ANALYSIS OF VIABILITY OF SOLAR WATER DISPENSER

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Abstract- *Solar energy technologies will enhance sustainability, reduce pollution, lower the costs of mitigating global warming, and keep fossil fuel prices lower. These advantages are taken in to consideration to analyze the viability of a water dispenser using solar energy. A water dispenser is a device that heats, cools and dispenses water. Water dispenser can directly connected to the water source for continuous dispensing of hot and cold water for drinking. Currently water dispenser uses electrical energy for their operation. The use of solar energy to power the dispenser will reduce the wastage of electricity. The water can be heated by solar trough collector and cooled by vapour absorption system. In this project, it is supposed to design and fabricate a solar water dispenser which operates on solar energy thus reducing the electricity consumption.*

Key Words: Solar Energy, Water Dispenser, Solar Water Dispenser, etc...

1. INTRODUCTION

In present world the prosperity of nation is measured by the energy consumption of that nation the Gross Domestic Product (GDP) of country is directly linked with energy consumption. Therefore demand for energy resources is increasing day by day. There are various types of energy resources, but mainly they are divided in to two forms, these are renewable energy resources (solar, air, wind) and non-renewable energy resources (coal, petroleum). The industrial growth is accelerated by non-renewable energy resources, but there stock is limited in nature. The rapid depletion of fossil fuel resources has necessitated an urgent search for alternative energy sources to meet the energy demands for the immediate future and for generations to come. Of many alternatives, solar energy stands out as the brightest long range promise towards meeting the continually increasing demand for energy. The major drawback with this resource is its low intensity, intermittent nature and non-availability during night. Even. In spite of these limitations, solar energy appears to be the most promising of all the renewable energy resources.

1.1 Overview of Solar Water Dispenser

Solar energy is an inexhaustible resource. The sun produces vast amounts of renewable solar energy that can be collected and converted into heat and electricity. Solar energy is contemplated to have a wide range of applications including water heating, air heating, air conditioning of buildings, solar refrigeration, photo-voltaic cells, green houses, photo-chemical, power generation, solar furnaces and photo-biological co versions to list a few. Out of these, the utilization of solar energy for power generation and heating is the subject of active research in the present scenario.

A water dispenser is a device that heats and cools and dispenses water. There are different types of water dispensers like wall mounted water dispensers, bottom load water dispenser, tabletop water dispenser, freestanding water dispenser, direct piping water dispenser. These gravity powered systems have a device to dispense water in a controlled manner. A solar water dispenser is a device that heats and cools and dispenses water with the aid of solar energy. These gravity powered systems have a device to dispense water in controlled manner. A solar water dispenser is any product, conduit, tank and spigot that draws water from a holding tank and allows it to be dispensed with the help of solar energy. The term water dispenser is quite varied and generic, and can incorporate a wide number of products, from a simple water jug with a tap, to a sink faucet or a refrigerator on-board water dispenser feature. However, more commonly, solar water dispensers refers to a unit that can accommodate a large prefilled water bottle and has a faucet with which to dispense both hot and cold water. When the unit design includes a compressor to cool that water, the water dispenser is also a water cooler. In this project vapour absorption system is used to cool the water.

1.2 Proposed Components of the Dispenser

The main components of solar water dispenser are :

- Solar trough collector

- Hot reservoir
- Generator
- Condenser
- Evaporator
- Absorber
- Pump
- Expansion valve
- Cold water storage

Solar Collector:A solar thermal collector collects heat by absorbing sunlight. A collector is a device for capturing solar radiation. The quantity of solar energy striking the Earth's surface (solar constant) averages about 1,000 watts per square meter under clear skies, depending upon weather conditions, location and orientation. A solar trough collector is a type of solar thermal collector. The most obvious feature of the parabolic trough solar collector is its parabolic-shaped reflector. The energy of sunlight which enters the reflector sheet is focused along the focal line, where objects are positioned that are intended to be heated. There is a tube, which runs along the length of the trough at its focal line. The trough is oriented so that sunlight which it reflects is concentrated on the tube, which contains the water coming from the main tank which is heated by the energy of the sunlight. The hot water can be used for drinking and it is stored in a reservoir.

Hot Reservoir: In a solar water heating system, a solar hot water storage tank stores heat from solar thermal collector. Here, the hot water from the tube is stored in a hot reservoir. This reservoir will act as a heat source to vaporize the refrigerant in the generator.

Generator: The purpose of the generator is to deliver the refrigerant vapor to the rest of the system. It accomplishes this by separating refrigerant from the solution. The solution absorbs heat from the warmer steam or water, causing the refrigerant to boil (vaporize) and separate from the absorbent solution. The hot water or steam is obtained from the solar collector. As the refrigerant is boiled away, the absorbent solution becomes more concentrated. The concentrated absorbent solution returns to the absorber and the refrigerant vapor migrates to the condenser.

Condenser: The purpose of condenser is to condense the refrigerant vapor. Inside the condenser, cooling water flows through tubes and the hot refrigerant vapor fills the surrounding space. As heat transfers from the refrigerant vapor to the water, refrigerant condenses on the tube surfaces. Condensed liquid refrigerant collects in the bottom of the condenser before travelling to the expansion device. The cooling water system is connected to a cooling tower.

Expansion Valve: From the condenser, the liquid refrigerant flows through an expansion device into the evaporator. The expansion device is used to maintain the pressure difference between the high-pressure (condenser) and low-pressure (evaporator) sides of the refrigeration system. As the high pressure liquid refrigerant flows through the expansion device, it causes a pressure drop that reduces the refrigerant pressure to that of the evaporator. This pressure reduction causes a small portion of the liquid refrigerant to boil off, cooling the remaining refrigerant to the desired evaporator temperature. The cooled mixture of liquid and vapor refrigerant then flows into the evaporator.

Evaporator: The purpose of evaporator is to cool the feed water and it is used for drinking. The evaporator contains a bundle of tubes that carry the feed water to be cooled and the liquid refrigerant is sprayed on the bundle of tubes. At low pressure, existing in the evaporator, the refrigerant absorbs heat from the feed water that has to be cooled and it evaporates. The refrigerant vapor thus formed tends to increase the pressure in the vessel. This will in turn increase the boiling temperature and the desired cooling effect will not be obtained. So, it is necessary to remove the refrigerant vapor from the vessel into the lower pressure absorber. Physically, the evaporator and absorber are contained inside the same shell, allowing refrigerant vapor generated in the evaporator to migrate continuously to the absorber.

Absorber: Inside the absorber, the refrigerant vapor is absorbed by the solution. As the refrigerant vapor is absorbed, it condenses from a vapor to a liquid, releasing the heat it acquired in the evaporator. The heat released from the condensation of refrigerant vapor by their absorption in the solution is removed by the cooling water circulating through the absorber tube bundle. The weak absorbent solution is then pumped to the generator where heat is used to drive off the refrigerant. The hot refrigerant vapor created in the generator migrates to the condenser. The cooling tower water circulating through the condenser turns the refrigerant vapor to a liquid state and picks up the heat of condensation, which it rejects to the cooling tower. The liquid refrigerant returns to the evaporator and completes the cycle.

Pump: The strong solution of LiBr and water is pumped by the pump at high pressure to the generator.

2. PROPOSED DESIGN ,WORKING AND EVALUATION OF THE SYSTEM

A solar collector is used to collect solar energy and evacuated tube collectors can be used. Through this tube the feed water is given and we get the hot water. This hot water is stored in a hot reservoir. The absorption system consists of an absorbent, lithium bromide and a refrigerant, water and a heat source substituting the electrical input in the vapour compression cycle. The hot reservoir that stores hot water is the heat source. The compressor is replaced by an absorber, a solution pump and a generator. The working fluid of the system is LiBr-water solution. The lithium-bromide solution is pumped into the generator and is heated by a heat source, raising the lithium bromide solution to a temperature where the liquid refrigerant vaporizes and flows to the condenser. The concentrated lithium bromide solution flows down to the absorber chamber.

In the condenser, the cooling water absorbs the heat of condensation from the vaporized refrigerant, changing the refrigerant into a liquid. The liquid refrigerant travels from the condenser through expansion piping to the evaporator during which the liquid refrigerant experiences a drop in pressure and temperature. The liquid refrigerant is pumped to the evaporator and sprayed on the top of the feed water tube bundle. At low evaporator pressures, the liquid refrigerant vaporizes, removing energy from the water and we get cold water and it is stored in cold water storage. The liquid refrigerant that is vaporized then travels from the evaporator to the absorber. In the absorber, the concentrated liquid lithium bromide solution absorbs the vaporized refrigerant and the cooling water absorbs the vapour absorption heat. As the refrigerant vapour is absorbed the concentrated solution returns to a diluted state. After the absorption, the diluted liquid lithium-bromide solution is pumped to the generator, completing the refrigerant cycle.

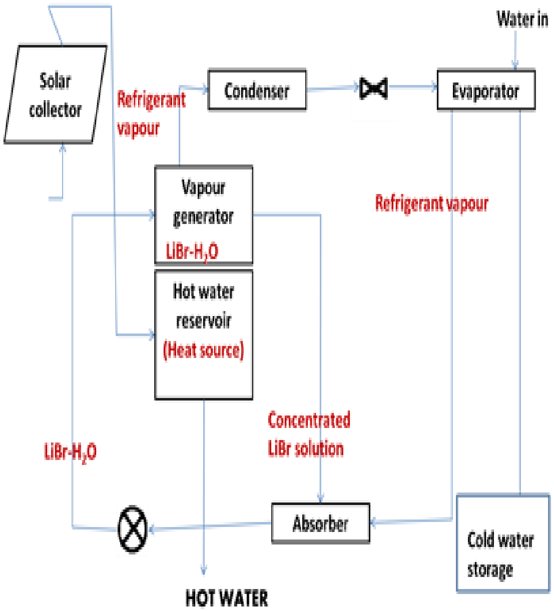

Fig -1: Schematic diagram of the system

The current commercial water dispenser systems have higher energy consumption in the operation and maintenance mode. For cooling the system utilize mechanical vapour compression cycles for refrigeration. The major part of these systems is the compressors. Electrical energy is supplied to the compressor for the mechanical compression of the refrigerant gas to become high pressure high temperature gas which is to be condensed and fed to the evaporator for producing the cooling effect. The water dispenser system works 24 hrs a days without any shut down period. This continuous operation of systems imparts a constant load on the power grid. If this load is reduced, then the grid will experience a good relief. The refrigerants used in the refrigeration systems are potentially harmful to environment. Initial refrigerants, like Freon, add on to ozone layer depletion. The modified refrigerants cause less effect on ozone layer but they add on to global warming.

Table -1: Specifications of Dispenser

Storage capacity	Cooling capacity	Normal demand	Refrigerant
10 litres	8 litres	25 glasses/hr	water

3. CONCLUSIONS

Reduction of the load on the grid and reduction of global warming and its after effects are of much importance today. If a water dispenser system could be designed to overcome these problems, then it will be a great achievement. In this project work, I have designed a water dispenser system which works on solar energy, thus providing a relief to the grid. The system utilizes a solar trough collector and a vapour absorption cycle instead of vapour compression cycle so that the compressor can be avoided and also an environmental friendly absorbent refrigerant pairs are used. The usage of electricity is reduced to a particular extent.

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