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Efficient Solar Heat Collector for Power Generation

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Abstract : Solar technologies have the potential to be major contributes to the global energy supply. The ability to dispatch power allows large scale central solar technologies to provide 50% or more of the energy needs in sunny regions around the world. Large scale solar technologies can provide energy price stability as well as quality jobs to the local community. Solar energy has the potential to become major a domestic energy resource in the 21st century. Solar thermal energy conversion for power generation for both low and high temperature systems is an active area of research aimed mainly at addressing environmental and climate change concerns but also as a possible complimentary avenue of tackling the current power supply deficits . A number of high temperature thermal power generation concept power plants have been installed worldwide. Passive solar Technologies often yield high solar saving fractions for space heating, when combined with active solar technologies even higher conventional energy savings can be achieved. This paper describes the efficient solar heat collector for potential power generation.

Key words: Solar Heat Collector for Power Generation.

Introduction

Solar power is the flow of energy from the sun. The primary forms of solar energy are heat and light. Sunlight and heat are transformed and absorbed by the environment in a multitude of ways.

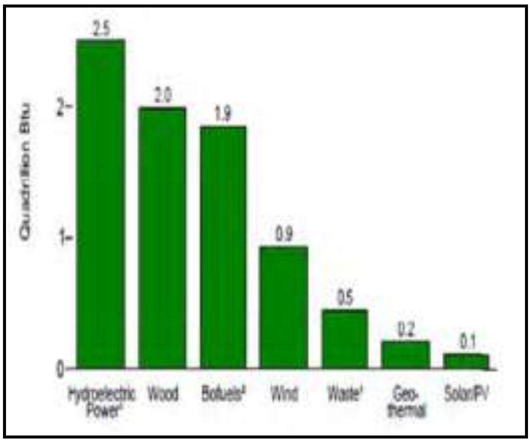

Fig 1. Energy source used in the world

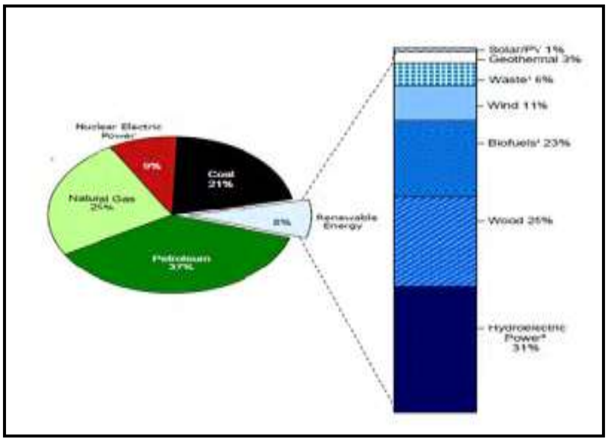

Fig 2. Renewable energy consumption

As availability of resource below the earth is going on reduced rapidly and the government is also seeking for alternative sources (Fig 1 and 2) for fulfilling the future generation requirement. Out of number of renewable energy sources Solar thermal energy accounts for one of the major forms of renewable energy utilization.

Solar energy has an enormous potential like all the different prototypes have shown, and the prediction about this type of technology show that the efficiency of these systems can be increased in a significant way.

The solar systems have a low environmental impact. The output of flat plate collector passes through the nozzle and then impact to the turbine blades. Developing advanced applications such as low cost solar water heating and collectors[1-7]. The collector's mean temperature assumed to be the algebraic average of the inlet and outlet fluid temperatures. In their study, they used a first and a second order differential equations to describe the collector. To design the solar thermal power generation Flat-plate collector is a device having an almost flat absorbing surface, with an area equal to the aperture of the collector. The solar radiation is collected on the absorbing surface of the collector.

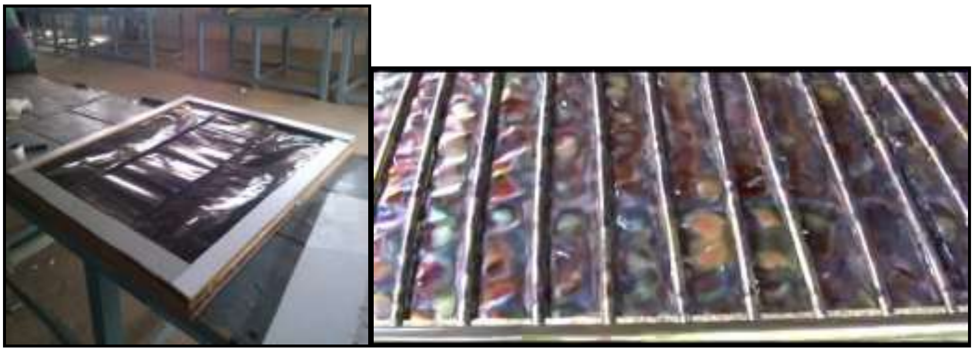

Fig 3. Flat-Plate Collector

Flat-Plate Collector (Fig 3) is a device having an almost flat absorbing surface, with an area equal to the aperture of the collector. The solar radiation is collected on the absorbing surface of the collector. It is possible to obtain the maximum energy only when it is rotated along the sun direction. In this context, tracking plays an important role. Tracking is desirable for orienting a solar device towards the sun there by collecting maximum solar energy and improving efficiency. This advantageous to water heater collector applications and this mechanism has been found more advantages than fixed flat plate collector. Flat-plate collectors are designed for applications requiring moderate temperatures usually up to 110°C above ambient temperatures. The simplest flat plate collectors are the solar ponds and the solar stills which operate by direct utilization of the incident solar radiation acting simultaneously as solar energy converters.

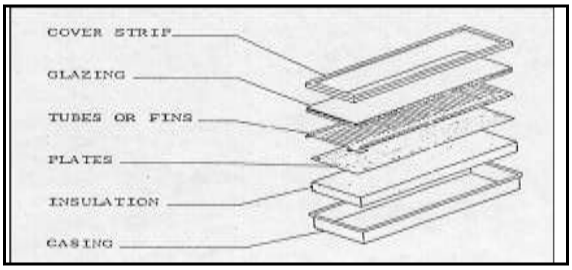

Fig 4. component arrangement

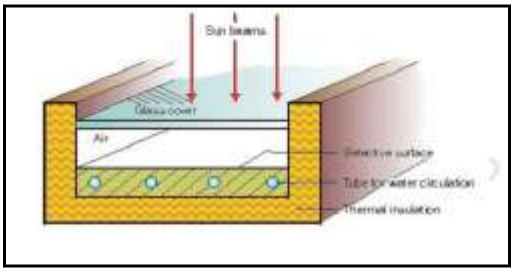

Fig 5. Cross sectional view of collector

Specification of Flat Plate Collector

Length of the collector = 1.2m, Width of the collector = 1m, Length of the absorber plate = 1.2m, Width of the absorber plate = 1m, Material of the absorber plate = Copper, Thermal conductivity of the plate material = 386 W/mK, Density of the plate material = 8954 kg/m3, Plate thickness = 30 gauge, Diameter of the tube = 6.35mm, Tube center to center distance = 100mm, Number of tubes used = 10, Glass cover emissivity/absorptivity = 0.85, Refractive index of glass relative to air = 1.5, Diameter of header pipes = 12.7mm, Insulating material used = Glass-wool, Thermal conductivity of insulating material = 32.2*10.3 W/mK, Density of insulating material = 200 kg/m3

Results from directly measured solar energy radiation intensity on horizontal and inclined surfaces from January to December are shown in Fig 6.

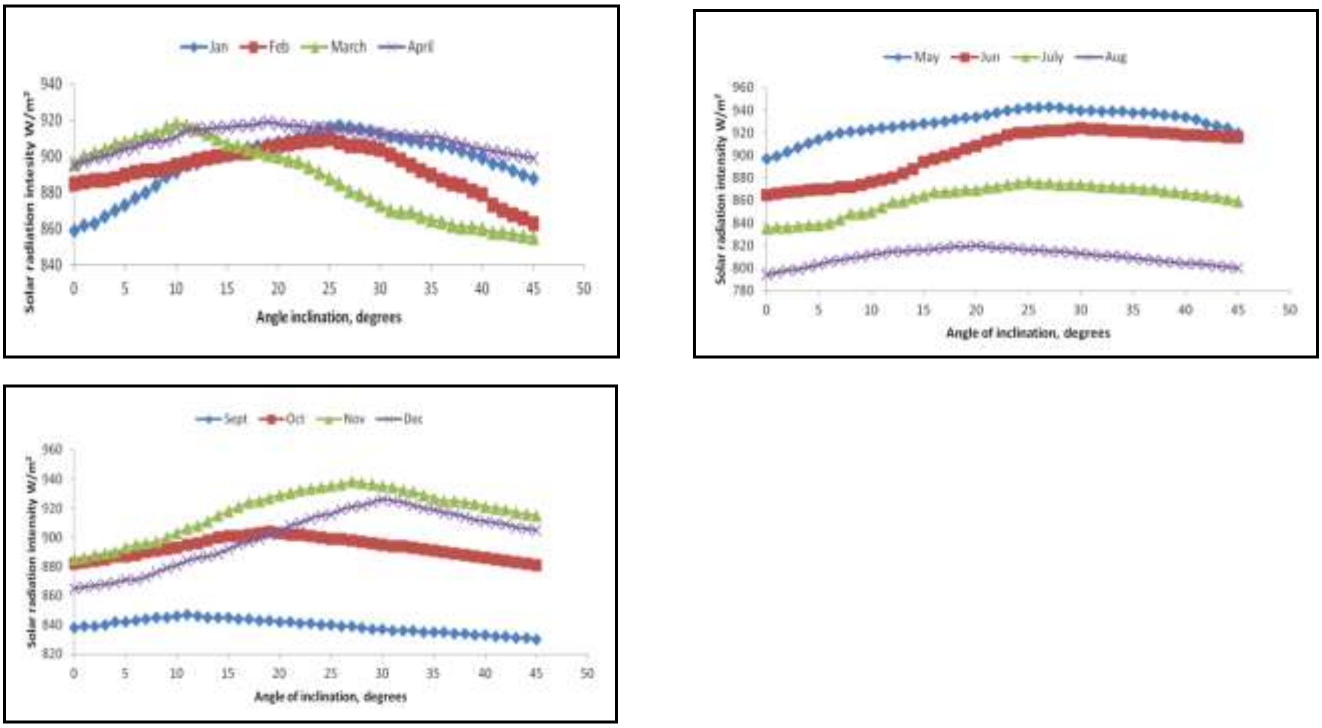

Fig 6. Responses of measured solar radiation intensity intercepted on flat plate surface at varying angle of inclination

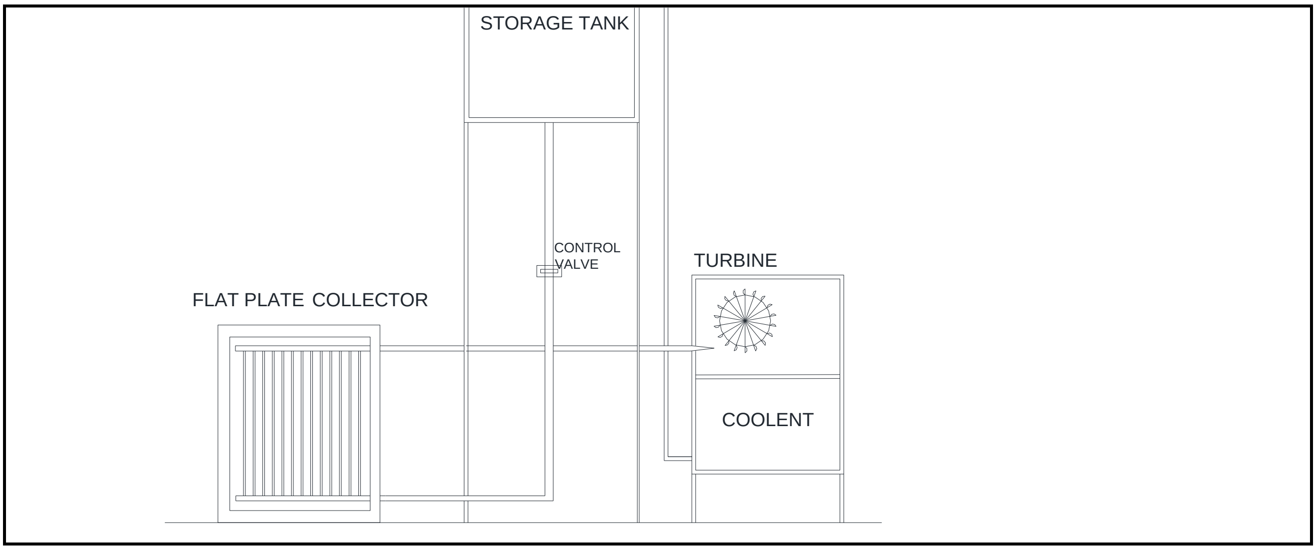

Fig 7 Components arrangements for solar power generation

Table 1: Average value of measured and calculated solar radiation intensity and energy

Month of the year	**Average value of optimum angle of inclination /degree**	**Average value of solar radiation intensity on horizontal level (0 o)/W·m-2**	**Average value of solar radiation intensity on optimum angle of inclination. /W·m-2**	**Solar radiation intensity gained at optimum angle of inclination. /W·m-2**	**Horizontal monthly average solar radiation energy generation /KJ·m-2**	**Monthly average solar radiation energy generation gained at optimum angle of inclination. /KJ·m-2**
Jan	26.5	860.5	916.5	56.0	739,444.86	48,121.92
Feb	24.5	884.5	909.0	24.5	692,643.11	19,185.71
March	10.0	896.5	918.5	22.0	770,380.38	18,905.04
April	19.5	896.0	918.5	22.5	745,113.60	18,711.00
May	26.0	896.0	942.4	46.4	769,950.72	39,872.45
Jun	30.0	865.0	924.0	59.0	719,334.00	49,064.40
Jul	24.0	835.5	871.0	35.5	717,961.86	30,505.86
Aug	21.0	795.5	819.9	24.4	683,589.06	20,967.41
Sept	11.5	837.5	846.9	9.4	696,465.00	7,817.04
Oct	19.5	883.0	904.5	21.5	758,779.56	18,475.38
Nov	27.0	884.5	938.5	54.0	735,550.20	44,906.40
Dec	30.0	865.5	928.5	63.0	743,741.46	54,137.16
Total	269.5	10,400	10,838.2	438.2	8,772,953.81	370,669.77

The analysis from Table 1 indicated that when a flat surface was located at the predicted optimum angle of inclination for each month of the year, an average annual increment of 4.23 % solar radiation intensity was achieved, when compared with the yearly average solar radiation intensity harnessed by a flat plate collector on horizontal position and under the same condition. This percentage increase amounted to annual average solar energy gain of 370,670 MJ/m^2. The average angle of inclination a solar flat surface collector should be mounted at fixed position is found to be 22.5^o

Conclusion:

Out of number of renewable energy sources, Solar thermal energy accounts for one of the major forms of renewable energy utilization. Solar technologies have the potential to be major contributes to the global energy supply. Large scale solar technologies can provide energy price stability. Solar energy has the potential to become major a domestic energy resource in the 21st century.

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