

A Review Paper on Solar Chimney Power Plant

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Abstract:-This paper gives a general view of solar chimney power plant which is an application of renewable sources of energy. It operates on principle of conversion of solar energy into electrical energy. The heat radiation of sun is used to heat the air under roof and the heated air is allowed to pass through a chimney, which will rotate the turbine. The turbine is used to drive the rotor of an AC alternator which will generate the electricity. This paper deals with basic components of solar plant and earlier research details. It also gives idea of actual work is to be carried on solar chimney power plant.

Keywords:- (Index Terms)Solar chimney, Turbine, Generator, collector, sensor, solar energy, Radiation, pressure, velocity.

1. INTRODUCTION

India is a developing country in which each sector such as automobile, process automation, real estate, agriculture growing with high speed. As each sector grows with very fast rate, they are facing major problem of power supply. Present power generation is less as compared to required demand. To balance the power distribution, they have to shut down their units for one or two days in a week in different region which will effect on Indian economy.

Maximum power generation is based on conventional source of energy i.e. fossil fuels such as oil, coal, which will not last for long time. Excess use of these fuels / energy may cause shortage of energy in future. Nature also has some limitations to develop fossil fuel. The use of conventional energy also cause problem of air pollution which will affect the nature creating global warming. So that research scholars and scientists are planning for non conventional source of energy such as wind, tidal, biogas, geothermal and solar.

The geographical location and fixed seasons in India is best suitable for solar power plant which gives idea about solar chimney power plant.

Solar chimney power plant is used to generate electricity by using solar energy. Solar energy radiations are used to heat the air under roof or collector. The hot air is allowed to pass through the tall chimney and it is then utilized to drive the turbine which will generate the electricity [1].

I am planning to vary the diameter of chimney to keep velocity and speed of turbine constant which will enhance the efficiency and stability of power plant. This can be done by pressure sensor transducers and closed loop control system.

2. PRINCIPLE OF SOLAR CHIMNEY PLANT

Figure 1 shows the basic details of solar chimney power plant. It consists of solar collector, chimney and turbine. The solar radiations are used to convert into electricity with the help of solar chimney plant.

Direct and diffuse radiation strikes the glass roof collector, where specific fraction of energy is reflected, absorbed and transmitted due to atmosphere, clouds and surface.

The quantity of reflected, absorbed and transmitted energy depends on the solar radiation incidence angle and optical characteristics of glass such as refractive index, thickness, and height and extinction coefficient.

The transmitted solar radiations through the roof strike the ground surface where part of radiated energy is absorbed by the surface and part is reflected. The reflected radiations are used to heat the air under roof. Hot air under roof rises up into the chimney of the plant [19], thereby drawing in more air at the collector perimeter and thus initiating forced convection which heats the collector air more rapidly. As the air flows from the collector perimeter towards the chimney [18] its temperature increases while the velocity of the air approximately constant because of the increasing height of the collector.

The heated air travels up the chimney causing to create pressure difference at the inlet and outlet of the chimney thus the air flowing through the chimney is used to drive the generator to generate the electricity.

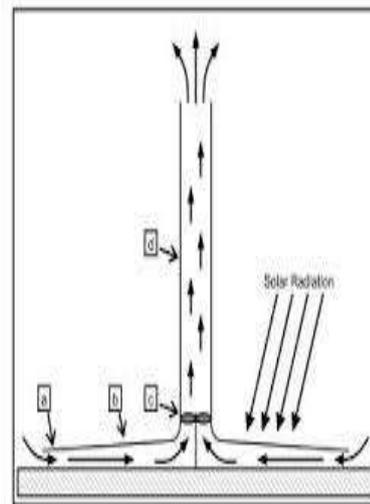


Figure 1: The Basic Details Of Solar Chimney Power Plant.

3. BASIC COMPONENTS OF SOLAR CHIMNEY PLANT

3.1. Collector

Collector is the main component of solar chimney power plant. Solar energy collectors are the special kind of heat exchangers that transform the solar radiation energy to internal energy of the transport medium [20]. Collector is used to produce the hot air by greenhouse effect. The radiations

received by the collector is used to heat the air between ground surface and collector [21].

The material used for collector construction is plastic film or glass plastic film. The collector roof is above the ground level. The height of roof adjacent to the chimney is more to divert the air towards chimney with less friction. The amount of radiations received will depend on material of the collector and the angle of solar radiation.

Significant research has been made in the design of collector to enhance the efficiency of power plant. Pasumarthi and Sherief has introduced and tested two types of collector i.e. by extending the base and introduced the intermediate medium in it which has enhanced the temperature [23]. An analytical model has been introduced by Schlaich (1995). Numerical models of collector are presented by Kroger and Buys (1999) [24]. They also presented transient collector analysis to predict maximum power for one year operation [25] cycle. Gannon and Van Backstrom (2000), Hedderwick (2001), Beyers et al (2002) present work in their paper specific to solar chimney collector [24]

M. O. Hamdan (2004) presented an analytical model to predict the performance of solar chimney power plant. In 2005 [27], Canadian E. Bilgen and J. Rheault proposed the construction of the solar collector in a sloped and tapered section to enhance the collector efficiency [28]. N. Ninic (2006) has analyzed the various types of collector and design for better performance of solar chimney [30]. Bonnelle (2003) suggests new collector configuration to improve the collector performance.

3.2. Chimney

Chimney is another most important component of the solar chimney power plant. The efficiency of plant depends on the material, structure and height of the chimney. It also depends on the diameter of the chimney. It is mounted at the centre of the roof collector. So that the chimney tower creates temperature difference at the base and top of the chimney which will suck the hot air towards the top of chimney. The upward movement of the hot air is utilized to drive the turbine located at the chimney. The turbine are generally located near the base of chimney to reduce the mechanical mechanism [25]. Efforts of different types of chimney are made to enhance the efficiency of power plant such as sloped solar chimney, floating solar chimney, geothermal solar chimney, hybrid cooling tower solar chimney.

Schlaich (1994) suggested the reinforced concrete as a building material structure tower high. Studies have shown that practically this method of construction is the alternative most sustainable and cost effective [21, 37, 38].

3.3. Turbines

Turbine is an important component of solar chimney power plant. It is used to convert air flow into mechanical energy and transmit to the generator. It is similar to the wind turbine and located at the base of chimney. The speed of turbine due to air flow causes to drive the generator to generate electricity and powered it to grid [18, 41, 43].

4. CONCLUSION

Solar chimney power plant is an alternate power generation technology. Implementation of these plants will help to balance the energy demand in India. The review discusses

basic concept, working and components of power plant. This paper also gives the details of solar chimney power plants worldwide.

5. REFERENCES

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