RESEARCH ARTICLE

Optimizing The Concepts of Solar Water Distillation System for Rural Communities in Sri Lanka

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Abstract: This study investigates solar water distillation as a sustainable solution for water purity challenges in Sri Lanka. Low production rates and high costs often limit traditional water distillation methods. In Sri Lanka's Northern province, groundwater is the primary source of drinking water, but is often contaminated due to poor sanitation and pollution, making water filtration necessary but expensive. An affordable filtration method could significantly improve access to safe drinking water. The region's ample sunlight offers a cost-effective and sustainable solution through solar water distillation. In this process, unpurified water flows from a tank into a solar distiller's boiling chamber, where solar energy heats the water to produce steam. This steam is captured through a spiral system and directed into a clean container. A heat exchanger between the water tank and the boiling chamber preheats the incoming water. As the distilled water collects in the container, it is further cooled by the heat exchanger. The resulting purified water can be consumed directly or treated with mineral drops to enhance quality. Testing by the National Water Board confirmed that this distilled water had significantly reduced turbidity, chloride levels, hardness, and total dissolved solids, proving its suitability for drinking.

Keywords: Water distillation, Solar Energy, Renewable Energy, Parabolic Reflector, Groundwater, Water Purification.

INTRODUCTION

In an era where the world population is rising exponentially, with growth in industrialization and the approaching challenge of climate change, the need for Conserving and well-manage water on Earth has become most significant. There has now been a critical requirement to win the battle against this scourge as water pollution is no longer a concern of only a few but a concern of every human who is either on water or about to drink, or touch water. There can be waste reduction as well as prevention of unreasonable demand, which is possible by making the conservation of water practices and technology popular among households, organizations, and businesses. Re-using and purifying water are essential elements of sustainable water utilization plans. Repurifying water refers to the process of cleaning wastewater to eliminate impurities and pollutants so that it can be used for industrial processes, household use, and other nonportable uses. But drinking water should meet a higher standard than the water used for simple washing of a car. And converting Unusable water into usable conditions is more critical. For example, seawater, rainwater, brackish water, hard water, and groundwater. The conversion of non-usable water resources into usable or drinkable water must be seen as one of the major solutions for tackling water issues. Many regions around the world are facing the problem of water scarcity, which is manifested in inadequate sources of fresh water like rivers, lakes, and natural groundwater.

The conversion can enlarge the finite water sources and hence relieve the pressure on the nonrenewable waters. Non-usable water resources are condemnable since they contain several pollutants and contaminants, which make them unfit for direct consumption. By applying the distillation, filtration, and disinfection methods, these water sources can be purified up to drinking water standards and ensure people's health and safety.

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In Sri Lanka's Northern Province, safe drinking water has been a perpetual issue, especially in rural as well as remote areas. Most of the communities in the Northern Province do not have the required water supply network, including piped water networks and treatment facilities. Consequently, the community members must depend on shallow wells, rainwater harvesting, or surface water sources, which may be contaminated with pollutants and pathogens. Where water supply infrastructure has been created, water quality might still be degraded because of contamination from various sources such as agricultural runoff, industrial discharge, and inappropriate sanitation practices. Consequently, many individuals opt to purchase water filters for improved filtration, yet cost remains a barrier to widespread adoption. Offering affordable filtration solutions could address this issue and enhance access to safe drinking water for communities in Sri Lanka.

LITERATURE REVIEW

Water is an indispensable basic need in the world, which is necessary for the survival of humans. The sun was always tapped for various purposes in our daily lives, such as a never-ending and costless source of energy. Solar energy technology is crucial for developed and developing countries in the twentieth century, not only to fulfill their energy demands but also to survive. Solar distillation seems to be the perfect match for rural domestic systems with problems of a shortage of fresh drinking water. Simple processes, installations, and low maintenance are the main advantages of solar distillers [1].

Sri Lanka is located within the equatorial belt, a region where considerable solar energy resources are available for most of the year in sufficient quantities, which could be used for solar water heating, solar electricity, and desalination [2].

Northern Province of Sri Lanka, where solar power is significantly higher than the rest of the country, in a sun-hour, an hour during which the intensity of sunlight is 1,000 watts per square meter, and a day becomes a Sunny day if an average of 7 Sun-hours per day is expected. Kilinochchi in Northern Province has the highest sun days and sun hours throughout the year, whereas Vavuniya and Mullaitivu districts have the lowest sun days and sun hours. In contrast to the other provinces of Sri Lanka, the Northern province – Kilinochchi district, with an average monthly sun hour of 289.3 h [3]. In this paper has been highlighted, Jaffna is influenced mainly by two monsoons: the North-east and South-west monsoons.

The average temperature generally reaches highs of around 31 ^{0}C during the day, and at night it reaches a minimum temperature of 20 ^{0}C. In recent years, the maximum sustained wind speed has reached 74 km/h (around 46mph). At the same time, the months of December, January, and February are affected by foggy conditions [4]. The people from the area of Jaffna and Kilinochchi face problems with the flow of clean drinking water services [5]. The findings of this study say that the majority of the houses in the Northern province have toilet pits next to their dug well and about 74% of the selected wells have a minimum distance between the toilet pit and the groundwater source well of 4.6m which is less than the recommended distance of 16m given by the PHI manual, Sri Lanka. While that, pathogenic contamination may take place because of the properties of the soils in the region. Jaffna is also positive for groundwater pollution with limestone, which is the main aquifer that has no purification capacity. Hence, the present study exhibited that 93 % of sampling locations have more than 100 mg / dm^3 hardness waters, amongst which 23 % of wells exceeded the drinking water guideline value (250 mg / dm^3) of SLS [6]. The only freshwater resource in the Jaffna Peninsula is groundwater. Open wells are the common source of domestic water, but these are generally contaminated with pollution from septic tanks and soakage pits located close to wells. In Jaffna District, there are about 53,600 protected wells, around 8,800 unprotected wells, and some 5,100 tube wells. However, the quality of water is generally not satisfactory due to the widespread presence of chlorides and pathogenic organisms [7].

Rural communities in the dry zone of Sri Lanka, which cover two-thirds of the island, have suffered from severe health issues regarding the consumption of groundwater. Introducing by considering the available solar resources in the Northern Province, and the urgent need for clean water, implementing solar-powered water distillers appears as a good solution. This strategy helps in solving the water scarcity issue of the region by utilizing renewable energy, suitably providing safe drinking water to the locals at affordable rates, with a focus on providing aid to lower-income families. Solar distillation is the best solution for small communities that are facing problems in getting fresh water. Solar still is good for operation, maintenance, and repair, and is friendly to human beings in nature [8].

EXISTING SOLAR DISTILLATION UNITS

In the world, there are many different types of water purification processes, such as filtration, reverse osmosis, ultraviolet radiation, carbon absorption, but the most reliable processes are distillation and boiling. Water purification, such as distillation, is especially important in regions where water resources or tap water are not suitable for ingesting without boiling or chemical treatment. Solar distillation systems can be classified as passive and active. Solar radiation is the energy input of the passive solar stills, but the efficiency of the system is low. Attempts have been made to increase efficiency and productivity by preheating the saline water in solar stills. This method is called active solar distillation [9].

The basic principles of solar water distillation are that the solar energy heats water to the point of evaporation. As the water evaporates, water vapor rises, condensing on the glass surface for collection. This process removes impurities such as salt and heavy metals, as well as eliminating microbiological organisms. The result is water cleaner than the purest rainwater [10].

The research team from Sir Syed University of Engineering and Technology, Pakistan, treats the water by combining different methods such as Filtration, Distillation, and a technique called concentrated solar power (CSP). Filtration is done by a sand filter and a carbon filter. Now this is the pre-treatment of water. The filtered water is then collected in a water container at the focus of a parabolic mirror, where the distillation process is done. This project can be easily installed in any remote area where purified water is not easily available [11].

An experimental study of the performance of solar water distillation using a collector box. The results obtained show that the amount of distilled water increased with increasing solar radiation temperature. The results indicated that distilled water can be obtained even if the weather condition is very bad and the very low solar radiation, as well as a higher amount of distilled water can be obtained at higher values of solar radiation intensity [12]. This team from University of Peradeniya, Sri Lanka, conducted a study to design and develop an efficient and cheaper, wick-type solar still, which can be used in tsunami-affected areas. Various wick materials were tested, and it was observed that handloom material gives better results. But to avoid salt building on the wick material, perfect maintenance is necessary. The turbidity, conductivity, and pH values of all the water tested were found to reach the drinkable standards [13].

This team is from Rajarata University of Sri Lanka. This study aimed to address this issue by introducing an advanced basin solar water distillation system by analyzing insights into the effectiveness of different treatment conditions. Such as a basin only (T1), a basin only with the flat-plate solar collector (T2), a basin only with the sand layer (T3), a basin only with sponge cubes (T4), and a basin with all the features(T5). The treatment T5 has recorded the highest distilled output, and it is 4143 ml/m2/day. The distilled water output from this system has a safe pH level, electrical conductivity (EC), and total dissolved solids (TDS), and it contains very low levels of heavy metals, making it suitable for drinking purposes [14].

In this paper, an experiment was carried out to increase the efficiency of the existing single basin solar distillation unit constructed by the NERD center, Sri Lanka, by incorporating a 2cm thick un-sieved river sand layer for heat retention due to its high thermal capacity. The modified solar distillation unit with a 1 m2 area produced about 2100 mL of water per day under the prevailing climatic conditions of Mapalana (6°3'39"N 80°33' 57"E) [15]. The purpose of this project is to fabricate a solar water distillation system that can purify the water, which is impure by using a systematic arrangement, must have a low cost for manufacturing, and work based on renewable energy from solar. In the experiment, it was found that the black coated solar still is more effective when compared with the white coated solar still [9]. Solar energy and seawater are readily available free of cost in the surrounding areas, which makes the whole process Cost-effective. Solar energy from the Sun, in the form of radiation, is focused and concentrated onto the Receiver pipe with the help of a parabolic collector. The water inside the pipes is heated, converted into vapor, and then sprayed on the Designed Distillation system, where it is re-condensed to make portable distilled water, which makes it possible to convert contaminated water into Clean, drinkable water through the Distillation process [16].

By considering all the designed configurations and results obtained from the existing Water distiller units, this paper investigates the optimization of different parameters of the distillation process to improve the overall efficiency and further cost reduction.

METHODOLOGY

A. Experimental apparatus and the operating principle

As the initial step in the design, compare all existing solar water distiller designs from around the world, as shown in Figure 01, to select the most suitable one for this requirement. While choosing the design, the Cost of the product, the size of the parts to be determined at the end of the project, weight, materials, simplicity, fewer maintenance requirements, and the efficiency of water harvesting and solar power collection were considered as key factors. On a global scale, there are two types of solar still: passive and active ones.

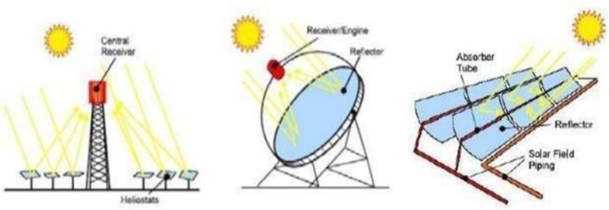

Figure 1: Types of Solar Collectors [18]

This modified solar water distiller could be simplified as a pot-shaped water container (boiler) used to store unpurified water. At the top of the pot, there was a cylindrical container that was used as a condenser, and in the center of this cylinder, a heat exchanger coil was fixed. On the bottom side of the apparatus, the outer surface of the pot is regarded as a focal point to capture the solar power. As illustrated in Figure 2, the solar energy is to be caught by a parabolic satellite dish. When the water flows from the tank or any resources that will be stored in the boiler (pot). To improve the performance of the final product, the water flow is controlled by the level sensor, and a water pump is used to supply water from the water tank. Once the water level is insufficient to continue the distilling process, the water pump will automatically fill the water into water. Owing to the solar heat, the stored water will be heated up inside the boiler. The liquid phase of the water will be transformed into vapor during the boiling process. As these vapors are going through the cylindrical-shaped container, they will be found in these two chambers. One for condensing the steam from the boiler, known as the inner chamber, and one for collecting condensed water from the end of the evaporation, known as the outer chamber.

The water vapors flow inside the cylinder through its hollow pipe and will then be collected in the form of spherical droplet collector. Vapor-to-water drop conversion was carried out by utilizing the heat exchanger mechanism. Next, with the help of the metal frame, the rest of the components are joined together as one product. This was the basis for the design of the solar water distiller. To increase the efficiency of water harvesting using this approach, some more alterations were incorporated. Those things are discussed one by one in a full, detailed way below.

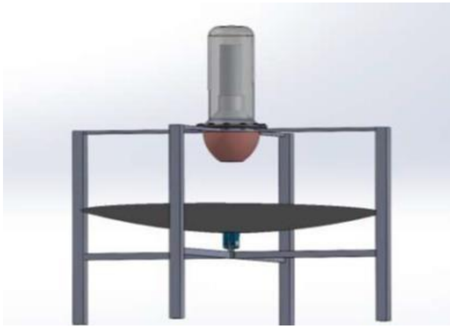

Figure 2: Basic design of the Solar Water Distiller

B. Component Selection and Property Analysis

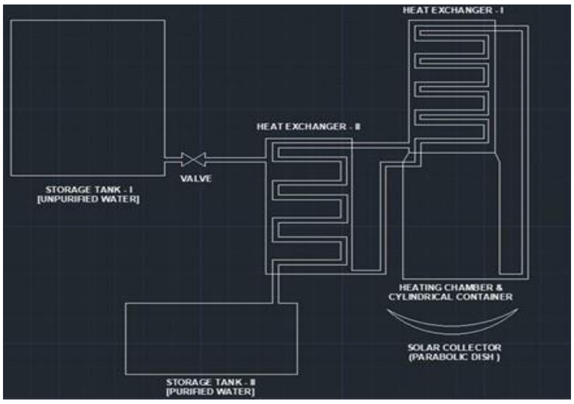

Figure 3: Final Design of the Solar Distiller

To improve the outcomes of the newly designed solar water distiller, the concept of the conventional solar water distiller's design is utilized while comparing each benefit and drawback to find the exact concept for this customized product. Also, a water motor and a set of sensors are used to improve the performance of the overall product with the help of Arduino technology beyond conventional water distiller approaches.

C. Solar Collector

One of the major components can be identified as a solar collector that is used to capture incoming solar radiation. According to the findings of some research, parabolic collectors are a promising technology for harnessing renewable energy to meet our needs sustainably. They have many advantages, such as high efficiency, minimal environmental impact, and compatibility with existing infrastructure [17]. A parabolic-shaped satellite is selected as a solar collector.

It is referred to as sunlight reflection when a sunlight ray hits a polished, smooth surface and bounces back. The incident of sunlight rays hit the surface and are reflected off it. The beam that returns is referred to as the reflected ray. A parabolic solar ray reflector is fabricated for solar energy gathering and projection onto the heating chamber, and it is fabricated with highly reflective material. During the fabrication, several materials were selected for the surface preparation of the reflector. Those materials provided different reflections. Heat-providing data by reflectors were collected and compared to selecting the proper material for the reflector.

For this approach, a small, parabolic-shaped satellite dish was used, which was painted with Nickel paint as a first attempt, and as a second attempt, the surface was changed to Aluminum paint to improve the reflection. Due to kind of rough surface of the Nickel paint and Aluminum foil, a low range of solar harvesting is recorded. Manufacturing parabolic mirrors is an expensive process [17].

The property of the material that is to be used for coating should be such that it should be able to withstand high temperatures, have better reflectivity, be resistant to corrosion, and have low transitivity and absorptivity. For this purpose, silver seems to be an ideal candidate [18]. Therefore, silver-colored paint is applied to get a smooth surface, as shown in Figure 4.

Figure 4: Solar Collector – Parabolic satellite

D. Heat Exchanger

When the system of distillation proceeds, the water flow begins from the storage tank via a suction water pump to the water distiller. This suction water pump works according to the water level of the distillation chamber with the help of the water flow control valve and level sensor. As shown in Figure 3, the heat exchangers can be found inside the cylindrical container of the boiler, the input water line of the system crosses over the output water line, which is made by using a copper coil. The purpose of the heat exchanger is to increase the efficiency of the system and minimize heat loss. To achieve the objective of the heat exchanger, material selection should be done according to suitable criteria.

The main scenario of a heat exchanger is heat transferring from a high temperature to a low temperature. It can happen by different methods called radiation, convection, and conduction. In this heat-exchanging process, conduction is proceeding. For the conduction process, conductivity is the most crucial property of the material selection for the heat exchanger fabrication. That should come with a higher thermal conductivity as well as being non-toxic for health. This design required two heat exchangers, as shown in Fig03.

The first heat exchanger can be found in the inner evaporating chamber of the cylindric container of the boiler as shown in Figure 7. The boiler is used to store the unpurified water which is going to heat. Usually, the temperature of unpurified water is nearly at room temperature. Once purified hot water passes through this inner evaporate chamber, the heat will dissipate to room temperature. Therefore, output purified water from the product can be provided for direct use. The second heat exchanger can be found in an outer condensation chamber of the cylindrical container, which is placed in the boiler pot, as shown in Figure 7. The operating principle of the second heat exchanger can be expressed as enhancing the speed of change, the form of water into water drops. Unpurified water from the tank flows to the boiler pot through the second heat exchanger, which increases the water temperature a bit higher than the room temperature when entering the boiler by absorbing heat from the outer condensation chamber.

This cylindrical outer chamber is used to collect the evaporated water, and with the help of the second heat exchanger, water vapors speedily change form as water drops.

A cylindrical metal container is used to place the second heat exchanger chamber, which can be highly resistive at high temperatures. The output water line is laid through this cylindrical container using a 1cm diameter copper (Cu) tube. Cu is a strong, reddish-colored metallic chemical element that ranks among the greatest heat- and electricity-conductors. It is mostly used for heat and electrically conductive purposes because of its material properties. As shown in Figure 5, The cu tube was formed into a helical coil shape to increase the interconnecting area with water. Because it boosts the heat exchange process. When the input water line flows through the heat exchanger, the water fills the chamber and then continues to flow to the evaporation chamber. Output line flow through the cu helical coil when both flows are occurring, the heat is transferring from high temperature to low temperature.

These two heat exchangers are made of copper tubes. Among the different geometrical shapes used in the heat exchangers. It shows that the helical tubes are found better than the straight tubes based on effectiveness and heat transfer rate [3]. When comparing these two helical and straight tubes, the helical shape can hold water vapors for a certain time. Straight tubes tend to sudden action to roll down the evaporated water drops from the top of the heat exchanger.

Figure 5: Inner view of the Heat exchanger

E. Heating Chamber (Boiler)

The heating chamber receives unpurified water through the water storage, as shown in Figure 3. The cylindrical container is placed on top of the heating chamber, which is fabricated with two chambers called the inner evaporating chamber and the outer condensation chamber. This is the part that proceeds with the distillation process of the system. Distillation is the process of turning a liquid into a vapor, which is then condensed back into a liquid state. The simplest illustration of it is when steam from a kettle condenses into drops of distilled water that are left on a cold surface. Water Distillation is the process that separates the freshwater from the contaminants. It evaporates the water molecules and sediment, contaminating the water, and the heat occurring during the evaporation process kills most of the microbial life in the water. Any water, whether it is drawn from a natural spring, an artesian well, or a conventional tap, may contain traces of pesticides, bacteria, minerals, or other impurities. Good heat conductivity, low emissivity, and corrosion resistance make the working fluid ordinary water, which can lead to calcification and rusting. The outer surface being exposed to the atmosphere should also have some kind of protection mechanism [18]. While considering all the required properties of the cylindrical container, stainless steel, copper, and aluminum are selected as the best materials. Among all of them, aluminum is selected due to its low budget, as shown in Figure 6. This cylindrical container and boiler are fixed to a support frame that is made of metal strips. While designing the support frame, the projection focal point of the parabolic solar collector is highly considered. The boiler needs to get sudden and continuous heat from the sun's rays was enhanced by painting the black color on the bottom part of the boiler pot as shown below in Figure 6.

Figure 6: Heating and evaporating unit.

F. Evaporating Chamber and Condensation Chamber

The above-mentioned distillation process in this system uses both the inner evaporating chamber and the outer condensation chamber. The inner chamber was designed to evaporate the water that is produced when the heat is provided to the boiler pot.

The inner chamber consists of a floating level sensor and a temperature sensor for controlling purposes. Usually, the water level is maintained by the controlling system with the help of the water pump according to the signal of the water level sensor. A temperature sensor provides temperature readings using a display. Depending on the supply of heat from the parabolic satellite dish, the water changes from its liquid state to its vapor state. Evaporated vapor from water has been directed into the outer chamber using fabrication methods for the condensate process.

Figure 7: Inner and Outer Chamber View

The outer condensation chamber consists of a helical cu coil, which is included to maximize the condensation process. This helical cu coil is responsible for the input water supply, which is directed into the inner chamber. This helical coil also proceeds with a heat exchanging

task, which is defined as a second heat exchanger. At the outer chamber, the heat of the evaporated gaseous water is absorbed by the input water line, then the vapor phase of the water is again changed into the liquid phase with heat extraction. Condensed water collects in the outer chamber and flows into the outer filtration unit. All this is dependent on the reflection of the parabolic satellite reflector.

G. Suction Water Pump

As the distillation process moves forward, water evaporation causes the water level to drop. Water needs to be replenished in the heating chamber in a continuous operation. The suction pump, which is shown in Figure 8, is operating following the level indication to fully satisfy that demand. Various types of water pumps exist based on the supply voltage and pumping technique. A 12-volt DC motor water pump was utilized for this arrangement. This water pump is powered by an electromotor located inside the waterproof container. When voltage is connected, the immersed pump's spinning component begins to rotate, sucking water from the pump's front side and draining it via a tube above. When the hose is attached to the tube and directed in the desired direction, the pump can discharge 120 liters per hour. This pump has a permanent magnetic rotor and is brushless. If so, there is no need for maintenance on this pump. These 12-volt pumps usually use centrifugal force generated by a fast-rotating impeller to raise, move, or circulate liquids such as water, oil, and coolant for sprayers, automobiles, fountains, showers, gardens, etc. 12V DC water pumps are tiny pumps that run on solar energy, DC power sources, or batteries.

All the controlling parts of this system are based on the Arduino board and the program code. Arduino is a platform that can be used to program according to requirements. When considering this system, all the sensor inputs are interconnected with the Arduino board. According to the requirements of the system, the Arduino code was written. Which considers the conditions given by the programmer and sends the signals to an actuator, like a pump. It provides data to the user by using display equipment. There are differences. Arduino is the most common and widely used for these kinds of applications. Arduino boards can be classified according to technology and size. For this system, an Arduino Uno board has been used.


Figure 8: Experimental Setup

Finally, all the components and parts were assembled as one product, which is shown in Figure 8. presents the circuit of the electrical components. This study builds on a preliminary investigation on solar water distillation conducted at the University of Ruhuna in 2022 [20]. The Experimental Setup shown in Figure 8 was developed, inspired by that foundational work.

Several tastings were conducted as part of this solar water distillation project to choose the best materials and techniques. The chosen material and methods were modified following the results. Increasing productivity and efficiency was the key objective of this project. These goals were taken into consideration during project design, with a primary focus on solar energy. The main objective was to capture more solar energy and use it with the least amount of loss.

RESULTS AND DISCUSSION

This process of solar water distillation included several trials to get the right combination of materials and techniques. The method and materials were altered after the results were obtained. Efficiency and productivity were the main objectives of this project to speed up manufacturing. These aims were involved in the conceptualization of the project, with solar energy being the focus. The most important objective was to catch and deliver as much solar energy to the customers as possible. Through different techniques, one solar collecting technology eventually gained acceptance.

The energy that comes from a distant source is collected by parabolic reflectors. Likewise, a parabolic reflector can convert an isotropic source into a parallel beam, as the laws of reflection can also be reversed. A Metal parabolic unit was the key element for selecting the instrument, and the correctly prepared reflective surface was another important factor to achieve the desired amount of reflection that influenced the thermal flow and the results. By way of the reflective surface preparation, the reflectors can be categorized as nickel-painted reflectors, glass mirror reflectors, polished metal reflectors, and aluminum foil reflectors. This project has used some of the above reflectors for a test. All the different types of reflectors produced different radiating heat at the same time, and similar environmental factors. Table 1 below explains briefly the results of these reflections.

Table 1: Maximum Temperatures obtained by different reflectors.

Image	Surface materials	Maximum temperature
	Nickel painted surface	58.9 °C
	Aluminum foil coated	79.8 °C
	Nickle foil sticked	115.8 °C

To put a summary in a few words of solar collector, and a reflector will be produced following the most appropriate technique, and the projection of solar light to the heating room will be found.

When the solar energy exits the chamber, the heat diminishes because of the absence of solar energy and the heat removal by the air. For this to be solved the evaporating chamber has a black sand layer filled because of its heat- storing ability.

Those implementations were useful for the system because the production rate of the system increased. As the experiment showed, the evaporated water gets out through the inner chamber while the condensate falls into the heating chamber. However, the steam should go out through the outer chamber, and the condensate falls on the outside of it in the initial design.

In the context of this problem, some methods of using steam as shown in Figure 11. Lastly, a cone-shaped reducer on the top of the heating chamber is placed, which has a cone cap to reflect the steam into the other chamber.

The trial-and-error approach is applied in the notable sampling of the wines and the watching of the outcomes caused by the changes in the design. Finally, all the upgrades that were made which are needed were made and the whole system implemented.

The system provided notched in production, and the recorded heat of the inner chamber is reflected in the attached Figure 12 below.

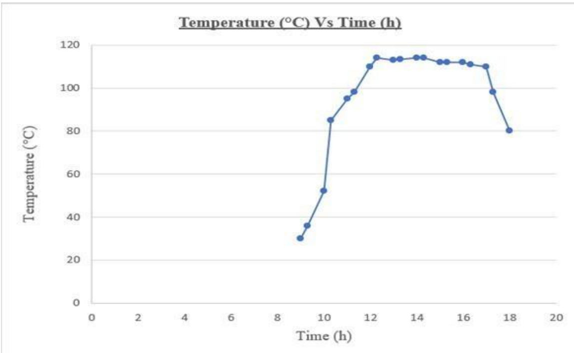

Figure 12: Recorded temperature variations

The following Figure 12 is the plotting of average non-collected within 14 days, and as a result, 02 L and 650 ml of output water were attained after 10 hours as on average, per day under cloudy and windy weather. A daily water intake of 3.7 L for adult men and 2.7 L for adult women meets the needs of most persons [21]. And finally, a few mineral drops were added as per the required amount to enhance the quality of drinking water.

The Center for Research of the National Water Board carried out a careful assessment of the distillate water outlet to see the difference between samples taken before and after distillation. Originating from the Kilinochchi district of the Northern Province, the water samples were meticulously evaluated against various parameters, including turbidity, total dissolved solids (TDS), and chloride levels.

Turbidity, a crucial indicator of water clarity, experienced a notable reduction through the distillation process. The initial turbidity level of 3.46 Nephelometric Turbidity Units (NTU) decreased to 2.12 NTU post-distillation, aligning closer to the acceptable standard of 1 NTU for drinking water. Moreover, the TDS content, ideally ranging between 100-150, was initially recorded at 217.14 TDS before distillation, subsequently decreasing to 198.23 TDS after the distillation process. Furthermore, the chloride concentration, a significant factor in water safety, exhibited a considerable decrease from 18 mg/L pre-distillation to 12 mg/L post-distillation. While the World Health Organization recommends a chloride level of 4 mg/L for drinking water, the achieved reduction signifies a noteworthy improvement in water quality.

Although the pH values of both samples remained within the standard range for potable water, the comprehensive distillation results demonstrate a marked enhancement in water quality. The system, utilizing a natural, sustainable process powered by renewable solar energy, has consistently yielded healthy and drinkable water outputs. Additionally, the cost-effective production method underscores the system's viability and potential for widespread implementation.

CONCLUSION

Although this general system of distillation is efficient, more purified water can still be produced. Thus, Further modification can lead this product into a high-level product. As discussed in previous chapters, the technology of collecting solar energy can be enhanced. Once the system can keep the temperature more than 100 Celsius continuously, the production rate can be increased. If the surface preparation is equal to that of a mirror there will be some reflection, but it will be improved as the one currently using the reflector gets a temperature around 100 °C. Hence, solar power extract can be improved to 100 %. While the contemplation of the solar reflector design changed by its shape. If the solar reflector is to be made feasible to use, then it should have a solar tracking system alongside it as well. If the solar redirector can change its reflection direction according to the deflection of the sun it can collect more energy when the sun is low.

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