SUNLIGHT, SALT WATER & SOLAR DESALINATION

– the effect container color may have on seawater desalination rates

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Question

How does the color of a desalination container affect the generation rate of freshwater from seawater?

Variables

Independent Variable (I.V.): The color of a desalination container.

Dependent Variable: The generation rate of freshwater from seawater.

Levels of the I.V.:
- A white colored desalination container
- A black container
- A clear container (my control)

Replicates: There will be 4-5 replicates of each level.

Constants:
- Method of desalination
- Amount of time the water is out in the sun
- Amount of water
- Amount of solar reflectors

Control Group: The control group will be the clear container.

Research

As time goes on, the worldwide population increases, humanity requires more and more fresh water. The current freshwater supply is becoming increasingly inadequate. (Parise) While we are running short on freshwater, there is an abundance of seawater that we can utilize to create more freshwater. This process is called desalination. (Zewe) Desalination is going to become a key component in the survival of humanity. (Parise)

Desalination Methods:

- Some ways to perform desalination include heating, electricity, and pressure. (Zewe) While desalination is very useful, it can also be very energy inefficient and costly. (Parise)
- Some desalination appliances require filters to clean their water, but others use electrical power to take particles from their freshwater. This is more efficient because it does not require the constant changing of filters. (Zewe)
- Other desalination processes use heat and evaporation to separate freshwater from the salt in seawater. (Zewe)

Light Absorption:

- Different materials absorb different types of light, which can impact the desalination process.
- Water is translucent, so it does not absorb visible light, but it does absorb some light that is not visible to the human eye.
- Some of these lights consist of microwaves. (Grainger)

In conclusion, desalination is going to become a process that will save many lives, one drop at a time.

Hypothesis

If a darker colored desalination container is used, then the generation rate of freshwater from seawater will increase.

Materials

The materials needed for this experiment are:

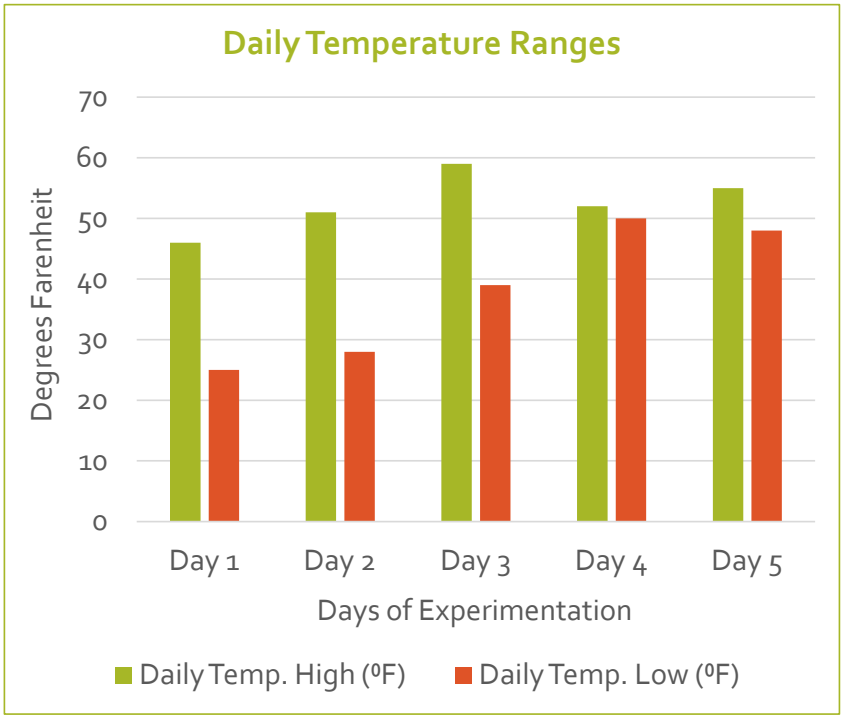
- Large plastic containers with a ¼ in. hole in each
- Colored construction paper
- Plastic tubes
- 12 10-12 in. wooden dowels
- Small weights
- Aluminum foil
- Graduated cylinders
- Plastic wrap
- Three large rubber bands
- Small washers
- Plastic cups with a ¼ in. hole
- Putty

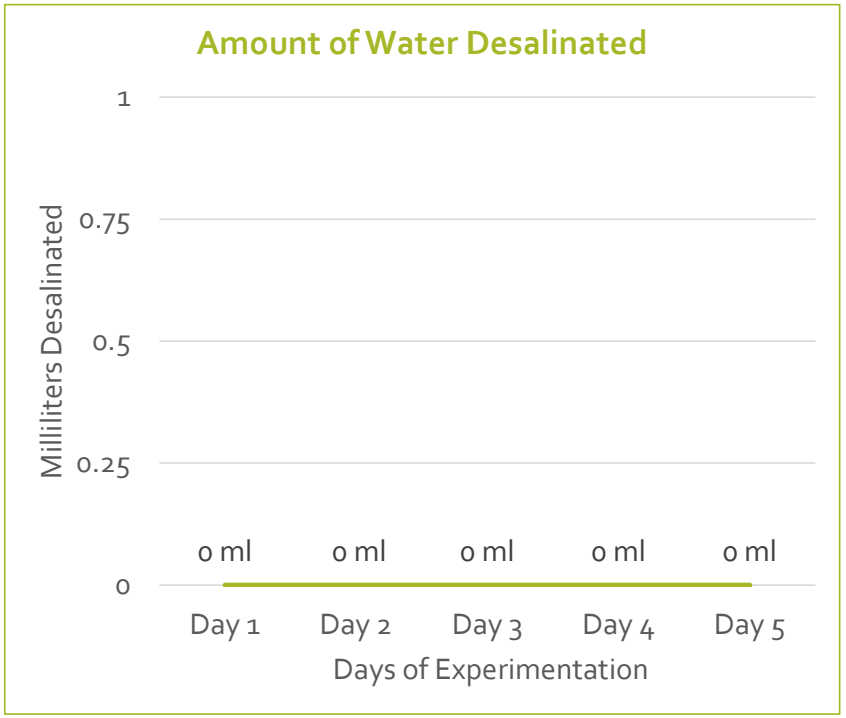
Data

		Amount of Water Desalinated	Daily Temp. Ranges (ºF)
Day 1 (12/28/22)	Day 1	0 ml.	46-25
Day 2 (12/29/22)	Day 2	0 ml.	51-28
Day 3 (12/30/22)	Day 3	0 ml.	39-59
Day 4 (1/1/23)	Day 4	0 ml.	50-52
Day 5 (1/2/23)	Day 5	0 ml.	48-55

		Daily Temp. High (ºF)	Daily Temp. Low (ºF)
Day 1 (12/28/22)	Day 1	46	25
Day 2 (12/29/22)	Day 2	51	28
Day 3 (12/30/22)	Day 3	59	39
Day 4 (1/1/23)	Day 4	52	50
Day 5 (1/2/23)	Day 5	55	48

Data


Daily Temperature Ranges
70
60
50
40
30
20
10
0
Degrees Farenheit
Day 1
Day 2
Day 3
Day 4
Day 5
Days of Experimentation
Daily Temp. High (ºF)
Daily Temp. Low (ºF)


Amount of Water Desalinated
1
0.75
0.5
0.25
0
Milliliters Desalinated
0 ml
0 ml
0 ml
0 ml
0 ml
Day 1
Day 2
Day 3
Day 4
Day 5
Days of Experimentation

Procedure

1. Using scissors, carefully cut your construction paper to fit the body of the plastic containers.
2. Cover one of the plastic containers with black construction paper, one with white construction paper, and leave one without construction paper. Do not cover the hole. Make sure to remove all labels from containers.
3. Use putty to attach the bendy end of the straw to the hole in the plastic container.
4. Attach a funnel to the bendable end of each straw on the inside of the plastic container. Ensure the funnel opening is facing up.
5. Use putty to attach the open end of each straw to a plastic cup outside the container through the ¼" hole in the cup.
6. Cover the container opening with plastic wrap.
7. Place the washer on the plastic wrap and above the funnel. Repeat for each container.
8. Cut 6 sheets of aluminum foil to 4in. high by 12 in. long.
9. Use clear packing tape to attach the short ends of the aluminum foil sheets to the wooden dowels. You will need 2 dowels for each sheet of aluminum foil.
10. You should now have 2 aluminum foil reflectors for each container. Set them aside.
11. Attach one foil reflector along each of the long sides of the containers with clear packing tape.
12. Mix 4 teaspoons of table salt with 750 milliliters of room temperature freshwater (approximately 3.25 cups) until the salt dissolves.
13. Make 2 additional batches for the other containers.
14. Fill the black colored plastic container with 3.25 cups of seawater. Repeat for the white and clear containers.
15. Bring the desalination device outside when the sun is shining.
16. Make sure there are no clouds or high winds.
17. Leave the device outside for 8 hours to desalinate.
18. After the 8 hours are over, record the results.
19. Repeat for 4-5 days

Conclusion

The hypothesis was null and void because the device produced no freshwater. This hindered my ability to gather data to test my hypothesis.

I have considered multiple ways to change the outcome of this experiment, however, this has also been unsuccessful. In conclusion, the hypothesis was nullified.

Error Analysis

There could have been many errors that may have impacted the productivity and working ability of this desalination experiment.

One random error could have been that the experiment was performed in winter! I performed this experiment during the week of the winter solstice, when the sun is furthest from the Earth. When I conducted the experiment, the desalination device was further away from the sun than it would have been during any other time of the year. Exposure to more solar radiation would have accelerated the desalination process.

Another random error could have been that the temperature was changing from day to day. The fluctuating temperatures could have affected my device's ability to convert freshwater from the seawater.

One systematic error that could have changed the outcome of this experiment may have been the structure of the freshwater collection device! The funnel position kept changing. It was tilting more to the side rather than remaining upright, preventing it from collecting any freshwater. This could have been a result of the straw not being able to support the funnel. While I knew that the water was evaporating due to the droplets on the plastic wrap, none of the water made it to the freshwater cup.

A final systematic error was that there was no cover to the freshwater collection cup. It is possible that any collected freshwater quickly evaporated before I could measure it.

"I have not failed. I've just found 10,000 ways that won't work."

- Thomas Edison

Citations

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Parise, Tom. “Water Desalination.” *Water Desalination*, 16 Dec. 2012, http://large.stanford.edu/courses/2011/ph240/parise2/#:~:text=At%20least%20three%20principle%20methods,collected%2C%20leaving%20the%20salt%20behind

Lallier, Samuel. Photo by entrant. 28 Dec. 2022