CALIFORNIA STATE SCIENCE FAIR
2009 PROJECT SUMMARY

Name(s)
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Project Number
J1103

Project Title
Water Conservation: A Nanoscopic Film Approach

Abstract

Objectives/Goals
The goal of my project is to study how different surfactant monolayers reduce evaporation in order to find a more efficient way to conserve water.

Methods/Materials
Two tests were done. One was conducted by making a monolayer on a surface of water followed by weighing the water in order to calculate the amount of water that evaporated. The second test was done by measuring the rate at which a monolayer spreads.

Materials:
10 ml plastic cups, surfactants, copper sulfate, microbalance, monolayer trough, pipettes.

Results
Water without a monolayer (control) evaporated at an average rate of 0.137 mg/min/cm2. The copper octadecanoic acid, the octadecyl sulfate combined with the hexadecanol, the hexadecanol (liquid), the calcium octadecanoic acid, and the octadecanol, all decreased the rate. Compared to the control, copper octadecanoic acid decreased water evaporation by 57%, octadecyl sulfate combined with hexadecanol decreased the evaporation by 42%, and calcium octadecanoic acid by 33%. All of these were better than hexadecanol at reducing evaporation.

The copper octadecanoic acid spread most slowly with an average rate of 3.34 cm/sec. Most of the surfactants spread at 10 to 11 cm/sec. Hexadecanol dissolved in heptane spread at 15.8 cm/sec, octadecyl sulfate+ hexadecanol at 17.8 cm/sec, octadecyl sulfate at 19.5 cm/sec, and octadecanol at 24.1 cm/sec.

Conclusions/Discussion
Monolayers of copper octadecanoic acid reduced water evaporation by ~50% while hexadecanol reduced the rate by 25%. Monolayers of hexadecanoic acid and octadecanoic acid increased water evaporation. All the acids spread at about the same rate, but the alcohols were faster. Each experiment was repeated five times and evaluated by calculating the standard deviation. The consistent results show that the experimental results were reproducible.

Addition of copper to octadecanoic acid reduced water evaporation by reacting with the octadecanoic acid -COOH groups. This #froze# the monolayer, making it more difficult for the water molecules to escape the surface of the water.

In many countries water is becoming increasingly scarce. I found a compound, copper octadecanoic acid, which works better than hexadecanol. Copper octadecanoic monolayers could help preserve water in

Summary Statement
The overall goal of my project, is to explore different surfactants and the way they reduce evaporation, in order to find a more efficient way to conserve water in resevoirs.

Help Received
Mother and Father helped edit report. Father provided necessary supplies.