

Innovation Park Water

Research Plan

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Rationale

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 m³/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.

Hypothesis, Research Questions, Engineering Goals, Expected Outcomes

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.

Research questions include: how can electricity be used to heat up the water in the first chamber? How can the two chambers be combined to make the water heat and condensate faster? How should a jug be designed to meet all the aspects of safe water storage, then improve the container to further prevent recontamination? How can we incorporate solar panels in our design while also saving energy for when the device needs to be used at night? How big should the device be so that it can be easily moved, while also working efficiently?

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 countries who are impacted daily by the effects of unclean water.

By building this device, saltwater and water contaminated by dirt and erosion will be purified in half the time it takes most devices, which is usually around eight hours. By including a storage container that has aspects geared for safe water storage, the distilled water can remain

purified for days following the purification process. The cost of production needs to remain cheap, so materials for the device will be durable and low in cost.

Research Methods and Conclusions

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. There are no risks involved in this project.

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.

References

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