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Solar Water Cooler

Rohan Kumar [1],Rishu[2],. Yash[3], Arun[4]
Guide: Mr Sachin Shishodia
College: IIMT College of Polytechnic, Greater Noida

Abstract: A solar water cooler that uses solar energy to cool the water directly or indirectly consists of a cool water storage tank, a condensing wall, an auxiliary refrigeration device and an insulating board that divides the cool water storage tank into an upper water-cooling tank and a lower water freezing tank. The system includes a solar water cooler with a dual-temperature cool water tank that uses heat dissipation to reduce the water temperature to the minimum temperature of the day, and the obtained minimum-temperature water is delivered directly for cooling purposes or delivered as cooling water to the condensing device to improve cooling efficiency. When the cooling water does not reach the required temperature, the auxiliary refrigeration unit assists in lowering the water temperature.

Key words: Mono crystalline Solar panel,battery, centrifugal pump and Electric Motor.

INTRODUCTION:

With rapid economic expansion in recent years, urban power demand has increased, and power consumption by air-conditioning systems in urban structures accounts for a significant percentage - more than 50% of total building power consumption. During the summer peak season, the power consumption of air conditioning systems in northern China accounts for 16% 18% of total power consumption in cities, whereas it accounts for more than 30% in developed cities in southern China (Guangzhou, Shenzhen, and so on). Air conditioners take a lot of electricity, and the peak hours of cooling load coincide with the peak hours of urban power consumption, exacerbating the power supply-demand imbalance and exacerbating the power deficit during peak hours. To alleviate this dire situation, the Chinesesystems. Cool storage air-conditioning technology began to gain traction in China in the 1990s, with large provinces and cities such as Shenzhen, Beijing, Guangzhou, Zhejiang, Shanghai, Tianjin, Wuhan, and Fujian launching several large- or medium-scale cool storage central air-conditioning programmes that achieved good economic efficiency and were promoted in more than 20 provinces across China. The current scenario demonstrates that users and power departments have given these programmes positive feedback. Users must pay lower power bills, the new system performs better than traditional systems, and the goal of "balancing peak and valley" of power departments has been met [2].

The temperature range of air-conditioning systems is 1530 °C, which is within the range of natural temperatures in China, and hence can meet the needs for natural cooling while also achieving the goal of energy savings. The nature of cooling energy is as follows: using the temporal and spatial difference in natural temperatures to store energy and achieve cooling [3].

2. Solar water cooler components and operation

2.1. Solar water cooler components

A cooling storage water tank, a condensing wall, heat dissipation pipes, heat dissipation sheets, an upper cooling water tank, a temperature-insulating board, a lower chilled water tank, a reflux pump, an auxiliary refrigeration device, intra-connected pipes, water inlets, and water outlets

Comprise the solar water cooler. Components of Solar Water Cooler are shown in Figure 1.

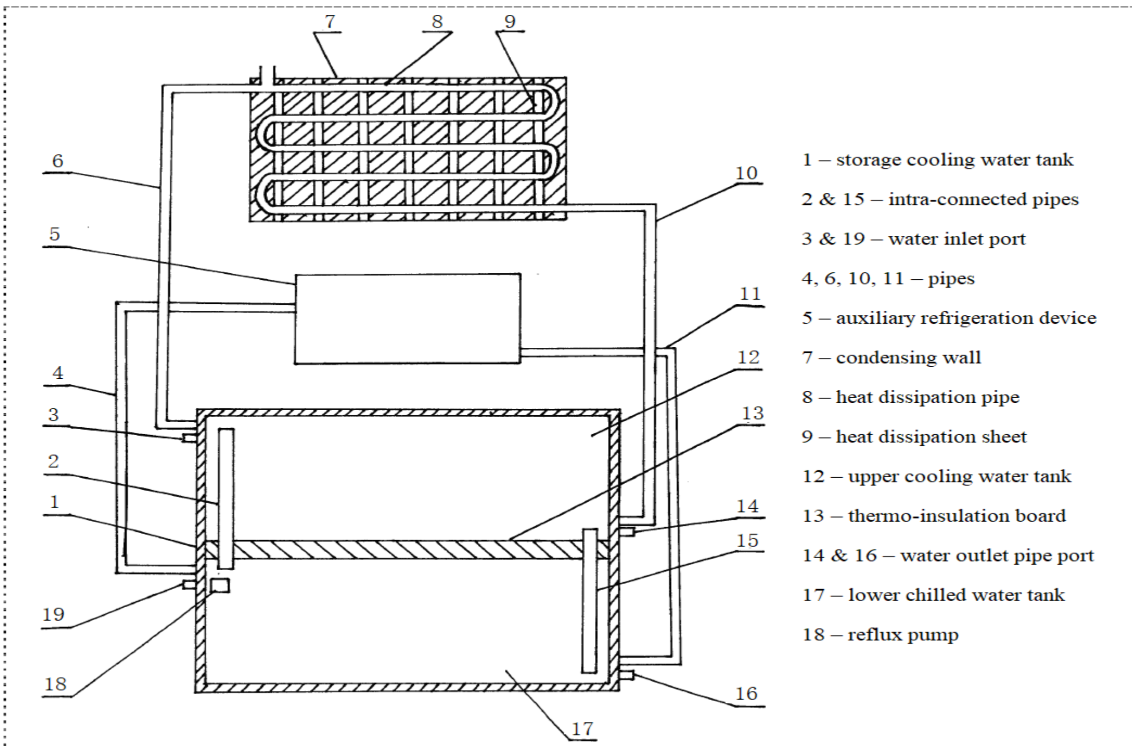

Figure-1 Components of Solar Water Cooler

2.2 The Solar Water Cooler's Operational Principle

As depicted in Figure 1, a temperature-insulating board (13) divides the cooling storage water tank into an upper cooling water tank (12) and a lower water refrigeration tank (17); connecting pipes (2 and 15) connect these two tanks; a reflux pump (18) is installed inside the tank at the chilled water tank's water inlet port to recycle the chilled water; and the condensing wall (7).consists of a temperature sensor and a thermopile cooling component. The chilled water tank (17) and the chilled water pipe of the auxiliary refrigeration unit (5) are connected by pipes (4 and 11). The higher temperature water in the upper part of the cool water tank (12) should be pumped up to the condensing wall (7) for natural heat dissipation before flowing back to the lower part of the chilled water tank because the proportion of cool water is greater than the proportion of chilled water. In order to obtain chilled water that is then delivered to the refrigeration device via the water outlet (14) to cool the condenser in the refrigeration device, the water temperature can be repeatedly reduced to the minimum temperature of the day.The required chilled water is then obtained, which absorbs heat and lowers the temperature in the pipes via the water outlet (16), and then flows automatically via the water inlet (19) or is driven by a reflux pump back to the upper part of the chilled water tank. This process is made possible by the temperature monitor in the auxiliary refrigeration device (5), which activates the thermopile condensing component to further reduce the water temperature in the chilled water tank. If the water temperature is higher than the chilled water, the chilled water flows upward through the pipe (2) to the chilled water tank's upper part, and the chilled water in the cool water tank's lower part flows back to the lower part of the tank if the water temperature is lower than the chilled water.1. A review of the solar water cooler's energy efficiency

2.3. Cooling with natural cold energy

The definition of natural cool energy, also known as "cool energy," is "low temperature difference-caused low temperature energy that exists in the natural environment." In actuality, the terms "hot" and "cool" are comparative; regardless of the temperature, energy always exists whenever there is a temperature difference. Since the environment can be kept at any temperature thanks to nature, temperature variations are commonplace. A type of massive low-grade energy, cool energy is therefore limitless. The majority of China's regions have a continental climate with significant seasonal and diurnal temperature variations; compared to regions with marine climates, these regions have more cool energy and pay less to use it.The Liyujiang Power Plant's central air conditioning system was self-developed, using river water as the cooling medium. With a planned total cooling load of 4350 kW and a planned total heat load of 3970 kW, the system serves the plant's homes and offices. Without the need for a refrigeration engine, the system uses the discharged water from Dongjiang Reservoir in the summer to keep the plant cool. In the winter, a steam engine powered by electricity is used to heat river water to provide heat for both residents and employees. The system was created in 1997, tested for issues in 1999, and put into operation in May 2000. The system is effective, and all after-put indicators satisfy the requirements.

2.4Radiant cooling

In order to create a cooling radiant surface and lower the temperature through heat exchange, radiant cooling involves lowering the temperature of one or more surfaces inside the surrounding support structure.

The surfaces of the surrounding support structure, the human body, the furniture, and the radiant cooling surface. The indoor temperature cooled by the radiant cooling system is 1 to 2 degrees Celsius lower than that cooled by a traditional air-conditioning system because radiant heat transfer accounts for 50% of the total heat transfer in the system. The radiant cooling system has the benefits of strong comfortability, low pollution, and energy savings [6]. In Europe, the practice of using radiant cooling technology can be traced back to the 1980s. It has so far been widely utilized in shopping centers, banks, and supermarkets all over Europe, particularly in Germany and Switzerland [7].The cool water temperature in radiant cooling systems is 16–18 °C, which is higher than the water temperature in conventional air-conditioning systems. For this temperature range, in northwest China, indirect evaporation cooling machines, deep well water, ground cooling energy, and evaporation and cooling by evaporation are some natural cooling sources that can provide the cooling water temperature needed by the radiant cooling system [8]. The radiant cooling ground could raise the amount of radiant heat that is transferred from the human body and increase the comfort level indoors by lowering the surface temperature of the nearby support structure. When compared to a traditional air-conditioning system, a floor radiant cooling-exchange ventilation system can raise the indoor temperature by 2.5 to 3°C while consuming less energy [9]. According to the aforementioned analyses, the radiant cooling system's chilled water temperature is 21–22°C. The minimum temperature at night in most parts of China is close to 20 °C; in regions where the minimum temperature is higher than 20 °C, the solar water cooler can produce chilled water at the minimum temperature of the day without requiring the use of any energy.The water-cooling unit uses the inexpensive electric power of the valley period to produce cooling energy during the day's lowest temperature period when the chilled water does not reach the required temperature. The cooling coefficient exceeds 10 [10], which can lower power consumption and lower electricity costs.As shown in Figure 2, when the compressor takes in saturated gas and the required cooling volume Q0 and the evaporation temperature T0 remain constant, the computer program calculates the condensing temperature Tk within 25 to 40 °C, the cooling coefficient, and the change ratio of the compressor's power consumption. The results of the experiment and the calculations indicate that, for every 1 degree Celsius increase in the condensing temperature Tk, the condensing coefficient decreases by 2% and the compressor's power consumption increases by 2%. [11

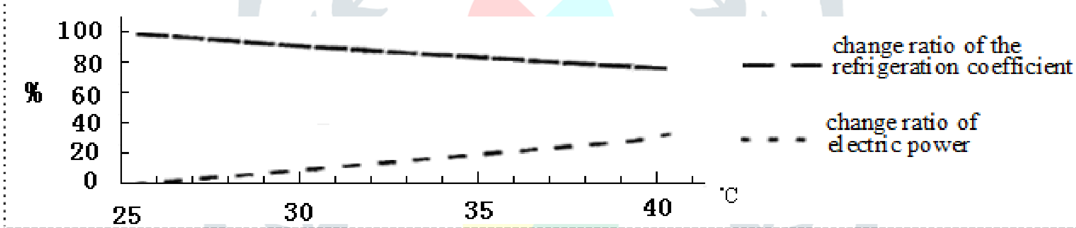

Figure 2. Correlation between the compression cycle performance andthecondensing temperature.

3. Recommendations

In this study, we proposed a solar water cooler that either directly or indirectly uses solar energy for cooling purposes and is made up of an upper cooling water tank and a lower chilled water tank that are separated by a thermos-insulation sheet, a condensing wall, and an auxiliary refrigeration device. The system offers a solar water cooler with a dual-temperature storage cooling water tank that uses heat dissipation to lower the water temperature to the minimum temperature of the day. The obtained low-temperature water then either flows into the condensing device as cooling water to increase cooling efficiency or serves the cooling purpose via pipes. When the cooling water does not reach the desired temperature, the auxiliary refrigeration device further lowers the water temperature.

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