REVIEW ON CAR COOLING USING SOLAR ENERGY

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ABSTRACT

This paper shows how we can make use of solar energy for cooling purpose in cars. As we know that number of cars are increasing day by day, and we cannot totally depend on fossil fuels, so we have to make use of alternative energy source such as solar energy, which is freely available. The car is less efficient while keeping the Air conditioning (AC) ON as compared to OFF. So to increase the efficiency of car, the battery which runs the AC will b powered by Solar energy, with the help of solar panels built on the roof of the car. The energy developed by Solar panels can also be used to provide electricity to other devices in the car itself. When the sun is shining bright, it will store the energy in the battery and it can be used at night when the sun is not present. This also proves the "law of conservation of energy" that is 'energy can never be created nor be destroyed, It can b just converted from one form to another useful form.

Keyword: Alternative energy, Conservation, Efficiency, Fossil fuels,

I. INTRODUCTION

Fossil fuels are depleting day by day, we cannot be totally dependent on these energy sources. This also causes a great effect on the environment. Petrol vehicles releases exhaust gases which are very harmful for environment. And to prevent these harmful hazards we need to think about clean fuel. The best fuel which is abundantly available for us is solar energy. Earth receives around 174,000 terawatts (TW) of incoming solar radiation out of this 30-40% is sent back to space. Even if we use the remaining energy it is more than enough for the whole world.

Solar energy is the Sun's light which falls on earth's surface. It is then harvested from it using several technologies for different applications like heating, providing electricity, artificial photosynthesis, and car cooling to name some.

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Figure 1.1 : Energy Absorbed and Rejected by Earth's Surface

The above Fig: 1 states the energy absorbed and rejected by Earth's surface. In 2002 a study say that the earth received about 3,850,000 exajoules (EJ) per year in one hour, which is sufficient enough to provide electricity for the whole world for one year.

The total amount of energy which the earth receives in one year is equal to the total energy produced by Earth's combined non-renewable sources available. Use of solar energy got exposure after 1960, but the only thing which comes as an obstruction in utilizing this energy is that we do not get sunlight all the time. As the sun sets, the process stops. Therefore we need to store energy.

Table1.1: Energy consumption				
Sr.No	Name of energy	Human consumption peer year		
1	Solar	3850000		
2	Wind	2250		
3	Biomass	200		
4	Electricity	536		
5	Primary energy use	67		

1.1 Some Energy Storage Methods are

- Thermal energy storage
- Mechanical energy storage
- Thermochemical energy storage
- Electrical storage

Harvesting of solar energy is done by the help of solar panels of Photovoltaic cells or panels. These panels actually absorb the sun's rays and convert them into electricity or heating.

ISSN 2319 - 8354

These solar cells are arranged in group of solar cells called as modules. Usually in 6x10 format. These modules contain a system of photovoltaic system which generates and supplies electricity for personal use at our homes of commercial use.

The rating of these modules done upon it DC output power which ranges from 100 to 365 watts. A single unit of module can provide very little amount of power, therefore modules are always set in a set of groups to produce large amount of electricity or heating.

1.2 A Photovoltaic System Typically Includes

- Solar modules.
- Interconnection wiring.
- A solar inverter.
- A battery and/or solar tracker.



Figure 1.2: Basic Design of Solar Module

1.3 Materials Used to Make Photovoltaic Cells are as Follows

- Crystalline silicon cells
- Silicon which includes single-crystalline, multi-crystalline, amorphous silicon
- Polycrystalline thin films which copper indium dieseline (CIS), cadmium telluride (CdTe), and thinfilm silicon
- Single-crystalline thin films which includes materials like gallium arsenide(GaAs)

1.4 The Material Should Posses Following Properties

- Crystallinity: This indicates how perfectly the atoms are arranged in the crystal structure.
- Band gap: The energy required for the electron to move from bound state to free state
- Absorption: how good the material is in absorbing the rays from sun. These materials should posses' high coefficient of absorption.
- Manufacturing complexity: As the setup may require several layers of semi-conductor material, hence it should not be difficult to manufacture these modules.

As we studied about harvesting solar energy, solar panels, photovoltaic cells etc, we can hereby use it for airconditioning of our cars. These technologies have to be applied inside our cars for an efficient vehicle and a clean environment.

1.5 Equipments Used Are

- Car battery
- Cooler
- Solar collector panel
- Fan
- Air conditioning unit

II. REVIEW OF SOME RESEARCHERS

2.1 M.F. Basar, M. Musa, M.Y. Faizal, and N.H.A. Razik et al [1] Millions of people travel by cars to their workplace, tourist etc. They all have to park the car somewhere. In countries like India where there is lack of proper parking facility, it has to be parked under open sun. As the car is parked for a continuous session of 6-7 hours under direct sunlight, the inside temperature of the car rises to a great extent. Sometimes the temperature even rises up to 70°C which can damage the goods kept inside as well as lead to aging of car. People inside the car should feel comfortable, but it takes times to cool the car from the AC. So, to prevent the above consequence from happening, a portable car cooling system is to be used. Portable car cooler is used to cool the car on hot sunny day. As this system uses solar energy, hence it won't require any power from the car, which makes the car more fuel efficient. And because the temperature inside is maintained at normal temperature by solar energy, as we enter the car the AC does not have to work too hard to make feel comfortable.

2.1.1 .Components used in this experiment

- Electrical Motor (Primary motor, secondary motor).
- Rechargeable battery.
- Peltier cell.
- Rotating cloth.
- Water compartment

Table 2.1: Components used in experiment				
Component	Function			
Water compartment	Small water reserve and place for cloth			
	moistening			
Primary button	Controls the main motor ON/OFF			
Secondary button	Controls the activation of secondary motor			
Primary motor	Main fan control			
Secondary motor	Rolling cloth rotation control			
Rolling cloth	Produces cool air when it starts to rotate			

2.1.2 Experimentation

This experiment uses a 12V DC motor which is used to run fan blades at the speed of 5m/sec. And simultaneously a 6V DC motor known as secondary motor also runs to run the wet cloth. So due to this the system produces cooling and vapours which thereby brings coziness.

The battery used is lithium polymer which is rechargeable, which can be charged by a charger or peltier cell. In this setup there are several peltier cell placed on the either side.

Peltier cell: these produces electricity when one side of the cell is exposed to hot air and other side of it is exposed to cold air. The temperature difference is directly proportional to the electricity produced, higher the difference in the temperature, higher is the electricity produced.

Due to high velocity of propeller blades, air pressure will decrease and the hot air will be sucked into the portable cooling system.

Results: The testing of this experiment was done under direct sunlight. Due to which the temperature of the car raised up to 62° C, but when the portable cooler were fixed in it, it was able to maintain the temperature inside the car to about 25° C.

2.1.3 Result

This experiment proves that the portable cooling system was successfully developed, and was working properly. It maintained the temperature of the inside area of the car to $25-30^{\circ}$ C as compared to 70° C, which was without the cooling system.

2.2 R. Saidur, H. H. Masjuki [2] In this paper the use of ventilator is shown, the ventilator removes the hot air from inside. Solar energy can be used to run this ventilator on a sunny day, but on a cloudy day it can be run on car's battery. As we have studied earlier about the car getting het up, this kind of ventilation can be to just throw out the hot air and keep the cold air inside. The solar radiation is absorbed by the car, which makes the car hotter and harder for it to be cooled. So the driver has to start the AC before he starts the drive. Due to this, the car consumes more fuel which thereby decreases the efficiency of car. If somehow the temperature inside the car is reduced it will directly lead to fuel saving. The technique which was used to cool down the car was the use of ventilator. This ventilator is connected to the battery as well as the power supply can be given by solar cells. Due to this when the car is parked under direct sunlight, the ventilator keeps on working to keep the car temperature cool.

2.2.1 Specification

Table 2.2: Components and ratings					
Sr. NO	Name of component	Rating			
1	Solar panels	1.2W per solar panel			
2	Flow rate	20 cfm			
3	Brushless DC motors	6V/200A			

2.2.2 Result

With the use of ventilator cooling can be provided inside the car, in this ventilator power supply is given by solar energy using solar panels.

2.3 George Ban-Weiss, Pablo Rosado, Riccardo Paolini et al [3] Studied how to lower the temperature in the interior of the car by using solar reflectors. Using of solar reflectors or absorbers absorbs the sun's rays falling on the vehicle, thereby not allowing it to enter the car's interior. When the car is stationary or parked at a particular place for a longer period of time. It tends to heat up the interior space of the car. And for this AC have to work a lot to bring it back to room temperature. Due this extra work done by car it requires more fuel. As we have scarcity of fuel already, we cannot afford this to happen. So by using solar panels we can absorb the heat which is falling on the car by placing the panels on the roof, doors etc. by performing this experiment it was observed that the temperature inside of the car was lowered by $5-6^{0}C$. As the car was at lower temperature the AC has to work less, thereby reducing its work and consuming less fuel.

2.3.1 Technologies to Reduce AC load include

- Solar reflective glazing.
- Solar reflective shells.
- Ventilation.
- Insulation.
- Window shading.

Since the sunlight is responsible for 70% of cars high temperature

2.3.2 Vehicle Surface Specification

Table2.3: Surface properties					
Surface	Solar reflection	Thermal	Area		
		emmitance			
Roof	0.05	0.83	2.0		
Ceiling	0.58	0.79	2.0		
Dashboard	0.41	n/a	0.6		
Wind shield	0.06	0.88	0.9		
Door	0.38	n/a	3.0		
Seat	0.11	n/a	2.4		

2.3.3 Result

In this method heat from outside is reflected back to atmosphere and is not allowed to enter the car by using solar reflectors. Due to this, most of the solar heat is reflector by the solar reflectors.

2.4 Y.-A.Yan, C.-Y. Tseng et al [4] Studied the use of solar powered cooling inside an electric car where the use of cooling device was done. As we know there should be a decrease in the use of fossil fuels due its harmful effects on environment, electric cars should be used. The drawback of using an electric car is its weight, time taken to charge the vehicle. This car runs on a set of batteries inside the car, which also supplies power to other systems like light, music and air-conditioning etc. Using air-conditioning on cars inbuilt battery can cause

a lot of difference on its economy as well as mileage. Therefore cooling of this car was given a separate power input from an external source which is solar.

2.4.1 The Components Used for this are

- Membrane solar panel
- Rechargeable battery pack.
- Four axial fans.

2.4.2 Specification

Table 2.4.1: Specification				
SR. no	Name	Specification		
1	Voltage	15V,21V,		
2	Current	1.8A		
3	Size of panel	1300x420x1		
4	Weight	1100 g		
5	Rotating speed	6100 rpm		
6	Fan flow rate	31.5 cfm		
7	Static pressure	0.42 of water		

This paper studies the work of KYMCO which is a two-wheeler manufacturing company based in Taiwan. It is manufacturing 2 wheelers since 1963. KYMCO has now manufactured KYMCO UXV-500 which has concentrated towards solar power to prevent emission of harmful gases and prevent green house effect. Also using this solar energy for cooling purpose by letting out the hot air from inside and allowing the fresh cool air from outside It consists of a diverging channel which has axial fans arranged in parallel. These fans works n such a way that when switched ON it creates a pressure difference which sends out the hot air put of the car

2.4.3 Result

The above study states that if we are able to create a proper boundary condition we can allow the hot air from inside of the car to flow outwards. And also let the outside cold air inside, which keeps the car cool. To run these fans solar energy is preferable.

III. CONCLUSION

Use of fossil fuels cannot be used permanently, because of its limited resource as well as its harmful effects on the environment like pollution which directly effects in rise of the earth's temperature. This leads to global warming, which is a very important issue for us.

Therefore, use of natural fuels like solar energy should be encouraged. As it is available abundantly and also free from pollution. Even our country is promoting solar at a large scale. And these methods when applied to

cars can save a lot of fuel, which reduces pollutant from the exhaust. And it also causes comfort to the person sitting inside.

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