

Experiment 2: THE ALCOHOL CONTENT OF WHISKEY AND VODKA

Ethanol and water as pure substances have different densities, but these substances readily form mixtures whose density is dependent upon composition. The efforts of the entire class will be used to obtain the densities of a wide range of water-ethanol mixtures. The first goal of this experiment is to produce a graph of the density of the ethanol-water mixtures as a function of the volume percent composition. This plot will then be used to determine the alcohol content of samples of whiskey and vodka based on their densities. Implicit in this experiment is the assumption that the whiskey and vodka samples contain only ethanol and water. You will discuss and interpret your results in light of this assumption.

Procedure

1. As a class, we will discuss the range of ethanol-water mixtures whose densities will be determined. You will be assigned a specific solution of a given volume per cent ethanol to prepare, and you will determine the density of this solution.
2. **Prepare a 10.00 mL sample of your assigned solution using a graduated pipet or volumetric pipet as appropriate.** Solution composition will be given in terms of volume per cent ethanol. For example, suppose you wanted to prepare 10.0 mL of a 50 % by volume (v/v) solution of ethanol and water. To do this, you would combine 5.00 mL ethanol with 5.00 mL distilled water. Similarly, 10.00 mL of a 70 % (v/v) solution would be prepared by combining 7.00 mL ethanol with 3.00 mL distilled water.

Combine the appropriate volumes of ethanol and water in a capped vial. Ethanol evaporates readily at room temperature, and if enough ethanol evaporates the composition of your solution (and hence the density) will change.

3. Weigh a separate capped vial and record the mass. Withdraw a 5.00 mL sample of your assigned solution using a volumetric pipet, place it into the pre-weighed vial, and record the mass of the vial and solution. Using the mass of the solution and the volume (5.00 mL), calculate the density of the solution in g/mL.
4. **Make three determinations of the density of your assigned solution, and calculate the average density of your solution, along with the standard deviation. Add your average density and assigned composition (% v/v) to the class data. The class data will be made available to you by your lab instructor. Report your average density and its standard deviation in your lab report.**

Calculations

The next part of this experiment involves learning how to use a computer in the analysis of experimental data. After all of the class data for your lab section have been obtained, plot the data using Excel. By convention, the *dependent* variable is placed on the y-axis, while the *independent* variable is placed on the x-axis. In this experiment, the density was found to depend on the volume per cent ethanol, so density (g/mL) is on the y-axis, and volume per cent ethanol is on the x-axis. **Be sure to include appropriate titles and axis labels on your plot.**

Import your lab section's density vs. percent alcohol data into Excel, and produce a plot. **DO NOT** plot the density of the whiskey or vodka samples. Record the calculated densities for the whiskey and vodka determinations, and calculate the average density of the whiskey sample and the vodka.