

Innovation Park Water

Paulina Hall and Shannon Woolfolk

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Dr. Psaker

Governor's School at Innovation Park

Observation and Research

Water covers over seventy-five percent of Earth's surface, yet only one percent is drinkable fresh water. Since the end of World War II, there has been an effort to find alternative ways to create safe freshwater, a common process being desalination, where salt water is separated into distilled water, or safe drinking water, and brine. Desalination is an expensive procedure that requires a lot of energy; 130 million tons of oil a year is needed to produce 13 million m^3/day of desalinated water and the energy necessary to continue to produce this amount of water is growing (Kalogirou). Underdeveloped countries cannot afford to spend this amount of money and energy, not including the damage this method has on the environment by burning fossil fuels. There are products already created to combat burning fossil fuels for desalination, but the length of time to produce a significant amount of clean water inconveniently takes hours. More efficient systems are not cost efficient for developing countries that struggle with finding clean water sources. Safe water storage makes freshwater sources even harder to obtain because even if the water is purified, there is no guarantee the water will remain uncontaminated in water storage. The goal of this experiment is to achieve a balance between efficiency and cost, significantly lowering the price of desalination methods, while also finding a method to ensure safe water storage.

Question

The goal of this experiment is to find an efficient and cheap way to purify water. In order to accomplish this goal, we need to create a water purification system. The plan is to use the process of distillation to separate the contaminants and the water. We will investigate the purity of the water using a TDS water purity tester. This experiment targets people in third world world countries who are impacted daily by the effects of unclean water.

Hypothesis

If a water purification device includes an activated carbon filter and is combined with solar panels, then the amount of time needed to conduct solar desalination will decrease and the amount of safe water storage will increase.

The null hypothesis is that the carbon filter will not keep the water from being contaminated or the solar panels will not maximize the amount of energy needed to heat the water for desalination.

The test can be applied to water purification efforts in developing countries that lack the natural resources, money, or time, to purify water using traditional boiling methods, or water purification using fossil fuels.

Materials and Methods

A water purifier will be constructed to be used in third world countries on a daily basis. The water is going to be purified using the process of boiling the water and then condensing the evaporation to separate the water from the contaminants. This process is known as distillation. The distiller will incorporate different chambers, one for boiling the water, and one to trap the water vapor and condense it, and then something to store the distilled water. The chambers will be constructed from plastic. The first chamber will contain a heater, which will be made from aluminum, and will heat up as electricity passes through. This heat will cause the water to boil. At this point, the water vapor will flow up into a stainless-steel condenser coil, which trap the vapor and condense it. A fan will also be in this chamber, to cool the air in it, and assist in the process of cooling the water vapor. The condensed vapor will travel through coil and through an activated carbon filter, the last step in distilling the water of impurities. The water will then drip down into a collector jug and will be distilled and safe to drink. The system will be powered by solar panels. These will be used because in most third world countries, the villages do not have electricity, so the photovoltaic cells in the solar panels will be used to trap the solar energy from the sun and generate a flow of electricity.

A TDS water purity tester will be used to determine the purity of the water and if the distiller was effective. The first step of testing will be to ensure that the boiler chamber works properly. A thermometer will be used to measure the temperature of the water and to ensure that it has reached 100°C, the temperature at which water boils. The next step of testing will be to make sure that the second chamber and the stainless-steel condenser coil are cool enough to allow the water vapor to condense. This will be tested using a thermometer. As long as the temperature is between 0°C and 100°C, the water vapor will condense. The final step would be to

see if the two chambers together purify the water, along with the activated carbon filter. This step of testing would include testing the amount of time taken to produce the amount of distilled water and the purity of the water itself. The purity will be tested using a TDS water purity tester. The goal is to create a distillation system that can purify enough water for people to live off of in an adequate amount of time.

Data Analysis

The variables being measured in the experiment are the length of time required to completely purify a jug of salt water and the percentage of salt and bacteria in the water after desalination. The purifier must be tested individually to ensure it purifies the water correctly, then two testing stages will occur to measure the independent variables. The two chambers in the purifier will be tested individually to determine whether the chambers work. A thermometer will measure whether the first chamber heats the water to 100 degrees Celsius and if the second chamber cools the steam down enough to condense it. Then they will be tested together, with the carbon filter, to ensure the process is executed correctly. The next stage of testing will be to measure how long the water distiller takes to desalinate the entire collector of water. A timer will record the time passed from the moment the purifier is placed in the sun, allowing the solar panels to collect energy, to when all the desalinated water has been purified into a safe water collector jug. The second stage of testing will be to determine the purity of the water. This will be done by measuring the amount of salt left in the water and the rejection rate of the carbon filter. A TDS water purity tester will measure the amount of minerals in the water in the collector jug and the filter performance of the carbon filter.

References

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