixture must not have been stirred well enough after the NaOH drops were added, and the pH meter was located in a higher concentration area.

Conclusions

It was predicted that clay would have the highest buffering capacity, meaning that it would have the least amount of change in the pH. The prediction was met, and clay did have the highest buffering capacity. It was surprising that silt had such a high buffering capacity as well. It is believed that the small particle size

of clay, makes it difficult for the pH level to change readily. Sand and silt have larger pore spaces allowing the pH to change more quickly, as the solution is able to penetrate the pores more readily.