CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)

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Project Number

S0623

Project Title

The Effects of Molecular Weight and Ion Size on the Refractive Properties of Dissolved Solids

Abstract

Objectives/Goals

Objective: To determine if concentration, molecular weight, and ion size affect the refractive angle of visible light through solutions containing solutes of various sizes.

It is not known if molecular weight and ion size affects the amount of light refraction.

Methods/Materials

Materials; light source, sodium chloride(NaCl), silver nitrate(AgNO3), sucrose, potassium iodide(KI), ovalbumin(OVA), polyethylene glycol(PEG), dH2O, along with basic lab materials.Solutions were made using substances stated above. For each substance, three 10-fold dilutions were made starting with 10 Molar. This was performed for the solutions using four concentrations. Percent Brix was measured for each.Each concentration of each substance was examined three different times to get an average of each substance concentration.

Results

The results are depicted in Table 1 for all concentrations. At low concentrations, there was very small differences in light refraction between the various substances. Sucrose had the smallest amount of refraction at 2.33%, while OVA had the largest amount of refraction at 15.23% at a 1 molar concentration. Once a 1 M was reached, there were large differences in the amount of refraction between the substances with the largest molecular weights. Solutions with AgNO3 and KI refracted differently despite having similar molecular weights.There appears to be an inverse relationship between the ion size and the amount of light refraction.

Conclusions/Discussion

Many industries use refractometers to measure the concentration of certain substances in solution. The concentration of dissolved solids in solution is known to affect the amount of refraction. However, it was previously not known if molecular weight and ion size also affects the amount of light refraction. I demonstrated that with increasing molecular weight, light refraction increases, independent of concentration.

In terms of ion size, it does not appear that larger ion sizes result in greater light refraction. Larger ion sizes (KI) resulted in a smaller of light refraction compared to smaller ion sizes (AgNO3), despite having nearly identical molecular weights. There appears to be an inverse relationship between ion size and the amount of light refraction, independent of molecular weight, so there must be another reason for this phenomenon.

These findings may provide another use for refractometers, in terms of determining the purity of

Summary Statement

To determine if concentration, molecular weight, and ion size affect the refraction of visible light through various solutions.

Help Received

My father helped me by donating supplies, find background research, and also served as my mentor. A family friend, who has a phd in Chemistry, gave my inspiration for my research. My AP Chem teacher lent me equipment and her lab.