CALIFORNIA STATE SCIENCE FAIR
2017 PROJECT SUMMARY

Name(s)
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Project Number
J1111

Project Title
The Best Method of Desalination

Abstract

Objectives/Goals
Which of the three methods of desalination- forward osmosis, freezing/cryo desalination, or thermal distillation, is the most effective and efficient method of desalination? My hypothesis is that if I control the experiments for volume, type of salt water, and length of experiment time, then thermal distillation will be the most effective, but cryo desalination will be the most efficient in cost, time, and energy, but will not completely desalinate the water. I knew from my prior science fair in 2016, that thermal distillation is effective, however inefficient because of the amount of energy required, and the length of time it takes to desalinate salt water, and the amount of water lost to evaporation.

Methods/Materials
For my thermal distillation experiments, I heated the water in a thermal chamber, let it evaporate and condense on a Lexan polymer screen at the top, and let the water slide into a pipe where the water dripped into a cup and was analyzed. During my cryo desalination experiments, I ran a few experiments in the freezer, and a few using dry ice. I had all four types of salt water freezing simultaneously in plastic containers. The forward osmosis experiments used a semipermeable membrane, and on one side was a draw solution with a high concentration of ammonia carbonate. The other side contained one of the types of salt water which should have passed through the membrane to balance out the concentration on both sides, thereby desalinating the water. I then had to heat the water mixture to evaporate the ammonia carbonate and leave behind fresh water.

Results
My results showed that forward osmosis did not work, due to the lack of proper materials (i.e., semipermeable membrane). Thermal distillation removed on average 99.8% of the salt and recovered 37% of the initial water. However, when the experiments were run for at least 9 hours, recovery was 83%. Cryo desalination removed on average 61% of the salt in water, and was more effective when the ice cube was washed with tap water. The process of cryo desalination took only 1.5 hours when dry ice was used, and recovered on average 41% of the initial water.

Conclusions/Discussion
My project supported my hypothesis that thermal distillation will be the most effective method, but that cryo desalination will be the most efficient in cost, time, and energy, but will not completely desalinate the water.

Summary Statement
I compared three types of desalination- forward osmosis, cryo desalination, and thermal distillation; and showed thermal distillation is the most effective method, and cryo desalination is more efficient but not a very effective method.

Help Received
My Dad helped me build the thermal distillation chamber, and my Mom helped me analyze the data.