An overview on solar powered drinking water cooler

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***Abstract*—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 the drinking water supply concerns regarding the adverse environmental impact of using fossil fuels has necessitated the exploitation of alternative cooling technologies.**

***Key words*—Renewable solar energy, drinking water cooler, evaporation, solar panel.**

I. 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.

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 [1-2].

Renewable energy is energy generated from natural resources—such as sunlight wind, rain, tides and geothermal heat—which are renewable (naturally replenished). In 2006, about 19% of global final energy consumption came from renewable, with 12% coming from traditional biomass, such as wood-burning. Hydroelectricity was the next largest renewable source, providing 4%, followed by solar hot water/heating, which contributed 1.6%. Modern technologies, such as geothermal energy, wind power, solar power, and ocean energy together provided some 0.7% of final energy consumption. Climate change concerns coupled with high oil prices, peak oil and increasing government support are driving increasing renewable energy legislation, incentives and commercialization. European Union leaders reached an agreement in principle in March 2007 that 22 percent of their nations' energy should be produced from renewable fuels by 2020, as part of its drive to cut emissions of carbon dioxide, blamed in part for global warming [3].

II. WORKING OF SYSTEM

A drinking water cooler is a device that heats and cools and dispenses water. There are different types of water coolers available in the market like as 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 [4]. 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 study the evaporation principle is adopted to cool the drinking water as shown in Fig. 1.

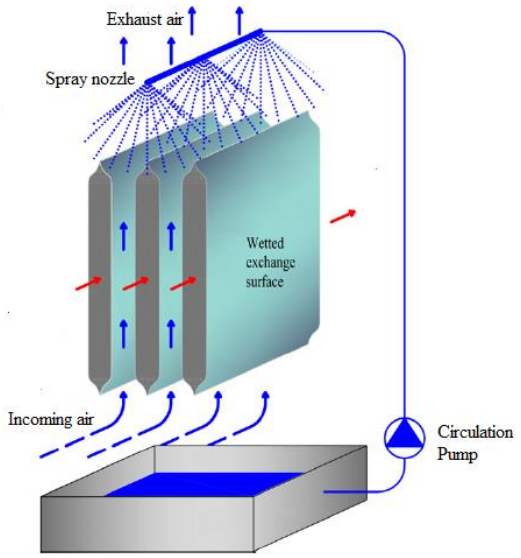

Fig. 1. Evaporation principle in water cooling.

In evaporative water cooler the cooling is attained by evaporation of flowing outside water however there is a heat exchanger in between wet air and dry supplied air stream. The heat exchanger can be a wall which is covered by a water resistance layer to prevent introduction of moisture in the supply air as shown in Fig. 2. The water in the wet surface is evaporated by the hot air stream and cools down the surface. This cold surface exchanges only heat with the supply air stream and results in a cold drinking water supply. [5-9].

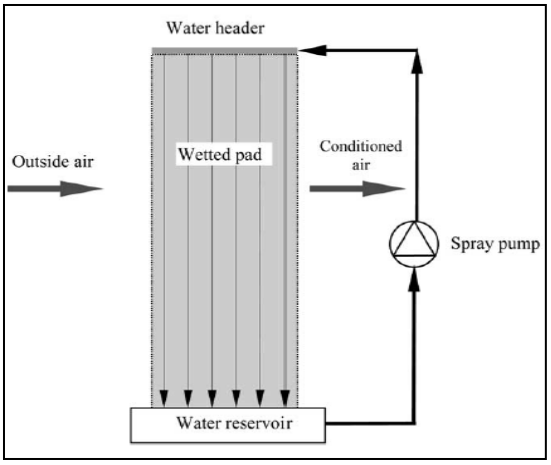

Fig. 3. Working of evaporative water cooler.

The main components in solar electric power generation system are photovoltaic panel, inverter, storage system, and an electrical generating device. As shown in Fig. 3 the electricity from the PV panels are used by the DC motor to drive a circulation pump to supply auxiliary power [10-13].

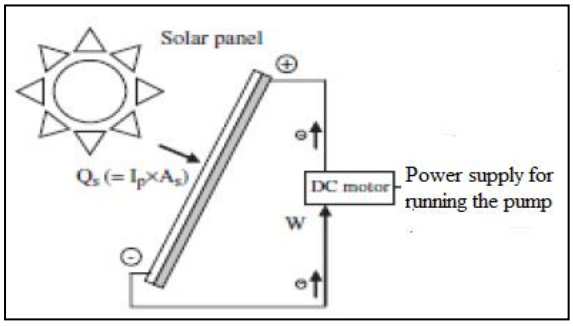

Fig. 3. Auxiliary power supply from solar energy.

Another advantage of this solar powered evaporative cooler is that these systems do not put additional pressure on the electricity grid in peak-demand times. As the vapor compression based water coolers can account for a large share of the electricity demand for running the compressors. In residential areas it is estimated that VCR based refrigerators are responsible for more than 30% of the total electric energy demand during peak times in hot summer environment. Especially during hot days and in countries where a lot of cooling and low temperature storage is provided via grid-connected compression cooling systems. Thus, VCR based coolers and refrigerators can have a major impact on the electricity grids. In the summer, when there is a period of very high temperatures led to an 8% increase of the electricity demand due to over burden on electricity supply system and can get set

new records with daily average energy demand [14-20].

A solar powered drinking water cooler will normally cool the water up to 16-18˚C, with an efficiency around 50%. It is seen that the novel solar powered evaporative cooling method is greener and environmentally safe as well as it has no operational costs. Furthermore, a typical water cooler costs around nominal as compared to the traditional vapor compression based water coolers. The price difference will be compensated by time as it has zero operation cost. Further study will compute the production costs in order to make the water cooler available in the market [21].

A solar panel is a device that collects and converts solar energy into electricity or heat as shown in Fig. 4. It known as Photovoltaic panels, used to generate electricity directly from sunlight Solar thermal energy collection systems, used to generate electricity through a system of mirrors and fluid-filled tubes solar thermal collector, used to generate heat solar hot water panel, used to heat water. It is energy portal. A solar power technology that uses solar cells or solar photovoltaic arrays to convert light from the sun directly into electricity. Photovoltaics, is in which light is converted into electrical power. It is best known as a method for generating solar power by using solar cells packaged in photovoltaic modules, often electrically connected in multiples as solar photovoltaic arrays to convert energy from the sun into electricity. The photovoltaic solar panel is photons from sunlight knock electrons into a higher state of energy, creating electricity. Solar cells produce direct current electricity from light, which can be used to power equipment or to recharge a battery. A less common form of the technologies is thermo photovoltaics, in which the thermal radiation from some hot body other than the sun is utilized. Photovoltaic devices are also used to produce electricity in optical wireless power transmission.

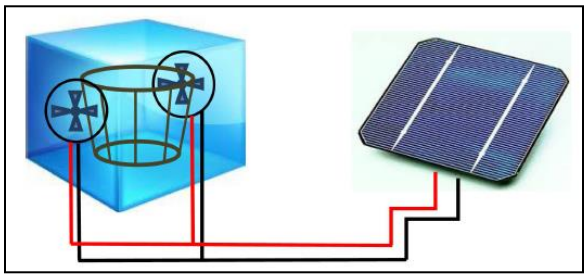

Fig. 4. Schematic layout of solar powered cooler.

A standalone fan is typically powered with an electric motor. Fans are often attached directly to the motor's output, with no need for gears or belts. Smaller fans are often powered by shaded pole AC motors or brushed or brushless DC motors. Many times it is powered by dc motor having three blades.

Solar panel consists of number of silicon cells, when sun light falls on this panel it generate the voltage signals then these voltage signals are given to charging circuit. Depending on the panel board size the generated voltage amount is increased. In charging circuit the voltage signal from the board is gathered together and stored in the battery. There are two tanks provided one at the top and another one at the bottom. The water from the top tank is made to pass through the tubes which are fixed between the two tanks. A fan is provided at the centre of the tank in such a way that the supply for the fan is coming from the battery which stores the current from the solar panel. When the water falls from the top tank to the bottom tank due to gravity, the fan is made to run, so that the cool air will be supplied all the way through. At the bottom of the tank, there will be a DC pump which pumps the water again to the top tank. The power for the DC pump is coming from the battery connected to the solar panel. The fan and pump is controlled separately with help of manual operated switch [22].

The battery used in the power storage and supply is of secondary type battery. It is rechargeable type. A battery is one or more electrochemical cells, which store chemical energy and make it available as electric current. There are two types of batteries, primary (disposable) and secondary (rechargeable), both of which convert chemical energy to electrical energy. Primary batteries can only be used once because they use up their chemicals in an irreversible reaction. Secondary batteries can be recharged because the chemical reactions they use are reversible; they are recharged by running a charging current through the battery, but in the opposite direction of the discharge current. Secondary, also called rechargeable batteries can be charged and discharged many times before wearing out. After wearing out some batteries can be recycled.

Batteries have gained popularity as they became portable and useful for many purposes. The use of batteries has created many environmental concerns, such as toxic metal pollution. A battery is a device that converts chemical energy directly to electrical energy

it consists of one or more voltaic cells. Each voltaic cell consists of two half cells connected in series by a conductive electrolyte. One half-cell is the positive electrode, and the other is the negative electrode. The electrodes do not touch each other but are electrically connected by the electrolyte, which can be either solid or liquid. A battery can be simply modeled as a perfect voltage source which has its own resistance, the resulting voltage across the load depends on the ratio of the battery's internal resistance to the resistance of the load. When the battery is fresh, its internal resistance is low, so the voltage across the load is almost equal to that of the battery's internal voltage source. As the battery runs down and its internal resistance increases, the voltage drop across its internal resistance increases, so the voltage at its terminals decreases, and the battery's ability to deliver power to the load decreases.

The design of solar powered drinking water cooler made an impressing task in the field of cost of generation of power is very less so the source of power is free and available in plenty and then is no power interruptions. The further improvement in the design has also reduced the cost involved in the concern.

III. CONCLUSIONS

Reduction of the load on the grid and reduction of global warming and its after effects are of much importance today. If a drinking water cooling system could be designed to overcome these problems, then it will be a great achievement. In the present study, the novel design of solar powered drinking water cooler which makes use of freely available solar energy, thus providing a relief to the grid. The system utilizes a solar trough collector and a evaporation 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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