Lab 30: Ocean Water, Salinity, and Density

Goals

1. Construct and calibrate a hydrometer.

2. Find the relationship between concentrations of salt in water and its density.

Materials and Equipment

9-inch Plastic pipet
1 cc plastic measuring scoop
100 mL Graduated cylinder
150 mL Beaker
Ruler

Materials Not Included

Salt
Various fluids
Drinking glass
Graph paper
Balance

Introduction

If you've ever tasted ocean water, you'll not likely forget that it is very salty. Wind erosion, rainfall, and water erosion carry sodium chloride (dissolved in water) to the ocean. The oceans continually receive salts and minerals, but thanks to their being used by ocean organisms, and that they precipitate out, the oceans' saltiness is fairly constant at 3.5% by weight.

As salt is dissolved in water, the fluid volume does not change but the mass increases. The more salt is present in water, the greater is its density. Therefore the density of salt water is a measure of its saltiness.

A hydrometer is a device that can measure the densities of solutions by floating at different levels. The higher the hydrometer floats, the greater is the density of the solution. In this activity you will construct a simple but sensitive hydrometer, calibrate it, and measure some densities.

Devotional

"When he established the force of the wind and measured out the waters, when he made a decree for the rain and a path for the thunderstorm, then he looked at wisdom and appraised it; he confirmed it and tested it. And he said to man, 'The fear of the Lord—that is wisdom, and to shun evil is understanding.'"
Job 28:25-28

The discussion in Job 28 between Job and his friends centers around the question of where wisdom can be found. Many examples of where wisdom is not found are given in this chapter. Since creation, true wisdom is found only in God. The phrase "measured out the waters" implies the measuring of the mass and volume of water, and the determination of the mass/volume ratio which is density. The book of Job is the oldest in the Bible, and this verse was written thousands of years before any mention of the density of materials as used in science. Who else but God can give the wind its force, can measure the parameters of the seas, and can know in advance the location of each thunderstorm? God is the only source of true, unchanging wisdom (the wisdom of science frequently changes). The lesson is to honor God (positive action) and avoid evil (negative action).

Procedure

1. Run about one inch of water in a sink. Lay the pipet (hydrometer) in the water and squeeze the bulb to bring in some water. Set it upright and check on the level of water. Adjust the water so that the bulb is full of water and the stem is full of air.

2. Put about 70 mL of water in the 100 mL graduated cylinder. Place the pipet with the bulb down into the cylinder. The pipet should float with the bulb about 5.5 cm below the water line and the tip about 12.5 cm above the water line. If the pipet tip is not 12.5 cm above the water line then adjust the amount of water in the pipet bulb. See Figure 30-1. ***Note: The 12.5 cm distance shown in Figure 30-1 is only for the tap water.***

3. Tap the side of the cylinder to make certain that the hydrometer is not sticking to the side. Measure the distance between the water line and the tip of the pipet stem (it should be 12.5 cm), and record in Table 2. This is a measure of the density of water with zero percent salt.

4. Keeping the amount of water in the hydrometer the same, remove the hydrometer, rinse and dry the outside, and stand it up vertically until the next use.

5. Empty the graduated cylinder, rinse it well, and shake out the water.

7. Put 70.0 mL of water into the beaker, add 1 cc of salt using the 1 cc measuring scoop. Mix the water to dissolve the salt. This is a 2.0% salt solution.

8. Pour the 70 mL of the salt solution into the 100 mL graduated cylinder. Place the hydrometer into the cylinder. Measure the distance between the water line and the tip of the pipet stem and record.

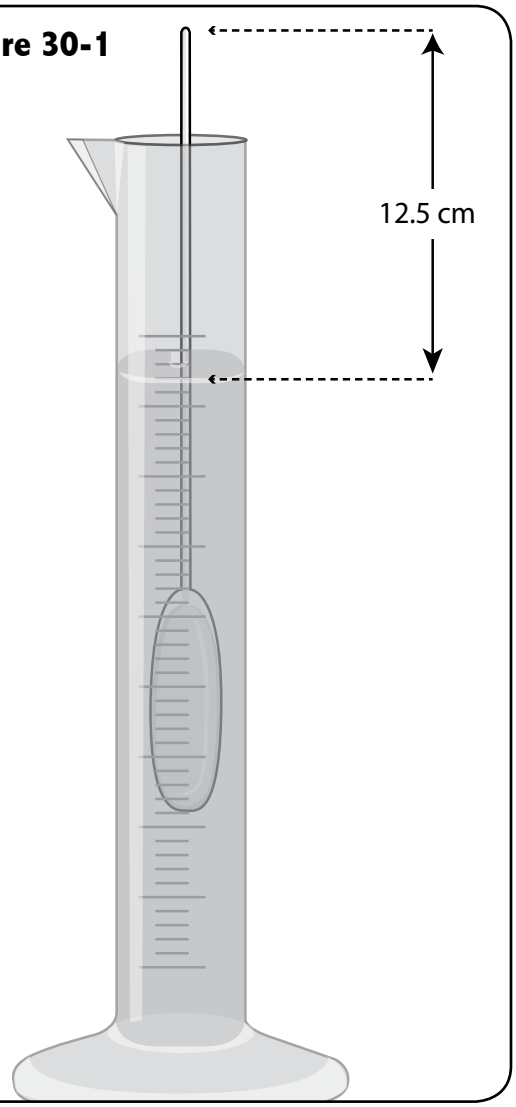
9. Repeat procedures 5-8, except with the water and salt amounts in Table 1.

10. Using the data from Table 2, plot a graph of hydrometer height in centimeters (vertical axis) vs. percentage of salt in water (horizontal axis). Connect the dots with a straight line.

Table 1

Water	Salt	% of Salt	Density of Salt water
70.0 mL	none	0.0	1.000 g/mL
70.0 mL	1 cc	2.0	1.020 g/mL
70.0 mL	2 cc	4.0	1.040 g/mL
70.0 mL	3 cc	6.0	1.060 g/mL

Figure 30-1



Lab 30

Questions for Ocean Water, Salinity, and Density

Table 2

Percentage of Salt (%)	Density (hydrometer height) (cm)
0.0	
2.0	
4.0	
6.0	

1. How does increasing the salt concentration in the water affect the height of the hydrometer?

2. From your answer to Question 1, how does the amount of salt affect the density of water?

3. Did you ever swim in ocean (salt) water? Compare swimming in fresh water and in salt water.

4. Is a given boat able to carry a larger load (more mass) in the ocean or a fresh water lake? Explain your answer.

5. From past experience, compare two identical balloons, one filled with air, the other filled to the same size with helium.
Do they behave the same? Why or why not?