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Review Article

A Review of the Study of the Cooling by Hybrid Solar Air Conditioners

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Abstract: The solar energy system is often used, which combines solar thermal heating and cooling by heat in the ground. The solar cooling system is one of the highly efficient systems in work; also it is one of the healthy and never harmful systems. It absorbs solar energy to heat the indoor medium with a vacuum solar collector. The refrigerant from the compressor passes a copper coil inside the accumulator and conducts heat exchange. The heated refrigerant then goes through a cycle inside the system not only for heating but also for cooling as well. The energy from the sun is fully utilized and therefore, less mains energy is required in the process, which in turn allows for the installation of smaller compressors, which offer better energy savings. This system adopts a four-fold heat exchanger as one of the core components of this air conditioner. The effective heat area is increased by 20-30% against the usual V-type and flat plate heat exchanger, which greatly increases the cooling efficiency. This study gives an overview of most studies on solar energy and its use and cooling with hybrid solar systems.

Keywords: air conditioner, heat exchange, vacuum solar collector, solar energy, hybrid solar systems.

1. INTRODUCTION

The twenty first century is rapidly becoming the right energy storm; modern society is faced with volatile energy prices and growing environmental concerns as energy supply and security issues. one in every of the best challenges facing mankind within the twenty first century is energy. Fossil fuels like coal, petroleum and fossil fuel are the most energy resources for everything vital for human society. The burning of fossil fuels has caused and is causing damage to the environment of earth. By 2050 the demand for energy could double or perhaps triple because the global population grows and developing countries expand their economies. This has already raised concerns over potential supply difficulties, depletion of energy resources and expediting environmental impacts like layer depletion, heating and temperature change etc. the foremost abundant energy resource available to human society is solar power. the use of solar power is as old as human history. Among various kinds of renewable energy resources, solar power is that the least utilized. air con is crucial for maintaining thermal comfort in indoor environments, particularly for decent and humid climates. Today, air-con comprising cooling and dehumidification has become a necessity in commercial and residential buildings and industrial processes. During the summer, the demand for electricity greatly increases thanks to the extensive use of air-conditioning systems. this is often a source of major problems within the country's electricity supply and contributes to a rise of CO2 emissions causing the environmental pollution and heating. On the opposite hand, vapour compression air con systems have impacts on stratospheric ozone depletion thanks to the chlorofluorocarbons (CFC) and therefore the hydro fluorocarbon (HCFC) refrigerants. the employment of solar power to drive cooling cycles is attractive since the cooling load is roughly in phase with solar power availability. to cool down with solar thermal energy, one solution is to use an absorption chillier using water and lithium bromide solution. Solar air con systems help to attenuate fuel energy use. Among the evolving energy efficient air-con technologies are liquid desiccant air con (LDAC) systems, which have showed promising performance during the past decades and are believed to be a robust competitor with the widely used conventional air con systems (CAC). Desiccant evaporation cooling technology is environmental friendly and might be accustomed condition the indoor environment of buildings. Unlike conventional air con systems, the desiccant air con systems may be driven by low grade heat sources like solar power and industrial waste heat. during this study, a spotlight is formed on reduction in air con capacity, fuel savings and emission reductions attainable through the utilization of alternative energy.

Roongutai *et al.,* (2008) studied the warm water making from air-conditioning system by using of the waste heat that released from the cooling. A pressure switch was used to activate both of the condensers, which are automatically controlled. Their results indicated that the very best temperature of the water within the reservoir is 490C. Vakiloroaya *et al.,* (2013) improved an air-conditioning system combined with a vacuum solar furnace so as to profit from alternative energy. A mathematical model of the system components was also developed and validated against experimental results. Paradeshi L. *et al.,* (2016) studied theoretically and experimentally direct expansion solar assisted apparatus system under a unique metrological condition in India. Their system included a flatplate reflector of two m2 total area, acting as an evaporator with refrigerant R22. Supported the experiment and developed system simulation model, the thermal performance of direct expansion solar assisted apparatus system was studied under the metrological condition of India. Saisanit *et al.,* (2013) design and construct the prototype of the hot water making machine using waste heat released from a standard air conditioning system. Two varieties of the hot water system such as "submerged coil" and "flow through" are utilized in their study. Solenoid valves were used to control the flow direction of the refrigerant. Cooling system with cooling capacity of three,51 KW and dealing wit h R-22 was used during this study. The result indicated that the hot water making machine with submerged coil type is more appropriate to use than the flow through type. As mentioned before, the needs of this study are to investigate the potential of plight making by employing a conventional air conditioning as an air-water heat pump then to compare the COP of the system between conventional cooling cycle and heat pump cycle. The energy saving potential for making of 120 L plight is additionally presented. Some work on the employment of a device for domestic water heating has been investigated by variety of authors Xingxing Zhang *et al.,* (2013), however, have an interest in characterization of a solar photovoltaic/loop-heat-pipe heat pump water heating system. Wonseok Kim *et al.,* (2012), performance analysis of hybrid solar-geothermal CO2 apparatus system for residential heating were tested Pradeep Bansal *et al.,* (2021) Status of not-in-kind refrigeration technologies for household space conditioning, water heating and food refrigeration. Boonrit Prasartkaew *et al.,* (2008) curious about a study of the Experimental study on the performance of a solar-biomass hybrid air-con system. Aruna S. N., & Nandihalli, R. (2014) studied the performance analysis of a solar hybrid air conditioner with waste heat recovery and re-use using evacuated tube collector (http://www.thermomax.com) studied the potential use of warmth energy wasted in condenser ac central for water heating to avoid wasting energy.

2. Thermal solar collectors

The objective of these collectors is to convert the thermal energy that is found in sunlight or solar radiation, the amount of solar energy that reaches the earth is approximately 1000 watts / square meter, depending on the weather and the place where these complexes are placed, where they are stored and become usable. The heat is collected from solar energy, the heat is used to heat the water that passes through the tubes inside, these tubes are directly connected to tanks, so that the sun's heat is stored in the water in the tanks, the ground is used as radiators of heat (radiant floor system), when needed it works These radiators.

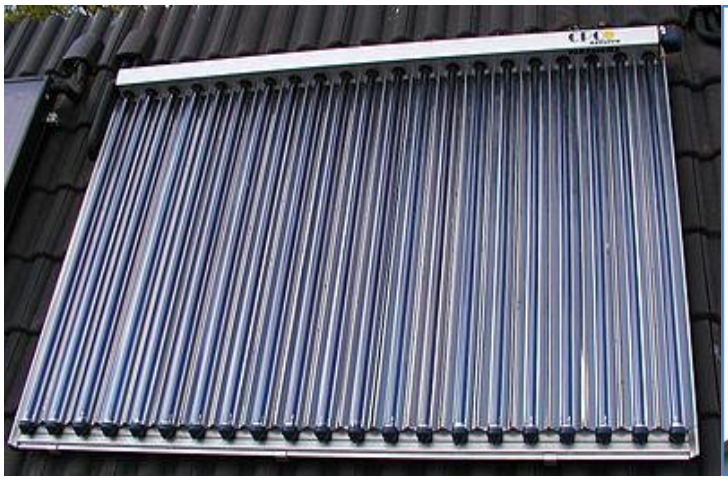
3. Applications of Thermal solar collectors

The main use of this technology is in apartment buildings where the demand for hot water has a significant impact on energy bills. This generally means a situation in a large family, or a situation where the demand for hot water is excessive or excessive due to frequent washing. Commercial applications include laundries, car washes, military laundry facilities, and food establishments. This technology can also be used for heating purposes if the building is located outside the network or if the power of use is subject to frequent interruptions. Solar water heating systems are more likely to be cost effective compared to hot water systems which are more expensive to operate. or with operations such as laundries or kitchens that require large amounts of hot water. Uncoated liquid collectors are commonly used to heat water in swimming pools. Because these assemblies do not need to withstand high temperatures, they can use less expensive materials such as plastic or rubber. They also do not require anti-freeze since swimming pools are usually only used in warm climates and can be drained easily during cold weather. While solar collectors are most cost-effective in temperate and sunny areas, they can be cost-effective almost anywhere in the country so they should be considered.

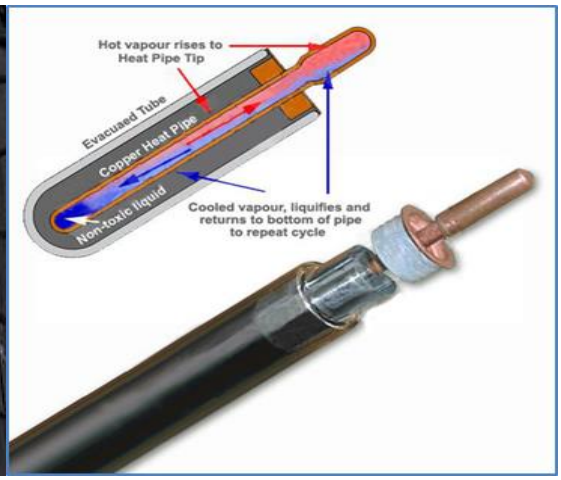
4. Vacuum tube collectors

Most of the evacuated tube collectors used in Central Europe use heat tubes for their core rather than passing liquid directly through them (http://eventhorizonsolar.com). Direct streaming is the most common in China. Vacuum heat tubes consist of several vacuum glass tubes, each containing an absorption plate embedded or fused to a heat tube. Heat is transferred from the heated end of the heat pipes to the transfer fluid (water or antifreeze mixture - usually propylene glycol) from a domestic hot water or heating system in a heat exchanger called a "manifold", which is wrapped in insulation and covered with sheet metal or plastic to protect it from the elements. Vacuum surrounding the outside of the tube greatly reduces convection, conduction and heat loss to the outside, so it achieves greater efficiency than flat plate collectors, especially in colder weather. This advantage is largely lost in hot climatic conditions, except in cases where very hot water is desirable, for example commercial process water. The high temperatures that can occur may require special system design to prevent overheating. Some evacuated tubes (glass - metal) are

made of a single layer of glass that welds or fuses to the heat tube at the upper end and surrounds the heat tube and the absorption plate in the vacuum. Others (glass-glass) are made of a double layer of glass fused together at one or both ends within the space between the layers (such as a vacuum bottle or flask), where the absorbent plate and heat tube are present at normal atmospheric pressure. Glass-glass tubes have a very reliable vacuum seal, but the two layers of glass reduce the light that reaches the absorbing plate. Moisture may enter the unvacated area of the tube and corrode the absorbent plate. The glass-metal tubes allow more light to reach the absorbent plate, and protect the absorbent plate and heat tube from corrosion even if they are made of different materials (see Galvanic Corrosion). Gaps between the tubes may allow snow to fall through the collector, reducing production losses in some snowy conditions, although reduced heat from the tubes can also prevent effective shedding of accumulated snow (https://web.archive.org).



(a) Vacuum tube collector (http://eventhorizonsolar.com)



(b) vacuum glass tube (https://web.archive.org)

5. Components of solar hybrid conditioning system

- Compressor: The compressor is that the pump that allows the flow of the refrigerant. The compressor works by increasing the pressure and temperature of the vaporized refrigerant. There are differing kinds of compressors for refrigeration applications. Reciprocating, rotary, and centrifugal compressors are the foremost common among refrigeration units.
- Condenser: The condenser may be a set of coiled tubes. within the domestic refrigerator, you'll find your compressor at the rear of the appliance. The condenser cools the vaporized refrigerant turning it back to liquid.
- Evaporator: The evaporator is that the cooling component of the cooling. It absorbs heat from the contents within the cooling appliance. Within the domestic refrigerator, the evaporator is in your freezing compartment.
- Expansion Valve: This device controls the flow of the liquid refrigerant. The expansion valve is thermostatic. It responds to the temperature that you simply set.

6. Cooling using solar photovoltaic panels (PV)

Solar photovoltaic panels can provide energy for any type of cooling with electrical energy, whether it is the type based on the air compressor or the adsorption and absorption types. Although the most popular applications in this field are those used for compressors, but it is the least efficient type of electric cooling.

Photovoltaic panels have been considered as the most widely used solar cooling technology in the cooling of small commercial and residential projects (equivalent to less than 5 MWh). The real reason behind its use in such projects is still a matter of debate, except for one of the most widely used explanations, which is the constructive incentives. And the shortage of equipment of the appropriate size for residential projects in other types of cooling, and the emergence of cooling devices with greater efficiency, or the ease of installing equipment compared to other types of cooling that use solar energy (such as cooling radiators). Because the economic efficiency of photovoltaic panels depends largely on the cooling tools used, and based on the low level efficiency of electrical cooling devices, even in the recent time, these systems were known to be of no economic feasibility without any other subsidies. Photovoltaic panels combined with SEER 14 are recognized as the least efficient systems among all other types of solar cooling. The use of more efficient, scheduling electrical cooling methods with a greater range will change the course of this scenario. It is very easy to halve the cooling and heating requirements of new buildings. This is often done without additional net costs because some of these costs are saved by using smaller cooling systems and many other benefits.

7. Geographical thermos-cooling (by natural geothermal heat)

Underground cooling pipes can take advantage of the surrounding ground temperature to reduce and eliminate normal air conditioning requirements. The use

of geothermal energy is distinguished in many seasons and atmospheres in which humans live, as its role is to reduce the accumulation of unwanted temperatures in a significant and important way, and it helps to remove heat from inside buildings. Although the use of this system increases the cost of construction in the beginning, it saves the costs of expensive conventional refrigeration equipment.

Ground cooling tubes are not considered economically efficient in humid tropical tropical environments where the temperature of the earth's interior may reach the equivalent of the normal human body temperature. It is possible to use fans that work on photovoltaic energy or the so-called solar heated heat to extract unwanted heat and draw air with low humidity that has passed through the surface temperatures of the earth inside. One of the most important things that must be taken into account when designing is that humidity factors are taken Densification is taken into account. A geothermal heat pump uses the surrounding ground temperature to improve SEER heating and cooling. A deep well is used to recycle the water and extract the ground temperature (usually extraction at a rate of 6 to 10 gallons per minute). The temperature of the Earth's interior is characterized by being lower than the highest temperatures recorded in the summer, and it is also higher than the lowest values of temperatures recorded in winter. The degree of heat conduction of water is 25 times that of air, so water is considered to be more efficient than external heat air pumps, which become less efficient when the outside temperature drops.

The same type of underground wells can be used without a heat pump, but its efficiency will be much lower. The water surrounded by the heat of the earth is pumped through a shrouded heating device (radiant) such as (refrigerant used in cars). In such systems, air is pumped through the radiators that cool the air without using a cooling system based on air pressure. The solar photovoltaic panels produce the electricity needed for the water pump and fans, as it eliminates the expenses and bills resulting from the use of cooling systems traditional. These systems are economically effective as long as they are used in environments where the temperature of the earth's interior is lower than the natural temperature of the human body (meaning its use away from the humid tropics).

8. CONCLUSION

Vacuum tube solar collectors work using materials that change phase from liquid to gaseous in order to help transfer heat with high efficiency. These solar collectors are distinguished by the fact that they contain heat pipes (conductors with high thermal efficiency) that are placed inside air-tight and sealed tubes. These heat pipes are made of copper material and attached to them are black coated copper fins (absorption plates) whose width is equal to the inner diameter of the evacuated glass tube. Protruding from the top of each heat pipe is a metal tip that acts as a condenser. The heat tube contains a small amount of liquid.

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