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Belgaum, Karnataka-590 018

A Project Report on

"DESOLENATOR: A Clean Technology Venture for Water Purification"

Project Report submitted in partial fulfillment of the requirement for the award of the degree of

Bachelor of Engineering
In
Electrical & Electronics Engineering

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Certificate

Certified that the project work entitled **"DESOLENATOR: A Clean Technology Venture for Water Purification"** carried out by Ms.Prathibha N S (1CR16EE053), 2016; Ms. Sangeetha S (1CR16EE068), 2016; Mr.Sai Prakash R (1CR16EE094), 2016 are bonafied students of CMR Institute of Technology, Bengaluru, in partial fulfillment for the award of Bachelor of Engineering in Electrical & Electronics Engineering of the Visvesvaraya Technological University, Belgaum, during the year 2019-2020. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the Report deposited in the departmental library.

The project report has been approved as it satisfies the academic requirements in respect of Project work prescribed for the said Degree.

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DECLARATION

We, [Ms.**Prathibha N S (1CR16EE053),** Ms. **Sangeetha S (1CR16EE068),** Mr.**Sai Prakash R (1CR16EE094)**], hereby declare that the report entitled **"DESOLENATOR: A Clean Technology Venture for Water Purification"** has been carried out by us under the guidance of Ms. **Priyanka Priyadarshini Padhi ,** Assistant Professor, Department of Electrical & Electronics Engineering, CMR Institute of Technology, Bengaluru, in partial fulfillment of the requirement for the degree of **BACHELOR OF ENGINEERING in ELECTRICAL & ELECTRONICS ENGINEERING**, of Visveswaraya Technological University, Belgaum during the academic year 2019-20. The work done in this report is original and it has not been submitted for any other degree in any university.

Place: Bengaluru
Date: 30/05/20

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Abstract

The lack of clean drinking water is a problem that plagues many areas of the world today. Approximately 884 million people suffer each day from insufficient quantities of clean, drinkable water. Most of the current technologies available to combat this problem are expensive and consume too much power to be effective in rural regions of the planet. The solutions that do not consume an excess of power generally require expensive and time consuming filter maintenance. The use of chemical processing mechanisms of purification is an affordable solution, but it has been known to be hazardous if used improperly. With the idea of low cost and sustainability in mind, we plan to develop a water filtration system that will take advantage of natural energy in order to power a water purification system.

Water will enter the system, where it will flow through a sediment filter and then be processed by a UV purifier. By using both standard sediment filtration and ultraviolet radiation purification techniques, our goal is to produce water with a total concentration of less than 0.01% Coliform bacteria. In order to save on energy and cut costs, water will enter the system manually and use gravity to pull it through the system, eliminating the need for a pump. We plan to use photovoltaic technology to transform sun rays into electric potential that will be stored in a battery backup system. This battery system will power the ultraviolet purification process of the system.

Acknowledgement

The satisfaction and euphoria that accompany the successful completion of any task would be incomplete without the mention of people, who are responsible for the completion of the project and who made it possible, because success is outcome of hard work and perseverance, but steadfast of all is encouraging guidance. So with gratitude we acknowledge all those whose guidance and encouragement served us to motivate towards the success of the project work.

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LIST OF ABBREVATIONS

CSMCRI - Central Salt and Marine and Chemical Research Institute

IUPAC - International Union of Pure and Applied Chemistry

UV - Ultraviolet

SUVA - Specific Ultra Violet light Absorbance

DNA - Deoxyribonucleic Acid

WHO - World Health Organization

HTF – Heat Transfer Fluid

PWM - Pulse Width Modulation

CHAPTER 1

INTRODUCTION

Scarcity of water and quality of water have long been a concern for many people in the world. Population is increasing on an exponential scale which leads to a greater need for water reserves. Also with the large population increase there is more pollution emitted into the environment contaminating many streams, lakes, and rivers. Contaminated water can carry different types of waterborne diseases. Drinking from untreated water can cause illness which leads to extreme pain or even death. Even water sources that are away from densely populated areas can carry pathogens detrimental to human health. There are many areas in the world that need a solution to make their polluted water potable. These areas are located in the Figure 1. Even areas that currently do not need a way to provide safe drinking water may need it in the future with the rapid increase of pollution and scarcity of water.

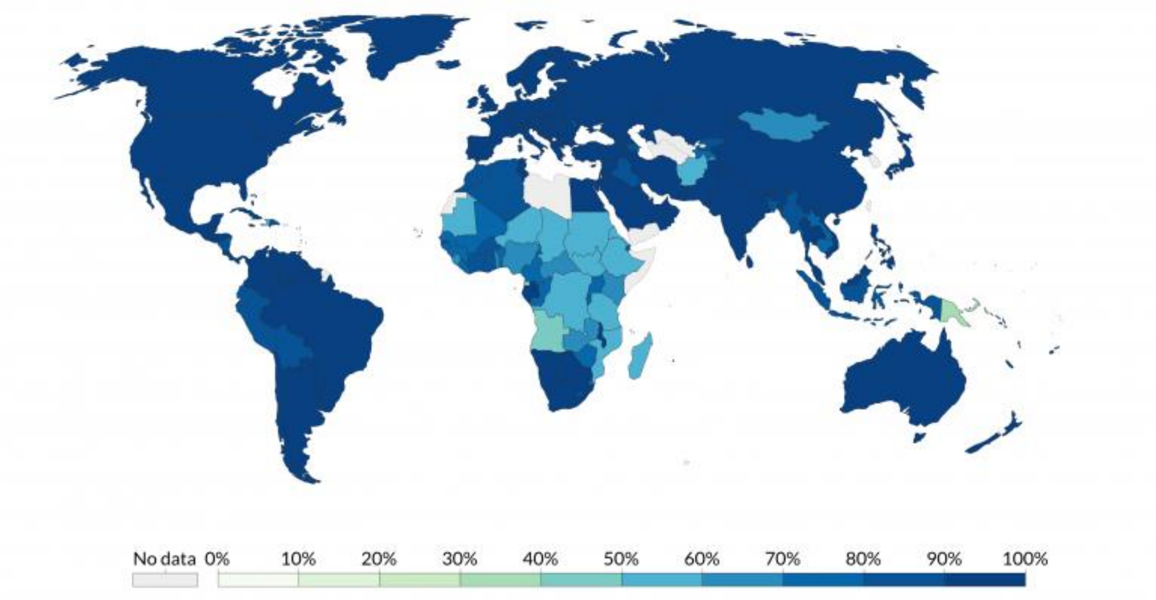

Figure 1: Countries without safe drinking water (Global Education Project, 2015).

Personal water purification systems allow families to provide themselves with a sufficient amount of safe drinking water that the body requires on a daily basis. It is very difficult and there are very high costs associated with completely repairing a natural reservoir even though it is a better for the environment. People need a quick solution to this problem while waiting for a more permanent fix. With a purification system, water sources that are normally too dangerous for consumption can now become useful. A personal system that is affordable for anyone can decrease the amount of preventable illnesses and deaths across the globe.

The goal of this project is to design a dependable way to purify water in locations that are off the grid and don't have constant sources of clean water. The design also needs to be able to be built on a low budget considering that most of the places that don't provide potable water to its citizens are frequently in the poor regions of the world. Understanding what kind of bacteria and viruses are present in water sources and how they can be eliminated will help with the selection of what type of system will be used. Finding a way to power the system without the use of a grid will allow the system to be used anywhere. Designing a water purification system for use in areas where water is contaminated and scarce will be an interesting challenge these days.

1.1. BRIEF BACKGROUND OF THE RESEARCH

The Institute of Medicine panel (part of the National Academy of Sciences) suggests that the average human consumes roughly eight cups of water per day to maintain a healthy lifestyle. To citizens of the United States, this doesn’t seem difficult to accomplish because running water is widely available. The abundance of fresh flowing water is common in developed nations, but is a privilege rarely experienced by those in the developing world. In fact, the shortage of water is a growing concern in many parts of the world, especially in developing or impoverished countries. It is ironic that such an issue could exist when over 75% of the Earth’s surface is covered by water. However, a vast majority of that water is ocean water, which has a salinity level that is too high for human consumption. Through proper water purification, the ocean can be a promising source of water, which could adequately provide for this growing need.

Currently, large investments are necessary for efficient, large-scale desalination systems which developing countries do not have. Unfortunately, these are the countries with the greatest need for fresh drinking water, as many of their current water sources are contaminated or insufficient in supply. As a result, 1.8 million people die from waterborne diseases every year. Purifying water is a crucial process for drinking safety and requires not only removal of inorganic material but also bacterial treatment. To address this problem, there are numerous ongoing efforts to provide fresh water for impoverished communities. In Africa, many of these projects involve drilling wells to tap into the groundwater. However, groundwater in Africa is limited and these wells must be dug deeper as the resource becomes depleted over time. Therefore, alternative sources such as ocean water can supplement the substantial clean water demand and alleviate the reliance on groundwater.

A solar water purification system removes the salt from ocean water, transforming it into potable water through one of many purification processes. Distilling, or boiling the dirty or salty water to produce clean vapor that is then condensed back to water, is perhaps the simplest technique. The process requires boiling salt water at temperatures over 100 °C, a temperature at which bacteria is killed. Therefore, it is worthwhile to pursue an efficient yet low-cost solar water purification system that will increase the potential for widespread application for water purification. A solar water purification system can work in conjunction with the tapped wells to help alleviate hardships felt by the lack of clean water, not only in developing nations, but also in countries around the world.

1.2. OBJECTIVES OF THE THESIS

The major objective of the team's Solar-Powered Water Purification System is to produce clean, drinkable water using a simplified system that powered solely by the sun. To become a marketable, worldwide product, the system must be portable and durable enough to transport through all terrains and conditions over long periods of time. In addition, it should be inexpensive and user-friendly. Finally, for ease of shipping and transportation, the system should be able to fit in a standard shipping container.

The combination of the system design constraints and objectives provide a strong base for the system to build upon in order to provide developing communities with clean drinking water. This system will contribute to the overall health and quality of life of those who lack clean drinking water resources.

CHAPTER 2

LITERATURE REVIEW

Solar water Purification has been used in many countries for various applications since many centuries. As early as in the fourth century B.C., Aristotle described a method to evaporate impure water and then condense it for potable use. The historical solar water Purification apparatus and it is exposed to the intense heat of the solar rays to evaporate water and collect the condensate into vessel placed underneath as reported by Nebbia and Menozzi.

A Swedish engineer, C.Wilson, was the first who designed conventional solar still for supplying fresh water to nitrate mining community in Chile, which become quite popular and was in operation for more than 40 years. During the 1950s, interest in solar water Purification was revived and in virtually all cases, the objective was to develop large centralized distillation plants. In California, the goal was to develop plants capable of producing 3,775 cubic metres of water per day. However, after about 10 years, researchers stated that large solar water Purification plants were too expensive to compete with fuel fired ones. Therefore, research is now shifted to smaller solar water Purification plants. In 1970, 38 plants were built in 14 countries, with capacities ranging from a few hundred litres to around 30,000 litres of water per day reported by Garzia-Rodriguez.

In India, the first largest solar distillation plant was installed by Central Salt and Marine Chemical Research Institute (CSMCRI), Bhavnagar with basin area of 350 m2 and production of 1000 litres per day to supply drinking water in Awania village. Awania is a non-electrified village, 12 km from Bhavnagar with a population around 1400. Natu et al. gave their operation experiences at Awania village water Purification plant. The villagers took some time to understand the difference between the quality of water produced by solar water Purification plant and water from well after that they started using plant water regularly. In many coastal areas where sea water is abundant but potable water is not available.

Solar water Purification is one of the many processes that can be used for purification as well as distillation. Solar still is the widely used solar water Purification device. A simple solar still can easily produce the water needed for drinking and cooking for households without access to potable water. Also distilled water can be used for industrial purpose as it is cleaner, reported by Abdul Jabbar N. Khalifa and Ahmad M. Hamood.

CHAPTER 3

PROPOSED MODEL WITH THEORETICAL BACKGROUND

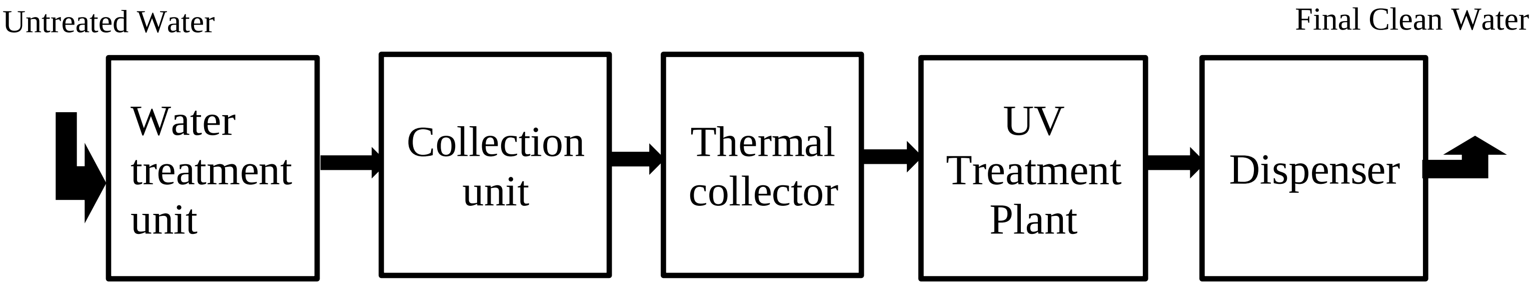

Figure 2: Model of a Solar Water Purification System

WATER TREATMENT UNIT

In the water treatment unit the process of flocculation and chlorination takes place.

Flocculation:

According to the IUPAC definition, flocculation is "a process of contact and adhesion whereby the particles of a dispersion form larger-size clusters". Flocculation is synonymous with agglomeration and coagulation or coalescence.

Chlorination:

Water chlorination is the process of adding chlorine or chlorine compounds such as sodium hypochlorite to water. This method is used to kill certain bacteria and other microbes.

COLLECTION UNIT

It is the compartment for collection of clean water.

7

THERMAL COLLECTOR

A solar thermal collector collects heat by absorbing sunlight. The term "solar collector" commonly refers to a device for solar hot water heating, but may refer to large power generating installations such as solar parabolic troughs and solar towers or non-water heating devices such as solar air heaters.

Solar thermal collectors are either non-concentrating or concentrating. In non-concentrating collectors, the aperture area (i.e., the area that receives the solar radiation) is roughly the same as the absorber area (i.e., the area absorbing the radiation). This type has no extra parts except the collector itself. Concentrating collectors have a much bigger aperture than absorber area (additional mirrors focus sunlight on the absorber) and only harvest the direct component of sunlight.

Non-concentrating collectors are typically used in residential and commercial buildings for space heating, while concentrating collectors in concentrated solar power plants generate electricity by heating a heat-transfer fluid to drive a turbine connected to an electrical generator.

UV TREATMENT PLANT

Ultraviolet light as a method of disinfection is to some extent effective against the chlorine resistant protozoa Giardia and Cryptosporidium. These organisms are only removed effectively by optimised sand filtration or inactivation by UV light. An effluence of at least 40 mg/cm2 is required to achieve a 3-log inactivation of the protozoa under optimal conditions. The required dose is affected by the amount of UV light that may be absorbed by impurities in the water such as suspended matter and dissolved organic compounds. In terms of suspended matter, it follows that the higher the turbidity of the water the higher the UV dose required.

The relative effect of the dissolved organic matter is expressed as the Specific Ultra Violet light Absorbance (SUVA), which is the relationship between the amounts of UV light absorbed at 254 nm/cm and the dissolved organic carbon concentration (DOC mg/l).

DISPENSER

The final clean water after different chemical process is obtained thereby removing bacteria and other harmful entities from water.

CHAPTER 4

DESIGN PROCESS

4.1. FLOCCULATION

Dissolved and suspended particles are present in most of natural waters. These suspended materials mostly arise from land erosion, the dissolution of minerals and the decay of vegetation and from several domestic and industrial waste discharges. Such material may include suspended, dissolved organic and/or inorganic matter, as well as several biological organisms, such as bacteria, algae or viruses. This material has to be removed, as it causes deterioration of water quality by reducing the clarity (e.g. causing turbidity or colour), and eventually carrying pathogenic organisms or toxic compounds, adsorbed on their surfaces.

To separate the dissolved and suspended particles from the water coagulation and flocculation processes are used. Coagulation and flocculation is relatively simple and cost-effective, provided that chemicals are available and dosage is adapted to the water composition. Regardless of the nature of the treated water and the overall applied treatment scheme, coagulation-flocculation is usually included, either as pre-treatment (e.g. before rapid sand filtration) or as post-treatment step after sedimentation (see also centralized water purification plants).

Most solids suspended in water possess a negative charge; they consequently repel each other. This repulsion prevents the particles from agglomerating, causing them to remain in suspension. Coagulation and flocculation occur in successive steps intended to overcome the forces stabilizing the suspended particles, allowing particle collision and growth of flocs, which then can be settled and removed (by sedimentation) or filtered out of the water. Coagulation-Flocculation is also a common process to treat industrial and domestic wastewater in order to remove suspended particles from the water.

Flocculation follows coagulation (and is often regarded as part of one process: coagulation-flocculation). The objective of flocculation is to cause the individual destabilized colloidal particles to collide with one another and with the precipitate formed by the coagulant in order to form aggregates that could easily be removed by means of sedimentation or flotation. Flocculation involves the stirring of water to which a coagulant has been added at a slow rate, causing the individual particles to "collide".

Flocculation is considered to be part of coagulation, although some handbooks treat it as a separate process. Flocculation can take place in different types of equipment. A simple mechanical stirrer can be used for flocculation or a specially designed channel with baffles to create the desired flow conditions can also be used to flocculate the particles in water. The basis of the design of a flocculation channel is that the flow velocity of the water has to be reduced from a high initial value to a much lower value to enable large, strong aggregates to form. If the flow velocity is too high the aggregates may break up again, causing settling of the broken flocs to be incomplete.

Chemical compound: aluminum sulphate (Alum, $Al_2\ (SO_4)3.\ 18\ H_2O$)

This indicates that the 18 molecules of water are attached to the $Al_2\ (SO_4)3$ but do not participate in the chemical reaction. The water molecules must, however, be taken into account when a solution of $Al_2\ (SO_4)3$ with a specific concentration is prepared.

$Al2\ (SO_4)3.\ 18\ H_2O + 3Ca\ (HCO_3)2 \rightarrow 2Al\ (OH)_3 + 3CaSO_4 + 6CO2 + 18\ H_2O$

4.2. CHLORINATION

Disinfection is the final safeguard against water-borne microbial disease, the application of disinfectants is of utmost importance as it also is the last point at which the water quality can be affected. It is essential that disinfectants and their dosage rates are selected such that the chemical demand of the water is satisfied and the desired residual after initial contact is achieved and maintained throughout the distribution system up to the consumer. Regular monitoring of disinfectant residuals at the purification plant and throughout the distribution system, in parallel with microbiological examination, is essential to evaluate and control the disinfection process.

In addition to the destruction of pathogens, a further advantage of disinfection is that the general microbiological quality of the water is also improved. This helps to maintain the water quality in long distribution lines and reticulation systems.

Chemical reactions of chlorine, sodium hypochlorite and calcium hypochlorite in water and implications for disinfection.

When gaseous chlorine is added to water the following reaction takes place to yield hypochlorous acid (HOCl) and hydrochloric acid (HCl).

$Cl2 + H20 = HOCl + HCl$

The HOCl dissociates according to the following reaction to form the hydrogen and hypochlorite ions. This reaction is pH and temperature dependent and has a significant effect on disinfection efficiency.

$HOCl = H+ + OCl-$

Sodium and calcium hypochlorite react in a similar way in water according to the following reactions:

$NaOCl + H2O = HOCl + NaOH$ $Ca (OCl) 2 + 2H2O = HOCl + Ca (OH) 2$

When hypochlorous acid is present in water that contains insignificant quantities of total Kjeldahl nitrogen (TKN), organic material or other chlorine-consuming substances, a rapid equilibrium is established amongst the chlorine species (HOCl + OCl- + H+) in the solution as indicated by the reactions above. In such circumstances, if the chlorine is not consumed in any other way, the chlorine concentration in the water will increase proportionately with the amount added.

The term free available chlorine is used to refer to the sum of the concentrations of molecular chlorine (Cl2), hypochlorous acid (HOCl) and hypochlorite ion (OCl-) present, each expressed as free available chlorine.

Because of its specific properties, hypochlorous acid is the most active and strongest bactericidal species of the available chlorine compounds. As a bactericide it is approximately eighty times more effective than the hypochlorite ion. It would therefore be desirable to have the highest proportion of the free available chlorine in that form.

4.3. THERMAL TREATMENT STORAGE

A solar vacuum tube collector works by transferring the heat energy from the sun to a copper heat pipe located inside the vacuum tube. This copper heat pipe contains a small amount of distilled water inside the tube. The tube is created like the glass evacuated tubes under a vacuum condition. This vacuum is the key to the solar water heater. It is seen that at sea level water boils at 100°C. However, as you reduce the pressure the boiling point of water changes. In fact, water boils at the top of Mount Everest at only 35°C. This is because there is less pressure. Because the water inside the copper heat pipe is in a vacuum (reduced pressure) it boils at a much lower temperature of only 30°C.

The boiling water creates steam vapour that rises to the top of the heat pipe into the expansion bulb. This bulb is inserted into a copper heat exchanger and the hot steam loses its temperature and pressure and turns back to water. This cycle is continuous and involves no moving parts.

Product Details:

Usage/Application	**Solar Heater**
Material	Evacuated Glass **Tube** with copper heat **pipe**
Tube Size	58mm x 1800mm / 58mm x 2100mm
Thickness of absorbance **pipe**	0.7 mm
Diameter of **pipe** condenser	14 mm

Figure 3: Product details of a solar vacuum tube collector

4.4. UV TREATMENT UNIT

Ultraviolet water purification is the most effective method for disinfecting bacteria from the water. Ultraviolet (UV) rays penetrate harmful pathogens in your home's water and destroy illness-causing microorganisms by attacking their genetic core (DNA). This is extremely efficient in eliminating their ability to reproduce. Disinfecting your water with Ultraviolet light is exceptionably simple, effective and environmentally safe. UV systems destroy 99.99% of harmful microorganisms without adding chemicals or changing your water's taste or odour.

UV water purification is usually used with other forms of filtration such as reverse osmosis systems or carbon block filters.

UV systems are an effective means of water disinfection for residential point of entry use to help disinfect the entire home. UV systems are highly recommended to homeowners who may suspect any E.coli, cryptosporidium, giardia or any other types of bacteria and viruses in the water. It is not advised to use chlorine or other chemicals to disinfect water like private well owners, because of the toxic byproducts they create. It is important to avoid drinking any water that is potentially contaminated from bacteria to protect yourself from any water-borne bacterial diseases.

CHAPTER 5

ENGINEERING STANDARDS AND REALISTICS CONSTRAINTS

5.1. SOCIETAL INFLUENCE

The Solar-Powered Water Purification System has widespread implications on the wellbeing of society through the vast improvement of public health in various portions of the world. The system utilizes a comprehensive distillation process, by which the dirtied water is shed of both its organic and inorganic contaminants. The World Health Organization (WHO) estimates that 4.1% of the total global burden of disease can be attributed to waterborne diseases, leading to an average of 1.8 million deaths per year. 88% of these deaths can be directly attributed to waterborne diseases, due specifically to poor water sanitation and hygiene practices.

The most prominent illness comes in the form of diarrheal disease, which accelerates dehydration in areas that already lack an adequate supply of clean water. This form of illness is the result of protozoal infections such as: Amoebiasis, Cryptosporidiosis, and Giardiasis, which have a strong presence in untreated water. Similarly, a number of familiar types of bacterial infection like, E. coli, Dysentery, Leptospirosis, and Typhoid fever, are all attributed to the consumption of unsafe water. A number of more serious illnesses, such as the parasitic Guinea Worm, Hepatitis A, and Polio, can be contracted from untreated water and very commonly lead to death. The Solar-Powered Water Purification System deals with these organic contaminants through the use of high-temperature water pasteurization.

The goal of pasteurization is different from sterilization. Instead of focusing on the complete degradation of all contaminants, pasteurization aims to reduce the number of viable contaminants to a level where they are unable to cause sickness.

In the milk industry, it is common practice to heat milk up to 71°C for a duration of 15 seconds, resulting in a 99.999% reduction in harmful microorganisms, with an overall effectiveness of around 90% in the elimination of harmful bacteria within milk. The Solar-Powered Water Purification System progressively heats unpurified water up throughout the day to temperatures in excess of 100°C, while the water itself is sustained at temperatures above 71°C for anywhere from 45-90 minutes. This vastly exceeds the accepted pasteurization procedures carried out in the milk industry. However, just the removal of microbial infection is not enough to adequately purify water.

Untreated water is also subject to a number of inorganic contaminants, which can cause a wide variety of unwanted illnesses, making the water undrinkable. These contaminants include: salt, silt, lead, nitrate, and volatile organic compounds. The distillation process serves to 54 separate any inorganic compounds with a higher boiling point than dihydrogen oxide exclusively through its evaporation and recollection. The once dissolved heavy metals and nitrates are left behind in solid form, where they can be safely disposed of. In addition, highly volatile and dangerous organic compounds, including a number of pesticides and herbicides, are quickly vaporized; and, thus, removed from the water in the early stages of the distillation process.

The system is aimed at providing an average of 30 L of water per day resulting in a cost of $0.046 per liter of water. However, the system is not limited to a 30 L production and can be scaled to accommodate any communal water requirement. Similarly, the cost of producing clean water is 50% lower than the average $2.00 fee for an 18.9 L jug of chlorine treated water. The low price and high level of self-sustainability create an attractive option for communities in need of a medium to large scale method of purifying water, and ultimately makes the acquisition of clean water more accessible to everyone. By providing a self-sufficient, comprehensive, and scalable solution to the world's shortage of clean water, the quality of life for many people around the world can immediately be improved with only a minor financial investment.

5.2. ENVIRONMENTAL IMPACT

Water distillation requires a large quantity of energy to take place. This energy can be supplied from a variety of sources, such as electricity and fossil fuels. However, burning fossil fuels result in large quantities of carbon dioxide emissions to the atmosphere. To minimize the environmental impact of the water distillation system, solar energy, a renewable clean source of energy, was used.

In addition to having no carbon dioxide emissions, the Solar-Powered Water Purification System produces very little noise. The loudest component in the system is the HTF pump. By controlling its speed using PWM and variable frequency, both the duty cycle and noise are lowered. By producing a system that uses only the energy captured from the sun to power its components and to distill water, carbon dioxide emissions will be minimized. In addition, no power lines will be needed to operate the low-noise system.

5.3. SUSTAINABILITY IMPACT

The Solar-Powered Water Purification System is designed with sustainability as one of its main design requirements. The operation of the system has been designed to be based solely on energy provided from the sun; thus, the entire heating process of the water, circulation of the vapor and HTF of the system, and the positional tracking of the solar collectors is done without the need for external electric or fuel sources. This results in the system having zero emissions, and relatively minor amounts of by-products. These by-products would generally be limited to salt cakes that form in the boiler after extended periods of distillation. However, these salt cakes could potentially be used or sold as salt licks for livestock, or even used as a means for nutrition and food preservation.

5.4. ECONOMIC IMPACT

When designing the Solar-Powered Water Purification System, it is aimed to sell the product to non-profit organizations (for use in developing nations near coastal regions) and to disaster relief agencies. Due to the limited funds of these groups, the system had to be retailed at a competitive price. Solar parabolic troughs were employed over the

Previous Mazdon solar collectors due to two main reasons. First, one Mazdon solar collector with 20 tubes costs approximately $2,650. On the other hand, each solar parabolic trough costs about $300. Therefore, more energy can be achieved for a lower cost by employing solar parabolic troughs. The second reason solar collectors are more desirous is that they are able to achieve temperatures above 100°C; therefore, the pressure within the boiler does not have to be lowered (as is the case with the Mazdon solar collectors).

Overall, the cost to produce the system is $3,000, and it would be retailed at $5,000. This price is attractive for agencies with limited funding. Additionally, more solar collectors can easily be added to yield higher water production levels. Since the cost of each collector is only $300, the productivity can be scaled easily and for a small additional cost. The Solar-Powered Water Purification System will require the buyer to pay an initial upfront cost; however, the cost will more than pay for itself over the system's lifespan. In addition, the system is competitive with current products on the market, with the advantage that it does not require maintenance like the other products.

5.5. HEALTH AND SAFETY IMPACT

The Solar-Powered Water Purification System poses many safety and health risks since it reaches very high temperatures and produces its own electricity. Many of the surfaces on the system are at temperatures that sometimes exceed 100°C. These surfaces include the HTF circulation piping and the boiler. To improve system efficiency, these hot surfaces are insulated to prevent heat loss. The insulation doubles as a safety buffer, preventing these surfaces from being touched by its users. Similarly, the envelopes placed over each of the parabolic trough collector tubes insulate the system while preventing users from touching its surface.

The system uses a 12 V, 120-W PV panel to produce electricity for component operation. To prevent overcharging of the battery, a solar charge controller is used. Severely overcharged batteries can explode, leaving its surroundings covered in battery acid. The charge controller shuts off current flow to the battery when its maximum capacity has been reached.

To protect users from potential electrical shock, the system must be properly grounded, using the grounding rod. The electrical components are all housed in insulated, weatherproof boxes, and the wires are run through conduit to minimize exposed wire. In addition, proper selection of materials and components will prevent electrical components from overheating and causing potential burn hazards.

CHAPTER 6

CONCLUSIONS

According to a World Bank report, 80% of communicable diseases in India are water related and with a population of 1.17 billion, only 15% have access to water fit for consumption purposes. Also, ground water sources have been over-exploited, which has caused the levels of mineral contaminants to increase dramatically. For example, in places such as Rajasthan, Gujarat and Andhra Pradesh, the population is consuming water that has high fluoride content which in turn will lead to increasing health risks such as mass poisoning.

The Desolenator is designed to purify 8 to 10 liters of water during 8 hours on a sunny day using only solar energy. It uses boiling and distillation to purify water for the purpose for drinking. It is designed to cater to the needs of people in villages and towns where there is a shortage of clean drinking water. The unique features which make it different from the other purifiers are its simplicity in design and its low cost of manufacturing.

The Desolenator is easy to construct and assemble locally. Most of the components are locally available and requires minimal technical assistance to assemble. It is open to modifications and adjustments according to one’s needs and requirements. Furthermore it is fully independent from any system and only requires solar energy. The design can be multiplied to meet the demands for communities and villages in remote areas.

As almost 30% of rural India has no access to safe drinking water, consistent electricity source or even the financial means to afford the relatively expensive modes of water purifying products. Therefore providing them with solar water purifiers, which makes use of solar photo voltaic systems would be a step in the right direction as an access to clean, safe, consumable water. There is an untapped opportunity in the rural areas but it is definitely an effort for the long haul.

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