

Innovation Park Water

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Abstract

Innovation Park Water focuses on making solar desalination more efficient and less time consuming. By using solar panels to collect electricity, the electricity will power a heater, used to boil the water, in a chamber faster than just using concentrated thermal energy from direct sunlight. The introduction of another heat source to boil the water will allow the time taken for evaporation and condensation to significantly decrease by providing an alternate heat source. In order to construct the device, two chambers will be cut, one for the boiling of the saltwater and another for cooling the vapor into fresh, drinkable water. The water will then pass through a carbon filter and be deposited into a container built to increase safe water storage. Supplies include plastic for the chambers, solar panels and wire, a carbon filter, and a thermometer and TDS water purity tester for testing and data collection.

The first plastic chamber will hold the salt water. Electricity collected and stored by the solar panels will power the aluminum heater to boil the water in the chamber. As the vapor rises to the second chamber, the salt will be left in the first chamber for easy disposal. The vapor will pass through a steel condenser coil where the vapor will be cooled and then into the second chamber for final cooling. As the water leaves the second chamber, it will pass through an activated carbon filter to trap and remove any lasting particles, flowing into a safe water storage container with a small opening, to discourage recontamination by inserting hands and dirty objects.

At the moment, no testing has occurred, as the project is still in the beginning phases. Supply order forms are being put together to initial constructing can begin after the holiday break. Once the device is constructed, the time for solar desalination to occur will be tested to

see if using electricity from the solar panels was a beneficial step in making solar desalination more effective. The amount of salinity and other contaminants will also be tested to ensure the chambers work together and the device works properly. The results of the experiment can then be implemented in other desalination devices in the future.

Introduction and Background

Less than one percent of the available water on Earth is drinkable and there has been a big effort to convert some of the saltwater into freshwater. Most modern technology for desalination takes a lot of energy and the burning of fossil fuels; 130 million tons of oil a year is needed to produce 13 million m³/day of desalinated water and the energy necessary is still growing (Kalogirou). Underdeveloped countries do not possess the resources to burn that much oil to provide enough fresh water to a village or town, limiting not only the location of where a village can be, but the number of people able to live in one village and still live healthy. The average American uses between 300 to 500 liters of water a day, whereas someone in Africa uses between 20 and 50 liters, and someone in Asia, a little under 100 liters (Food). Since most of the freshwater in underdeveloped countries is spent on agriculture, using desalination provides a medium for the amount of drinking water necessary for healthy living, and necessary irrigation to provide food. The devices already invented are either too costly, reaching almost \$10,000, or take too long to provide drinkable water as some mechanisms take up to eight hours to fully produce drinkable water. Innovation Park Water provides another source of fresh, drinkable water by using solar desalination to take abundant saltwater and change some of it to safe water for other people to use. To improve what already exists, solar energy will be converted into electrical energy used to heat the water and act as an additional thermal energy source. The additional energy source will allow the water to boil at a quicker rate, combating the time necessary for solar desalination using direct sunlight while also using cheaper methods to lower the cost of desalination in the hopes of creating a device that can be applied in underdeveloped countries.

Question

In order to successfully complete Innovation Park Water, research on how a chamber system can be used to conduct desalination, how to link solar energy and desalination together, and how to construct a solar desalination machine from scratch must be conducted. The goal of this experiment is to find an efficient and cheap way to purify water. In order to accomplish this goal, a water purification system must be created. The plan is to use the process of distillation to separate the contaminants and the water, so how can the chambers be constructed and the components, of the device, designed so they work effectively with each other. The purity of the water will be investigated using a TDS water purity tester? Regulations on safe water drinking and the salinity of not only saltwater, but freshwater, must be investigated to ensure the water after going through the device meets regulation standards for healthy drinking water. This experiment targets people in third world world countries who are impacted daily by the effects of unclean water. Research on how other water purification devices and plants work will help the construction of Innovation Park Water as the objective is to significantly improve the smaller, more easily accessible devices already available to the public, but not realistic to people in underdeveloped countries.

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 improve safe water storage.

The null hypothesis is 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/ 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 traps the vapor and condenses 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.

Data/ Results and 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 water has been purified and condensated 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.

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 chamber 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.

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