CALIFORNIA STATE SCIENCE FAIR
2013 PROJECT SUMMARY

Name(s)
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Project Number
S0321

Project Title
Go with the Flow: The Effect of Solute Concentration on Viscosity

Abstract

Objectives/Goals
The objectives are to determine if varying concentrations of sugar and salt affect the viscosity of water, and if so, see which solute has the greater effect on viscosity.

Methods/Materials
A falling ball viscometer was constructed using a 120 cm plastic tube capped on one end and sealed with clay, tape, rubber bands, and plastic wrap. 40 different sugar and salt solutions were prepared, ranging from 0.04 M to 0.80 M in increments of 0.04 M. A stopwatch was used to measure the amount of time it took for a stainless steel ball bearing to travel through 1000.00 mL of the solution. Each trial of each solution was videotaped, and the recorded video was imported into Windows Movie Maker to ensure the accuracy of the recorded times. This time was used to find the velocity of the ball bearing so that the viscosity of each solution could be calculated using the velocity, the acceleration due to gravity, the radius of the ball bearing, the densities of the ball bearing and the fluid, and the volume of the ball bearing.

Results
The average time of all trials for the control solution (pure water) was 0.030 seconds, which when calculated, yielded a viscosity of 0.0107 P. A total of 410.8 g of sugar were added to 1.5 L of water, resulting in an overall increase of about 0.030 P. 46.8 g of salt were added to 1.5 L of water, resulting in an overall increase of about 0.005 P.

Conclusions/Discussion
Because perspectives can differ, neither solute consistently affects the viscosity of water more than the other. When comparing the solutions in terms of solute concentration, the sugar solutions caused a greater increase in the viscosity of water; however, when comparing the solutions in terms of grams of solute added, the salt solutions caused a greater increase in the viscosity of water. Regardless of the solution, the addition of solute resulted in a near linear increase in the viscosity of water. Equations for the best fit lines of the graphed viscosities were created; using these equations, a scientist could potentially find the solute concentration of a body of water (e.g. the salinity of an estuary) if the viscosity is known. Said scientist could then deduce the living conditions of organisms that dwell in the body of water. In this way, the solute concentration of a body of water can be found with only knowledge of the solute within the body of water and the viscosity of the water or vice versa.

Summary Statement
This project examines the effect of various solute concentrations on the viscosity of water and explores the differing relationships between the viscosities of sucrose water and saline solutions.

Help Received
Materials were lent by cousin; Tube purchased by father; Sister took pictures and videotaped; Ms. Judy Fusco verified the equation for viscosity; Mr. Paul Hunt provided advice.