CALIFORNIA STATE SCIENCE FAIR
2002 PROJECT SUMMARY

Name(s)
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Project Number
S0522

Project Title
Can Conductivity be Used to Determine Diffusion and Other Ionic Properties?

Abstract

Objectives/Goals
I was interested in using conductivity to evaluate the diffusion characteristics of different ionic solutions to see if properties of their original molecules that affected diffusion could be determined. My hypothesis was that conductivity would allow me to obtain experimental data about how diffusion of permeate solutions into deionized water was affected by membrane combinations for different cations and anions.

Methods/Materials
I built an apparatus to use conductivity to measure diffusion into deionized water from a permeate reservoir over time for different membranes [0.45 and 1.2 micron cellulose, dialysis tubing, Parafilm, plastic wrap, and coffee filter] and water-based permeate solutions [KCl, NaCl, KNO_3, NH_4Cl, $CoCl_2$, $MgCl_2$, Sugar, $Cu(NO_3)_2$, $Ba(NO_3)_2$, and $BaCl_2$]. My test vessel was made out of plexiglass and a Mason canning jar.

Results
When plotted, the raw data from each run showed a smooth, logarithmic shape. Using a spreadsheet, I took the antilogarithm and then took roots to find a curve to fit each set of data. When I compared the roots of these equations with properties of the chloride cation, I found that there was a trend linking the atomic weight and the exponential power of the equation for that run. I confirmed the trend with additional permeates.

Conclusions/Discussion
Conductivity proved to be an excellent way to measure diffusion. After I analyzed my conductivity data, I found a correlation between chloride cation atomic weight and the exponential power of the diffusion curve for that permeate, once I adjusted for valence. I plotted that correlation as a linear graph that allows anyone to predict the diffusion rate for chloride permeates knowing only the atomic weight of their cation or, alternately, to determine cation atomic weight from a measured diffusion rate.

Summary Statement
My project used conductivity measurements of diffusion to establish a correlation between chloride cation atomic weight, valence, and the exponential power of the measured diffusion curve.

Help Received
Reference potassium chloride standard solutions obtained from Metropolitan Water District of Southern California.