An overview on solar powered evaporative water cooler with UV protection

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***Abstract*—The microbial disinfection using ultraviolet radiation is a worldwide technology for drinking water purification. The effectiveness of this technology depends on certain important parameters like as the UV intensity, the exposure time, the area, clarity of the water etc. This technology is very convenient and fast, doesn't alter the taste of the water or adding chemicals into the water. The selection of UV wavelength is very important for the efficient disinfection process. The optimum microbial killing efficiency ranges from 254 to 260 nm wavelength probably varies with the type of organism. Viruses and bacteria in vegetative forms are most sensitive to UV radiation. This overview review the use of ultraviolet (UV) light for using as a disinfection technology in potable water supplies to inactivate disease-causing bacteria, viruses, and cysts. Furthermore, user 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, Evaporative cooler, UV protection, Drinking water.**

I. INTRODUCTION

Water borne disease has been a concern to human being ever since its cause had discovered and the most appropriate treatment process adopted is microbial disinfection. Disinfection is necessary to destroy pathogenic (disease causing) bacteria and other harmful microorganisms that are present in water due to contamination. Over several years, Ultraviolet (UV) disinfection has developed into a viable technology for drinking water disinfection. UV disinfection systems inactivate protozoa, bacteria and
viruses. Through all-embracing research and meticulous field experiences, UV disinfection has proven to be safe, reliable, and inexpensive and accepted this as a worldwide technology for drinking water disinfection.

UV disinfects water without adding chemicals. It does not create any new chemical complexes, does not change the taste or odour of the water and does not remove beneficial minerals from the water. UV devices are the most effective when the water has already been partially treated for sediments and organic chemicals. Therefore UV disinfection devices are often combined with other treatment devices such as sediment filters and carbon filters. The key factor of a UV treatment system is the UV dosage which can be measured from the known UV intensity, exposure time and water flow rate. The dosage is very important to disinfect the microorganism. This is again based on many factors like water clarity, water flow, flow pattern, UV intensity and quality of the quartz sleeve. The water quality of India is a real challenge to all water purifier manufacturers. There is a wide distinction in water quality from place to place like high turbidity, heavy microbial contamination, iron content, presence of other toxic chemicals etc. Surface water in river is the main drinking water source for urban and semi urban areas of India. Open Wells and bore wells also provides drinking water to the human community as well [1-2].

In solar cooling systems, heat energy from the sun is used to drive the cooling process. Thermally driven cooling machines, such as evaporative cooler provided solar energy for pumping the drinking water cooler. A solar cooling system installation consists of a typical thermal system made up of solar collectors, storage tank, control unit, pipes, pumps, and a thermally driven machine. To date, most solar collectors used in solar cooling systems are the high efficiency collectors available in the market today often double glazed flat plat collectors or evacuated tube solar collectors. In order to limit the negative impact of peak energy consumption on the electricity network management, new environmental friendly concepts for the small capacity range of particular importance is used. This solar assisted water cooling system underline the

necessity of new solutions with lower electricity consumption and in reduced consumption at peak electrical loads. This could translate into both energy savings and also reduction in future emissions of climate change agents.

II. WORKING OF SYSTEM

All water borne enteric pathogens can be inactivated by ultraviolet light, provided a sufficient dose is administered. Different micro organisms show different sensitivities to UV radiation. The published data on the exact doses required to inactivate different species vary substantially depending among other things on the germ strain and UV source. In general, bacterial spores and viruses have a relatively high resistance while most bacteria are in activated by significantly lower UV doses as shown in Fig. 1.

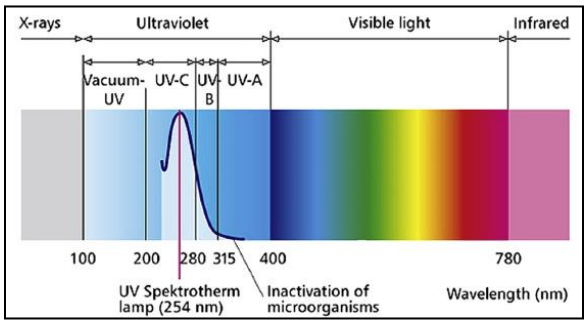

Fig. 1. Electromagnetic spectrum and UV protection wavelength.

There are a number of different models are available in the market, differing in aspects like size, energy source, and the presence of rubber plug which allows for turning a narrow mouth bottle upside down as shown in Fig. 2 [3].

Fig. 2. Use of UV light for water purification.

A standardized germ concentration was achieved by determining the optical density of germ solution in a spectrophotometer. The stock solution was then diluted in steps of 1:10 which resulted in four different test concentrations. The test bottles are filled with mineral water the respective test solutions in relation of 1:500 of water were supplemented with 2 ml of the germ solution. Watching the UV light through the wall of plastic or glass bottle can be considered as non hazardous. This procedure yields proper disinfection results if the water is clear. Thus, turbid water needs to be filtered before application of this device [4].

In evaporative 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. 3. 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 and dry air stream. Then the cold dry air will be supplied without any additional dehumidification process [5-9].

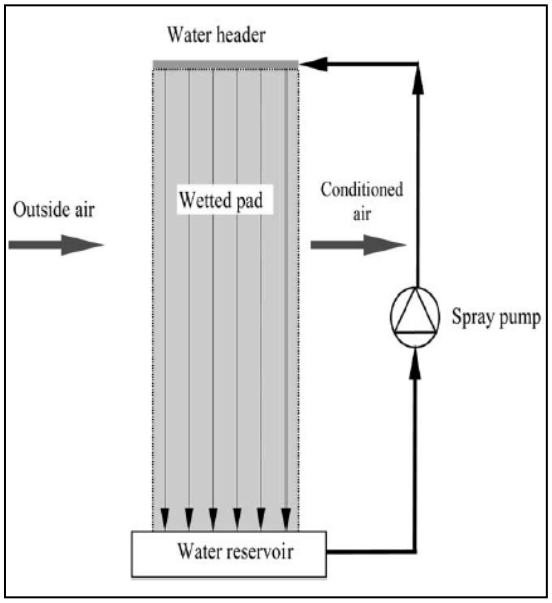

Fig. 3. Working of evaporative cooler.

The main components in solar electric power generation system are photovoltaic panel, inverter, storage system, and an electrical generating device. As shown in Fig. 4 the electricity from the PV panels are used by the DC motor to drive a circulation pump to supply auxiliary power [10-13].

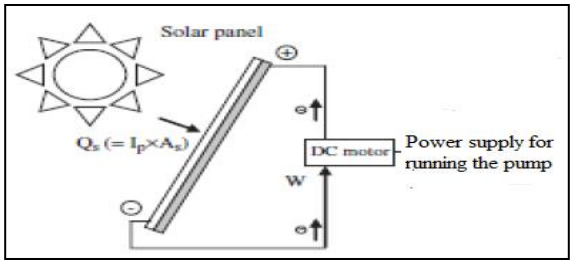

Fig. 4. Auxiliary power supply from solar energy.

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 as shown in Fig. 5 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].

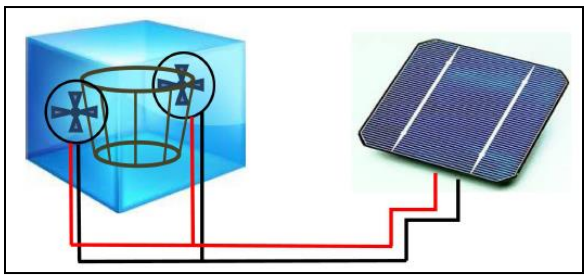

Fig. 5. Schematic layout of water cooler.

Sometimes use of desiccant dehumidifier in integration with the evaporative cooler will increase its climatic applicability in humid environment as shown in Fig. 6 [22].

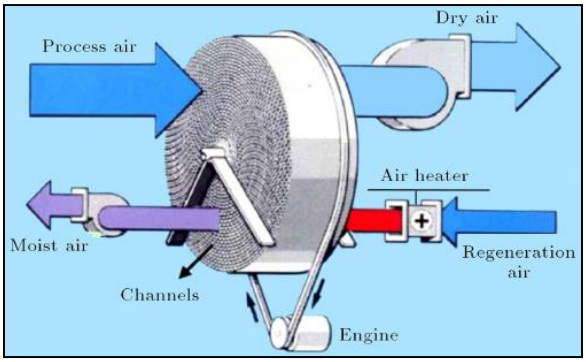

Fig. 6. Working of desiccant dehumidifier.

III. CONCLUSIONS

Ultraviolet disinfection is a proven technology for disinfecting drinking water and is being used worldwide since long time. UV light is most effective against Cryptosporidium and Giardia followed by bacteria. UV light is least effective against viruses. It does not create any new chemical byproducts, does not change the flavour or odour of the water and also does not remove any beneficial minerals. Its effectiveness depends upon many factors and it is very important to design the water purifier scientifically so as to deliver the safe as well as purified water. Evaporative cooling system is cheap in cooling water as the water waste from UV purification is used for the purpose of the evaporation. This combined system of drinking water purification and cooling hold a great promise since they have low operating cost and do not use CFC base environmental polluted refrigerants.

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