Fabrication of Hot and Cold-Water Dispenser by Using Solar Energy

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Abstract: **The main objective of the project is to fabracte the hot and cold-water dispenser by using solar energy. Water dispenser faciletes easily supply of drinking water it is very useful equipment and can supply cold, moderate and hot water. Water dispensers play a virtal role in work places are Restaurants, hospitals, and public places for sharing clean drinking water it will be run by solar energy with the help of solar panels. the Results of a cold-hot water dispenser with a thermoelectric module system (TMS) are presented. The cold-hot water dispenser with thermoelectric module system consists of a cold-water loop, a hot water loop, a coolant loop, and a thermoelectric module. The thermoelectric cooling and heating modules consist of four and two water blocks, nine and three thermoelectric plates, respectively.**

I.INTRODUCTION

- In the past, solar energy has been used in many applications. Early usage of the sun was used in heating, worming up, and drying. The sun was a good source to build fires and produce energy. In the past two decades, many scientists and engineers have utilized solar energy. With more advancement in its technology, solar energy has emerged drastically. Increasing cost of oil production made it more cost effective to produce power via solar cells. Electric water coolers are scattered all over Saudi Arabia. As individuals, companies, and government agencies have placed these water coolers to overcome the hot and harsh environment in the country in order to help individuals. The existing water coolers are sophisticated and waste a lot of needed energies. As the modern water coolers uses a compressor to cool down the water temperatures. Figure 1 shows a picture of one existing water cooler. The design of pottery cooling system of the cooling water will appear by controlling the airflow in measurable space that will increase the efficiency of cooling the water inside the pottery. Solar powered drinking water cooler principle is explained in the present article. The system contains solar panels, two low energy fans, water tank fabricated from clay (pottery), thermally sealed box, and pipes. Once these contents are connected together, testing was conducted on water temperatures at both ends. The preliminary results showed a drop in temperature of around 17˚C. This is achieved by utilizing free power from the sun. Furthermore, use of solar cooling as potential option for driving evaporative cooler for cooling necessitated the exploitation of alternative cooling technologies.

II. LITERATURE REVIEW

Chaouki ghenai et.al.,[1] This journal tells about drinkable water production and system energy consumption.To address the problem of freshwater scarcity, this study examines the potential of atmospheric water generation(AWG). Filters made of minerals remove impurities from the water produced by the AWG process, which extracts moisture from the air and transforms it into drinking water. Water production can be decentralized, and water quality can be controlled even in remote areas thanks to AWG. Tests of an atmospheric water generator in hot and humid climates are the focus of this research. In an outdoor area, a water generator is installed, and its daily output is recorded for a year. Temperature and humidity are measured in both the ambient and exhaust air, as well as the energy consumed by the devices in the workspace. The results show that both air humidity and temperature have an impact on the water extraction rate. Water is generated at a maximum rate of 0.95 L/hr.alternative technologies such as desalination of seawater and at atmospheric water harvesting. Desalination of seawater is adopted widely to produce fresh water and reverse osmosis (RO) membrane technology is generally used that evolves as cost-effective in the last decade and consequently widely adopted.

Jahidul Haque Chaudhuri et.al.,[2] In this journal says about the study of existingdirect evaporative coolers (DEC) is modified in such a way that DEC consume lessamount of water and provide better cooling effect. In desert area, water consumptionby air cooler is a serious problem. Therefore, the present study addressed this issueand primary objective of the study is to minimize the consumption of water. For thispurpose, the property of the endothermic reaction is utilized. There are few salts thatproduce endothermic reaction if it is diluted in water. Those salt crystals absorb heat from the surrounding environment (water) and ultimately the temperature of theoverall solution gets reduced. This cold solution is then passed through honeycomb cooling pad, as a result more amount of air can be cooled using the same volume of water as compared to the traditional air-cooler. Ammonium Chloride (NH4Cl), Ammonium Nitrite (NH4NO3) salts satisfy the basic criteria for the endothermic reaction but NH4Cl will be more useful to use in the air-coolers, as Ammonium Nitrite is costlier and also hazardous. Mr.Shivam Singh et.al.,[3] In this we obserbed In our model we are using peltier effect so as to extract the heat from the water tank, thePeltier effect is a temperature difference created by applying a voltage between two electrodes connected to a sample of semiconductor material, any moving parts like compressor and condenser which consume more energy are absent here . Also the system do not require refrigerants instead peltier is used which directly extract the heat from the surrounding water and releases out to the heat sink. Now to provide the power to the peltier we are using the dual axis solar tracker . By harnessing the renewable energy i.e. sunlight we are charging our secondary battery . And the batteryis used so as to drive our solar tracker’s motor . There are LDR on the solar panel which are use to sense the intensity of light and sends these signals to arudino uno which helps to rotate the solar panel in two perpendicular plane according to the changing intensity of light during a day . The secondary battery in the model is used as to create potential drop between two peltier electrode which creates a temperature difference at the junction of module . Takao Morib et.al.,[4] This journal says about the Fabrication and characteristics .Organic thermoelectric (TE) materials capitalize on advantages such as low thermal conductivity, low-cost, eco- friendly, versatile processability, light-weight, mechanical flexibility, roll-to-roll production, which are advantageous for the development of portable and wearable self-powered electronics. On the negative side, the figure- of-merit of polymer TE materials is low,mainly owing to typical low electrical conductivity. Various efforts have been made to enhance the TE performance of organic TE materials, i.e. chemical ectrochemical doping, modification of molecular structure. And fabrication of polymer-based composites or blends, which is the simplest and most cost-effective method for modifying polymer properties. Solution-processed polymer/inor- ganic or organic hybrids pave the way for formulation of functional TE inks/paste which can be used to fabricate large scale cost-effective manufacturing of TE generators. Eugenio Aermac et.al.,[5] We observed in this journal are Any individual is basically moved to do a particular task when in need or when challenged by the environment.the study was conducted use of stock water dispenser.To enhance instruction for students in refrigeration and air conditioning Anyindividual is basically moved to do a particular task when in need or when challenged by the environment. The study is divided into three components namely acceptability, effectiveness and inferences. the study assessed the value and effectiveness of the innovative design of water dispenser in performing mechanical and electrical activities. Innovative design, construction and function were validated and results revealed that the design of water dispenser was Highly Acceptable implying that the design meets the required competency. Driven by the principle of Prosser & Quigley (1949) on environment habits, individuals are trained in school, equally similar with the industry. thus a innovative design is recommended to be utilized and duplicated for similar use. alculated by dividing the kWh consumption to the total amount of produced water. Kajal Pawar et.al.,[6]The purpose of research paper is to illustrate the implementation of automatic water dispenser system. The voice based water dispenser is the idea which will be helpful for old age home, hospitals, canteens and offices. The main aim of project is not only to make water hot and cold but also it work on voice command. This system works onthe primary input of user’s voice. Additionally this system includes temperaturesensor which display temperature and also control temperature. Water dispenser consisting of compressor, ARM processor, and evaporator were designed. It provide good result but heat pumps were added because of which temperature increasesduring winter season, thereby decline its effectiveness .Hot cold water dispenser with inbuilt inverter, consist of Peltier module, hot cold chamber, inbuilt inverter. This device work without compressor, condenser or evaporator but was not automated or based on voice command .Water dispenser system using coin consisting of components like IR sensor, microcontroller and water pumps. Automatic heating and cooling of water were absent . Voice command using raspberry pi which help to get best performance from system terms of space, time and complexity. This also provide way of using IOT. G.Venkata Subbaiah et.al.,[7].In this paper, we are observed experimental work was developed to produce thehot and cold water simultaneously along with them conditioned air is also obtained all the above stated conditions are obtained by using a one third horse power of thecompressor that means it is able to produce the hot and cold water along with conditioning air. Control of temperature, humidity, purity, and motion of air, in an enclosed space independent of outside conditions is called air conditioning. Refrigeration air conditioning equipment usually reduces the humidity of the air processed by the system. The called air conditioning. Refrigeration is the process ofremoving heat from an enclosed space, or from a substance and moving it to a placewhere it is un-objectionable. When the high-pressure refrigerant vapour enters the condenser heat flows from condenser to cooling medium thus allowing vaporized refrigerant to return to liquid state. Amali Gunasinghe et.al.,[8] This journal tells about the enables specific users to receive alerts and reminders of when to refill the dispenser. As well as for all the users who have access to the specific floor will get the notification regarding the consumption of water according to the temperature. This paper presents the sensor enabled smart water dispenser's initial results. We present the system architecture, methodologies and current system performance. A smart water dispenser integrated with two sensors along with the smartphone. One sensor for taking environmental temperature, that will analyze the temperature in the environment and then according to the read value from the sensor it generates a notification to the user how much water user needs to be consumed in that day. The second sensor is to measure weight. It will take the weight of the water bottle in the water dispenser. Even though there are few sensors available these days which we can attach inside thewater bottle, we chose this weight measuring sensor, because users will reluctant to use water if the sensor is inside the water bottle by thinking about health issues come through an electronic device. S.Wiriyasart et.al.,[9] The says about the Thermoelectric for cooling air flow in the different eliminate conditions and used for the heating and cooling system in the residential building , it has been used to cool down the temperature in refrigeration system by embedded with many channels heat sink. Heat sinks made of aluminium alloy are commonly used cooling systems to extract heat from the system and dump into the environment. Heat transfer depends on the material properties and contact area between two materials. ANOVA and TAGUCHI statistical methods are used to predict parameters that affect the heat transfer. Analysis of variance (ANOVA) is an analysis tool used in statistics that splits an observed aggregate variability foundinside a data set into two parts: systematic factors and random factors. The systematic factors have a statistical influence on the given data set, while the random factors do not. Taguchi developed his method for designing experiments to investigate how different process factors will affect the mean and variance of a process performance characteristic. In this they took some assumptions, and they are: The air-flow is incompressible, laminar, and steady and the fluid used in the model is considered to be Newtonian. Only heat transfer through conduction and convection is considered. However, heat transfer through radiation is neglected. Many inventions were made to control the water disparities in order to make the whole system automatic. The research result were flexible, proposed a web and cellular based monitoring service protocol to determine and sense water level globally. Here in this work the block diagram of the operations of the system of Automatic Water Dispenser is presented. It consists of the following major units: Sensors, Microcontrollers, Display Unit, TDS, and Water temperature. Samir M.Shariff et.al.,[10] This journal says about the Solar powered cold water dispenser apparatus is fabricated and experimental results are shown in this work. The system contains solar panels, two low energy fans, water tank fabricated from clay (pottery), thermally sealed box, and pipes. Once these contents are connected together, testing was conducted on water temperatures at both ends. The preliminary results showed a drop in temperature of around 15˚C. This is achieved by utilizing free power from the sun The design of pottery cooling system of the cooling water will appear by controlling the airflow in measurable space that will increase the efficiency of cooling the water inside the pottery. Early usage of the sun was used in heating, worming up, and drying. The sun was a good source to build fires and produce energy. In the past two decades, many scientists and engineers have utilized solar energy. With more advancement in its technology, solar energy has emerged drastically. Increasing cost of oil production made it more cost effective to produce power via solar cells.

III.METHODOLOGY

A hot and cold water dispenser that uses solar energy is a sustainable and eco-friendly way to provide clean, safe and accessible drinking water in homes, offices, and public spaces. The concept of this dispenser is based on the use of a solar panel and a battery storage system to generate and store electricity, which powers the dispenser. The solar panel captures the sun's energy and converts it into electrical energy, which is then stored in the battery. The stored energy can be used to power the hot and cold water dispenser. The dispenser is connected to the battery through an inverter, which converts the DC power from the battery to AC power for the dispenser. The water dispenser itself is designed to provide both hot and cold water, with separate heating and cooling systems. The water is stored in a tank that is connected to the dispenser. The plumbing and electrical connections are designed to ensure that the dispenser is powered entirely by solar energy. The use of a hot and cold water dispenser that uses solar energy has several benefits. Firstly, it is a sustainable and eco-friendly way to provide clean, safe, and accessible drinking water. Secondly, it reduces the carbon footprint by eliminating the need for electricity generated by non-renewable sources. Thirdly,

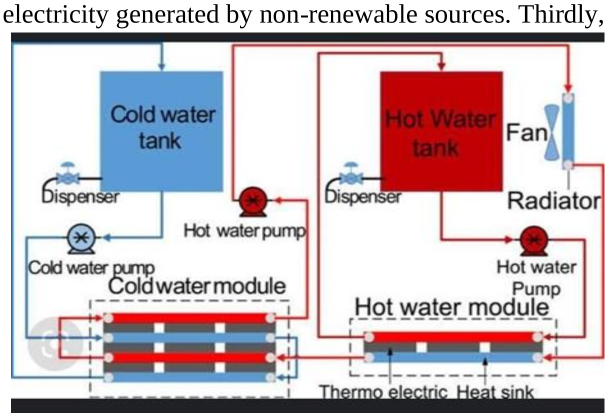


Fig. 3.1: Thermo Electric Module

it reduces the cost of electricity bills, which is especially beneficial for low-income households as shown in figure.3.1

SOLAR WATER DISPENSER:

The solar water dispenser is typically composed of a solar panel, battery, pump, filter, and a storage tank. The solar panel captures the sun's energy and converts it into electrical energy, which is stored in the battery. The pump is then powered by the battery to extract water from a nearby source such as a well, borehole or even a river. The water is then passed through a filter that removes any impurities and then stored in a tank that is connected to the dispenser. The solar water dispenser is especially useful in remote areas where access to clean drinking water is a challenge. It is also an eco-friendly and cost-effective alternative to traditional water dispensers, which require electricity generated from nonrenewable sources. Additionally, the solar water dispenser is portable and can be easily transported to areas where it is needed the most.

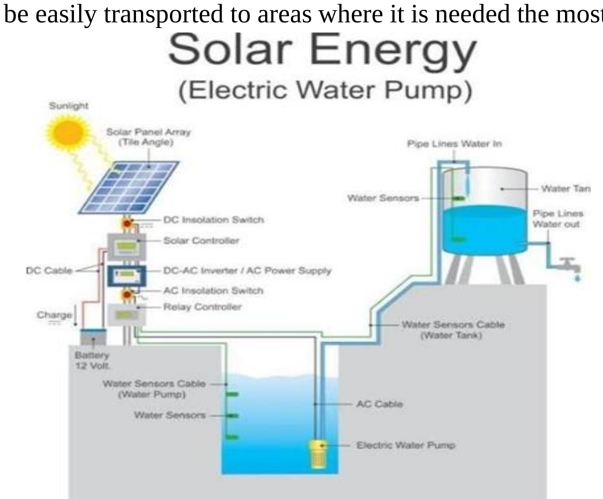


Fig. 3.2: Solar Water Dispenser

solar panels use the sun's power to create a flow of electricity. This is the most widely adopted method of harvesting solar energy todayas shown in fig 3.2.

IV.WORKING PRINCIPLE

Increasing awareness of global warming forces policy makers and industries to face two challenges: reducing greenhouse gas emissions and securing stable energy supply against ever–increasing world energy consumption, which is projected to increase by 71% from 2003 to 2030. In addressing these two issues simultaneously, renewable energies prove themselve attractive, as they are independent from the fossil fuel supply and do not contribute to greenhouse gas emissions. Along with the global warming impacts and climate changes, the demands for air conditioning and refrigeration have increased. Therefore, providing heating and cooling by utilizing renewable energy such as solar energy is a key solution to the energy and environmental issues.

Point of use water dispensers usually has the ability to cool and heat water by storing dispensers usually filters the wastewater in a tank and using electricity to warm or heat the water prior to dispensing it. Point of use water coming from the water line.

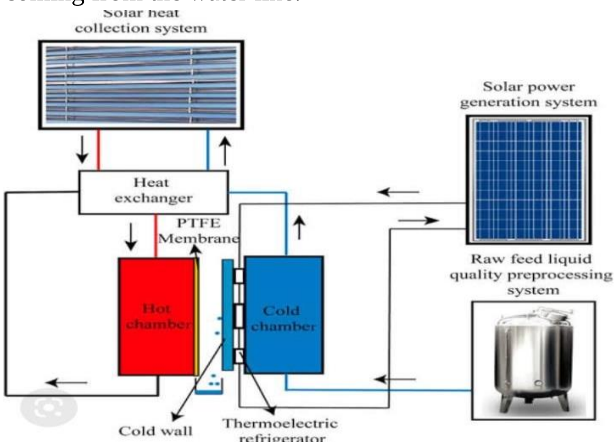


Fig. 4.1: solar power generation system

The Sun's rays fall on the collector panel (a component of solar water heating system). A black absorbing surface (absorber) inside the collectors absorbs solar radiation and transfers the heat energy to water flowing through it. Heated water is collected in a tank which is insulated to prevent heat loss.

The process that makes the refrigeration possible is the conversion of sunlight into DC electrical power, achieved by the PV panel. The DC electrical power drives the compressor to circulate refrigerant through a vapor compression refrigeration loop that extracts heat from an insulated enclosure as shown in figure 4.1.

V.FABRICATION

Pump **:**DC powered pumps use direct current from motor, battery, or solar power to move fluid in a variety of ways. Motorized pumps typically operate on 6, 12, 24, or 32 volts of DC power. Solar-powered DC pumps use photovoltaic (PV) panels with solar cells that produce direct current when exposed to sunlight.

Fig. 5.1: D.C pump

The main advantage of DC (direct current) pumps over AC (alternating current) pumps is that they can operate directly from a battery, making them more convenient and portable. They are easier to operate and control, since AC systems typically require a controller to manage speed. DC pumps also tend to be more efficient. However, AC pumps usually are designed for higher speeds and larger bursts of power. They also have a longer working lifespan than DC pumps as shown in figure 5.1.

Heat sink :

A heat sink (also commonly spelled heatsink[1]) is a passive heat exchanger that transfers the heat generated by an electronic or a mechanical device to a fluid medium, often air or a liquid coolant, where it is dissipated away from the device, thereby allowing regulation of the device's temperature. In computers, heat sinks are used to cool CPUs, GPUs, and some chipsets and RAM modules. Heat sinks are used with high-power semiconductor devices such as power transistors and optoelectronics such as lasers and light emitting diodes (LEDs), where the heat dissipation ability of the component itself is insufficient it.

Fig. 5.2: heat sink

A heat sink is designed to maximize its surface area in contact with the cooling medium surrounding it, such as the air. Air velocity, choice of material, protrusion design and surface treatment are factors that affect the performance of a heat sink. Heat sink attachment methods and thermal interface materials also affect the die temperature of the integrated circuit. Thermal adhesive or thermal paste improve the heat sink's performance by filling air gaps between the heat sink and the heat spreader on the device. A heat sink is usually made out of aluminium or copper as shown in figure 5.2.

Peltier aluminium water cooler **:**

Aluminum water cooling blocks in 40*40, 80*80, and 80*240mm sizes fit 1, 4, or 12 peltier coolers (Peltier chips not included). This allows you to design your own custom water cooled Peltier apparatus that uses four chips in one small, convenient package.

Fig. 5.3: Aluminium water cooler

Possibility of up to 800 watts cooling by using four TEC1-12715 chips. Or, daisy-chain four peltiers in series and connect to a 12 volt power supply so that each chip gets 4 volts, which will still get you down to almost freezing temperatures while creating much less heat and increasing peltier efficiency exponentially as shown figure 5.3.

Thermoelectric peltier cooler :

Thermoelectric coolers operate according to the Peltier effect. The effect creates a temperature difference by transferring heat between two electrical junctions. A voltage is applied across joined conductors to create an electric current. When the current flows through the junctions of the two conductors, heat is removed at one junction and cooling occurs. Heat is deposited at the other junction.

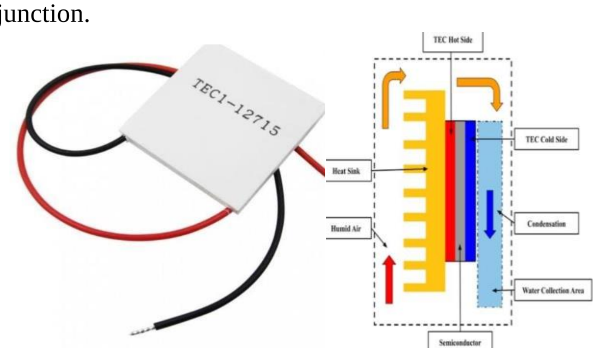


Fig. 5.4: Thermo electric module

The main application of the Peltier effect is cooling. However the Peltier effect can also be used for heating or control of temperature. In every case, a DC voltage is required.

Thermoelectric coolers from II-VI act as a solid-state heat pump. Each features an array of alternating n- and p- type semiconductors. The semiconductors of different type have complementary Peltier coefficients. The array of elements is soldered between two ceramic plates, electrically in series and thermally in parallel. Solid solutions of bismuth telluride, antimony telluride, and bismuth selenide are the preferred materials for Peltier effect devices because they provide the best performance from 180 to 400 K and can be made both n-type and p-type. The cooling effect of any unit using thermoelectric coolers is proportional to the number of coolers used. Typically multiple thermoelectric coolers are connected side by side and then placed between two metal plates. II-VI features three different types of thermoelectric coolers including: Thermocyclers, Single Stage, and Multi-Stage as shown figure 5.4.

Thermometer:

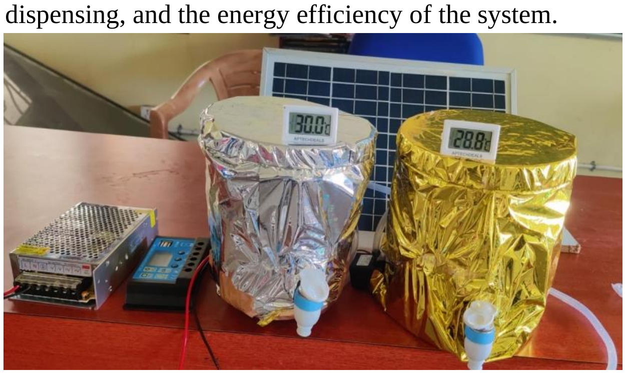
Fig. 5.5: Thermometer

The metric system of measurement also includes units of mass, such as kilograms, and units of length, such as kilometers. The metric system, including Celsius, is the official system of measurement for almost all countries in the world. Most scientific fields measure temperature using the Celsius scale. Zero degrees Celsius is the freezing point of water, and 100 degrees Celsius is the boiling point of water. Three nations do not use the Celsius scale. The United States, Burma, and Liberia use the Fahrenheit scale to measure temperature. However, even in these countries, scientists use the Celsius or kelvin scale to measure temperature. Water freezes at 32 degrees Fahrenheit and boils at 212 degrees Fahrenheit. The Kelvin scale is used by physicists and other scientists who need to record very precise temperatures. The kelvin scale is the only unit of measurement to include the temperature for "absolute zero," the total absence of any heat energy. This makes the kelvin scale essential to scientists who calculate the temperature of objects in the cold reaches of outer space. Water freezes at 273 kelvins, and boils at 373 kelvins as shown in figure 5.5.

VI.EXPERIMENTATION:

Experimenting with a hot and cold-water dispenser powered by solar energy is a great way to explore the potential of renewable energy sources. Here's how you can set up the experiment:

1.Gather materials: a solar panel, a battery, a water pump, a hot water tank, a cold-water tank, and a dispenser unit.
2.Assemble the solar panel and battery: Connect the solar panel to the battery, making sure the voltage and current ratings match. This will allow the panel to charge the battery when exposed to sunlight.
3.Connect the water pump: Connect the water pump to the hot and cold-water tanks. The pump will circulate water from the tanks to the dispenser unit.
4.Connect the dispenser unit: Connect the dispenser unit to the hot and cold-water tanks. This unit will control the flow of hot and cold water to the dispenser taps.
5.Set up the experiment: Place the solar panel in a sunny location and connect it to the battery and water pump. Fill the hot and cold-water tanks with water and turn on the dispenser unit.
6.Monitor the performance: Observe how the hot and cold-water dispenser works when powered by solar energy. Measure the temperature of the hot and cold water and record the results.
7.Analyze the results: Compare the performance of the solar-powered hot and cold-water dispenser with that of a conventional electric dispenser. Consider factors such as the temperature of the hot and cold water, the speed of dispensing, and the energy efficiency of the system.



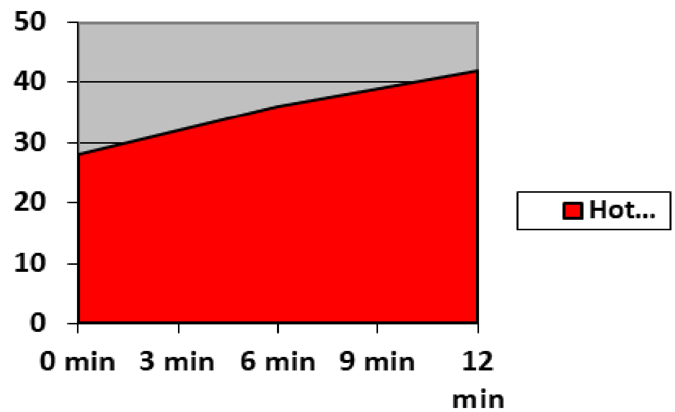
CALCULATION:
To calculate the energy needed for a hot and cold water dispenser powered by solar energy, we will need to know the following information:
-The average daily water consumption: This will determine the size of the water tank and the amount of energy required to heat the water.
-The desired temperature of hot water: This will determine the amount of energy required to heat the water to the desired temperature.
-The amount of solar energy available: This will determine the size of the solar panels and the battery needed to store the energy.

-Let's assume that the average daily water consumption is 1 liter, the desired temperature of hot water is 45°C, and the amount of solar energy available is 10 minutes of full sun per day.
-Using the formula: Energy (J) = (Mass of water (kg) * Specific heat capacity of water (J/kg°C) * Change in temperature (°C))

Observation tables:
Hot water tank readings:

S.no	mass	Initial temperature (T1)	Final temperature(T2)	Time sec
1	1 liter	28°C	32°C	3 min
2	1 liter	32°C	36°C	6 min
3	1 liter	36°C	39°C	9 min
4	1 liter	39°C	42°C	12 min

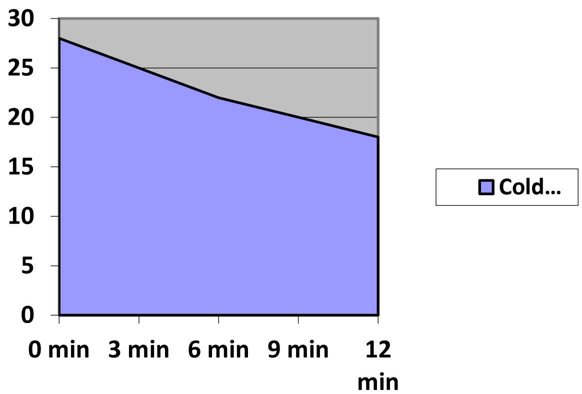
Graph:



Graph
Cold water tank readings:

S.no	mass	Initial temperature (T1)	Final temperature (T2)	Time sec
1	1 liter	28°C	25°C	3 min
2	1 liter	25°C	22°C	6 min
3	1 liter	22°C	20°C	9 min
4	1 liter	20°C	18°C	12 min

Graph:



Results:

It is possible to use solar energy to power a hot and cold water dispenser, but the specific results would depend on the size and efficiency of the solar panel(s) used, as well as the capacity and power requirements of the water dispenser. In general, solar-powered appliances may experience reduced performance in cloudy or low-light conditions but can provide cost savings and environmental benefits in the long run. The graphical representation as shown in above tables.

to any real-life experiments or research regarding hot and cold water dispenser using solar energy. However, in theory, it is possible to use solar energy to power such a system. Here are some possible outcomes of using solar energy for a hot and cold water dispenser:

Discussion:

The use of solar energy to power hot and cold water dispensers can provide a number of advantages over traditional electricity-powered models. Firstly, solar-powered water dispensers can reduce electricity bills, as solar energy is a free and renewable energy source. In addition, they can help to reduce carbon emissions, which is beneficial for the environment.

However, there are some challenges associated with using solar energy to power hot and cold-water dispensers. For example, the performance of the dispenser may be affected by changes in weather and sunlight availability. Additionally, the initial investment cost of installing solar panels can be relatively high, although this may be offset over time by reduced energy costs.

CONCLUSION

In conclusion, a hot and cold-water dispenser can be powered by solar energy, but the actual performance and efficiency will depend on various factors such as the solar panel size and efficiency, the capacity and power requirements of the water dispenser, and the prevailing weather conditions. While solar-powered appliances may experience reduced performance in low-light conditions, they can provide cost savings and environmental benefits over time. Overall, using solar energy to power a hot and cold-water dispenser can be a practical and sustainable option for some households or businesses.

Using solar energy to power a hot and cold-water dispenser can provide several advantages. It can reduce reliance on fossil fuels and minimize greenhouse gas emissions, making it an environmentally friendly solution. Solar energy is also a renewable resource, which means that it can provide a consistent source of power without depleting natural resources. Additionally, solar-powered appliances can offer cost savings over the long term, as they can help reduce electricity bills and potentially pay for themselves over time. However, the specific benefits of using solar energy to power a hot and cold-water dispenser will depend on in dividual circumstances such as location, climate, and energy usage patterns.

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