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Design and Experimental Analysis of Solar air Conditioner

Ajay S.Koli[1], T.A.Koli[2], V.H.Patil[3]

[1]M E Student GFs, Godavari Coe Jalgaon, State-Maharashtra, Country-India
[2]Assistant Professor, Dept. Of Mechanical Engineering, GFs, Godavari Coe Jalgaon, State-Mahar., Country-India
[3] HOD of Dept. Of Mechanical Engineering, GFs, Godavari Coe Jalgaon, State-Maharashtra, Country-India

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Abstract- the use of renewable energy is on the rise worldwide because of the increasing demand of energy, high oil price and concerns of environmental impacts. But now days a highest progress of solar- powered air conditioning has increased. The air conditioning system is almost a must in every building because we want to good indoor comfort inside the building. This system focuses in the design and construction of a direct current (DC) air conditioning system integrated with photovoltaic (PV) system. It is consist of PV panels, solar charger, inverter and batteries. This system operated on solar energy and can be used in non-electrified areas. but we all known solar energy cost is effective ,renewable and environmentally friendly.

***Key Words*: VASystem, Solar Energy, AC System,**

1. INTRODUCTION-

The demand of air conditioning is increasing due to the effect of to change climate and global warming. the conventional electric air conditioning are electricity through generated from fossil fuels, and greenhouse gas emission would continuously worsen global warming; in turn the demand of air-conditioning would be further increasing. In subtropical cities, air conditioning is a standard provision for buildings. However, this type of are consumption of electricity in building. Air conditioning is defined as the simultaneous processing of temperature, humidity, purification and distribution of air current in compliance with the requirement of space needing air conditioning. In general, air conditioning which also can be known as refrigeration is defined as any process of heat removal. Solar energy one of the sources of renewable energy, solar energy is the most suitable system for installation for building and residential areas. This is most common globally and preferred type of thermally driven technology is absorption cooling. The system, is simple, capacity control, easy to implementation, highly reliable, easy to operation, long life and low maintenance etc.. the solar energy are most efficient and economic from cooling. But these systems are development and improvement of a normal air conditioner unit and it is operated by using electricity generated from the PV panels. After that to utilize solar energy and to run the air conditioning system is a practical technique to replace conventional electricity. In order to obtain a feasibility of the air conditioning system using solar, a lot research and testing have been initiated to learn and discover the design and operation of the air conditioning and solar system which is consist of PV system.

1.1 Solar Air Conditioning

Solar air conditioning is the application of solar thermal energy (heat) to production of conditioned air through a thermally-driven refrigeration process.

1.2 Solar energy

Almost all the renewable energy sources originate entirely from the sun. Photovoltaic solar energy conversion is the direct conversion of sunlight into electricity. This can be done by flat plate and concentrator systems. An essential component of these systems is the solar cell, in which the photovoltaic effect the generation of free electrons using the energy of light particles takes place. These electrons are used to generate electricity.

Solar radiation is available at any location on the surface of the Earth. The maximum irradiance of sunlight on Earth is about 1,000 watts a square meter, irrespective of location. It is common to describe the solar source in terms of in insolation the energy available per unit of area and per unit of time (such as kilo-watt-hours per square meter a year).

The ratio of diffuse to total annual insolation can range from 10 percent for bright sunny areas to 60 percent or more for areas with a moderate climate, such as Western Europe. The actual ratio largely determines the type of solar energy technology that can be used.
The sun's rays that reach the outer atmosphere are subjected to absorption, reflection, and transmission processes through the atmosphere before reaching the earth's surface. Solar radiation is the world's most abundant and permanent energy source.

The amount of solar energy received by the surface of the earth per minute is greater than the energy utilization by the entire population in one year. Solar energy is referred to as renewable and/or sustainable energy because it will be available as long as the sun continues to shine. Estimates for the life of the main stage of the sun are another 4 – 5 billion years. The energy from the sunshine, electromagnetic radiation, is referred to as insulation.

There are two ways in which solar energy can be converted into electrical energy:

1. Solar Thermal Plant
2. Solar Photovoltaic

2. Solar Concentrator

Solar concentrators are the collecting devices, which increases the flux on the absorber surface as compared to the flux existing on the entrance aperture. Optical concentration is achieved by the use of reflecting or the refracting elements to concentrate the incident flux to onto suitable absorber. Due to the apparent diurnal motion of the sun, the concentrating surface, weather reflecting or refracting will not be in a position to redirect the solar radiation on the absorber throughout the day if both the concentrator surface and absorber are stationary. Ideally the total system consisting the mirror/ lens should follow the sun's apparent motion so that the absorber always captures the sun's rays. In general, therefore, a solar concentrator consists of

- Non-concentrating
- Concentrating type

Table -1: Obs. Table

		Absorber	Generator	Condenser	Evaporator
Temp		(TA)	(TG)	(TC)	(TE)
˚C		33	90	38	19
Temp K		306	363	311	292
Pressure bar		5.4	9.2	9.2	5.4
Specific Enthalpy (kJ/kg)	Liquid (hf)	228	254	254	228
	Latent (hfg)	409	418	418	409
Specific Entropy (kJ/kg K)	Liquid (sf)	1.0885	1.1809	1.1809	1.0885
	Vapour(sg)	1.719	1.7122	1.7122	1.719
Enthalpy (kJ/kg)	Liq+Vap(hg)	181	264	264	181

Calculations based up on Human comfort. (For ease of calculation and compactness of the model we have made all of our calculations, taking Capacity = 1TR)

Coefficient of performance (COP) = [Te/Tc-Te] X [Tg-Ta/Tg]
COP= [292.0/311.0-292.0] X [363-306/363]
COP= 2.41

Work done (Winput) = [Te/Tc-Te] X [Tg-Ta/Tg]
Work done = [292.0/311.0-292.0] X [363-306/363]
Work done = 87.02Kj/min = 1.45Kw

Mass of Refrigerant flowing (mf) = Hgc-Hfc / capacity 210
mf = 418-254/210 Kg/min
mf= 0.78Kg/min

Volume of Refrigerant flowing (vf) = mass of flow rate / density = 0.000059 m^3/sec.

Power Required to Drive the Suction Pump = volu.of flow rate X (Pg-Pa) X 10 /η pump
0.000059 X (9.2-5.4) X 10^5/ = 26 W

Amount of eat required in Generator = (Win X 1000-Ppump) watts= 1.424 kj/sec

Amount of heat rejected by refrigerator = Mass of Refrigerant flowing in cycle X Sp.heat of refrigerant X (Tc-Ta) kj/min
= 0.78 X 1.350 X (311.0-306.0) = 0.088kj/sec.

Where

W= work done
COP= coefficient of performance
MF= mass of refrigerant flowing
VF= volume of refrigerant flowing

Result:
To calculate the theoretical COP of the solar air conditioner to solve above equations

Table: 2 calculated cop values for different generator temperatures

Tg (ºK)	Ta (ºK)	Tc (ºK)	Te (ºK)	COP
363	306.0	311.0	292.0	2.41
353	306.3	310.5	294.0	2.37
343	306.5	310.2	294.8	2.03
333	307.1	309.9	296.3	1.69
323	307.4	309.0	299.0	1.42

At certain limit of temperature as per design we reached Generator temperature at 363^0k, Absorbing temperature 306^0k,Condensing temperature 311^0k, evaporating temperature 292^0k and COP is 2.41.Based on these

Temperatures we have drawn various graphs with different parameters.

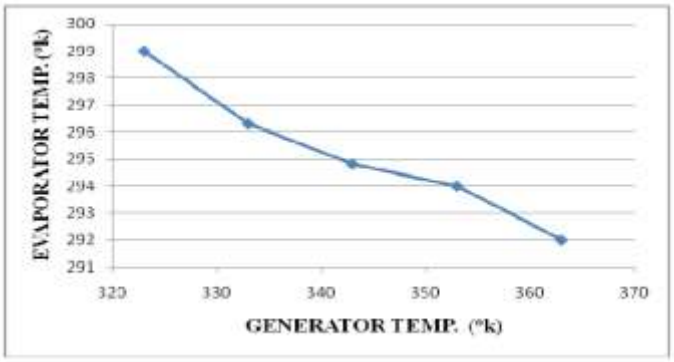

Chart -1: The variation of Evaporator temp with Generator temperature

The above graph shows that when the generator temperature increases the Evaporator temperature is decreased.

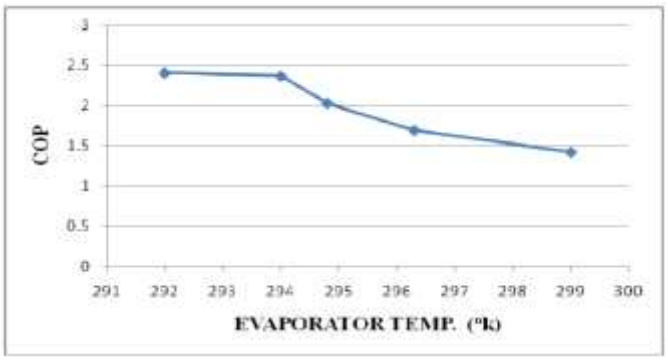

Chart -2: The variation of COP with Evaporator temperature

The above graph shows that when the Evaporator temperature decreases the COP is increased.

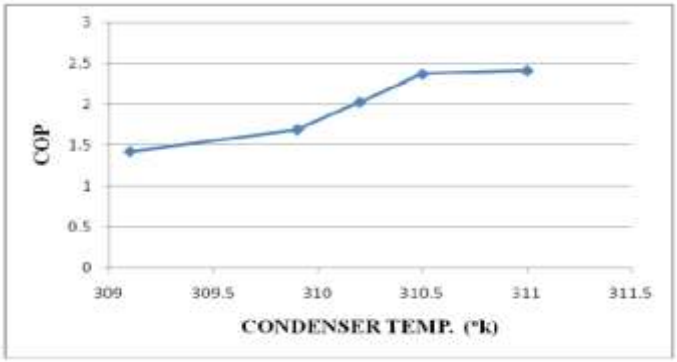

Chart -3: The variation of COP with Condenser temperature

The above graph shows that when the Condenser temperature increases the COP is increased.

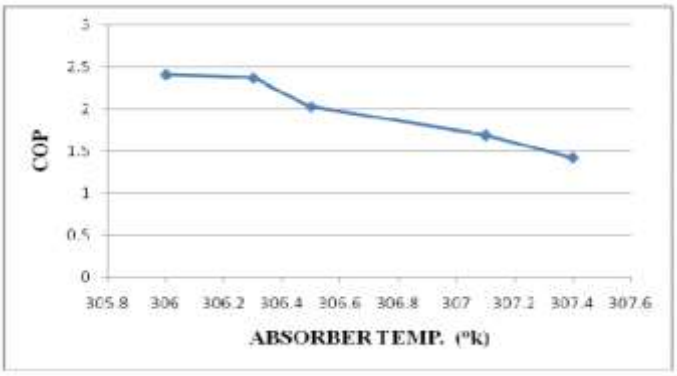

Chart -4: The variation of COP with Absorber temperature

The above graph shows that when the Absorber temperature decreases the COP is increased.

Fig -1: Final actual system cycle

3. CONCLUSIONS

An experimentally to analyze and is constructed to predict the performance of solar air conditioner made up of different parameters. It is found that the temperature of the still increases or decrease with the increase in COP.

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