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Hybrid Chimney

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DEVELOPMENT OF HYBRID CHIMNEY

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ABSTRACT

Hybrid chimney is a new electric power generating method for utilizing solar and wind resources. Solar radiation is converted to heat by solar collector, which heats up the air. This heated air rises due to buoyancy effect thereby powering the turbine while flowing through the chimney. This cycle continues and electricity is produced via generators. The chimney serves as a link between the low air pressure to higher air pressure. Inside the chimney, turbine converts the wind energy into electricity.

I. INTRODUCTION

India is situated in equatorial sun belt of earth, hereby yielding great amount of radiant energy from the sun. Power can be generated by the hybrid solar plants. Solar hybrid chimney is designed with the same concept. The solar hybrid chimney operates on the natural phenomena that deals with the use of thermal solar energy which revolves around the earth surface heating it & therefore surrounding air also gets heated by the sun light. This warm air expands, causing upward buoyancy force promoting the flow of air towards the earth atmosphere. A system connected to turbine electricity, this entire concept of heating is based on greenhouse effect.

II. LITERATURE REVIEW

There were many researchers conducted researches on thermoelectric refrigerator some of which are:

The main purpose of using hybrid chimney is its eco-friendly behavior, cheap, compact, and it has low running cost as compared to other type of methods that are used to generates electricity.

i. This paper investigates a novel hybrid system combining thermal electrical generators and a wind turbine. In the proposed system, solar energy is converted to heat by an absorber plates. A wind current is accelerated before passing through the turbine. [Suhil kiwan, et all (2018)].

ii. This paper investigates that this type of system will produce some power. The sun will heat the collector, which will heat the air above it. The higher air temperature will expand the air, reducing air pressure. Air must move from high to low pressure through the chimney and pass the wind turbine, producing power. [Amit Sharma, et all (2018)].

iii. The paper investigates, as India is a country of large barren land, so this technology can have used to produce large amount of electricity. It can be beneficial for countries like Asia, Africa and Australia which have unproductive land and huge amount of solar energy. One of the drawback is that it need larger chimney for large production of chimney. [Farhan Ali, et all (2016)].

iv. Generation of electricity using solar energy is a feasible alternative for power generation over conventional power plant like thermal and hydraulic power plant. The review gives basic principle and operation of this system. This method is adopted by many researchers because of high construction of other power plants. [P.J bonsad, et all (2014)].

v. Solar chimney Solar chimney power plant is an interesting alternative to centralized electricity generation power plant. The review discusses the principle and characteristics of such a system, its requirement, its construction and, its operation. It can be concluding that such systems need

to be very large if they are to generate significant qualities of power. [Amel Dahari, et all (2013)].

vi. Hybrid solar chimney technique has been proposed and analyzed in the present work. It is very useful in countries like India and Pakistan. [Mohammad ayub, et all (2018)].

III. COMPONENTS

a) SOLAR COLLECTOR

The solar collector has low reflectivity and have complete black color such that most of the sunlight that strikes on it gets absorbed and converted into heat instead of reflecting back.

A metal color scheme is efficient. However, the collector must absorb light well in the ultraviolet light, 44% visible light & 51% infrared light.

Hot air from the solar chimney is produced by greenhouse effect via air collector consisting only of a glass or plastic films covering stretched approximately 2 to 6 m above the ground. Thus surface under the roof heats and transfers it to the air flowing radially above it from outside the chimney.

b) CHIMNEY

It converts pressure energy into kinetic energy. The chimney is plant's actual thermal engine. The air shaft has low friction losses because of its optimal surface volume ratio. The upward thrust generated in the collector is proportional to the temperature rise of air.

c) TURBINE

Turbines is the powerhouse of the plant. It generates the K.E into electric energy via generators situated at the base of the chimney. The speed of the turbine is governed by the air flow inside the chimney.

IV. METHODOLOGY

This is quite simple concept. The solar chimney has a large chimney at the center of the field, which is covered with glass. The solar heat generates hot air in the gap between the ground and the glass collector which is then passed through the central tower to its upper end due to density difference between relatively cooler air outside the upper end of the tower and hotter air inside tower. While travelling up this air drives wind turbines locate inside the tower. These systems need relatively less components and were supposed to be cheaper. Glass pipe are used below the solar collector in which water is kept.

These water pipes receive sunlight in the day time and the water inside these water tubes gets heated. In the night time when there is no energy from the sun, these water pipes emit heat and the air between the collector and the ground gets again heated and due to density difference between the hotter air. The cooling air outside the chimney the air moves toward chimney and drives the turbine-generator system. There by generating electricity in day as well as at night.

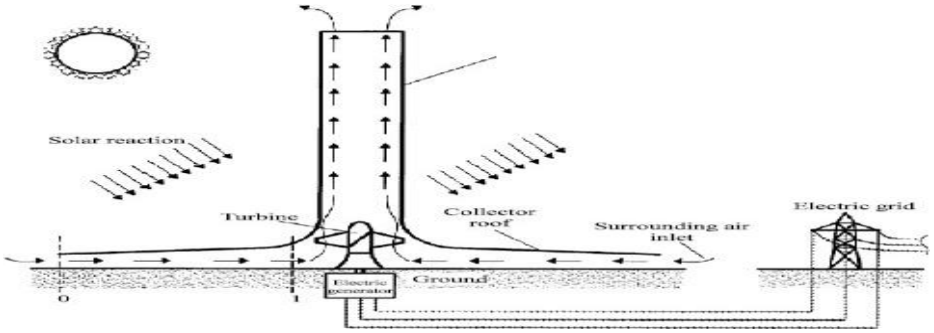

Fig. 1 (a) Process of hybrid chimney.

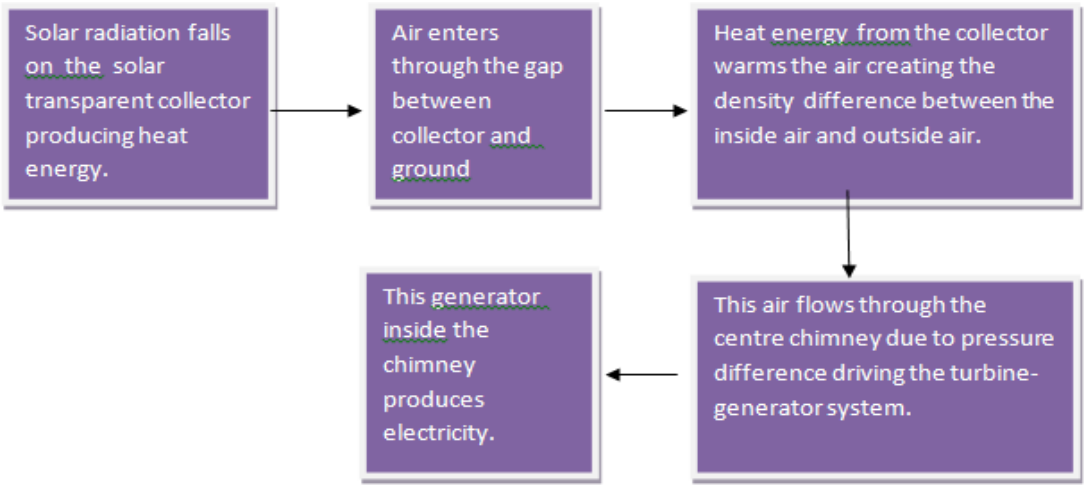

Fig. 1 (b) Flow chart.

V. DESIGN

The design of the hybrid chimney module is created with the help of the SolidWorks software for the proper and efficient analysis of the respective module design. The gives option of analyzing the problems related to the design and provides us the solutions to overcome them and come up Thebes efficient module design possible.

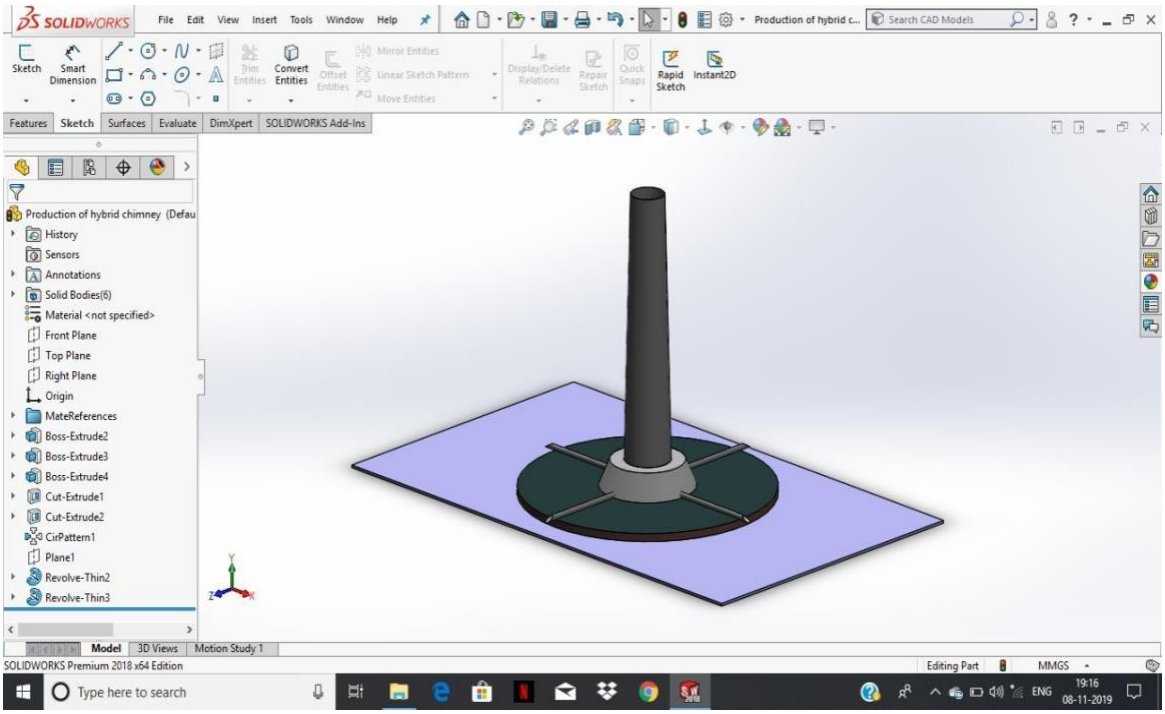

Fig. 2. Solid work Design of Exterior of Hybrid Chimney.

VI. EXPECTED OUTCOMES

a) COST

The initial investment cost of hybrid chimney power plant is much higher than that of the conventional coal power plants. But, the operating cost of HCPP is much more economical than other resources.

Variables	Solar Chimney Pf/kWh	Coal Pf/kWh	2 x C.C. Pf/kWh
Investment	11,32	3,89	2,12
Fuel	0,00	3,87	6,57
Personnel	0,10	0,78	0,31
Repair	0,52	0,92	0,83
Insurance	0,01	0,27	0,12
Other running costs	0,00	1,16	0,03
Tax	2,10	0,69	0,37
Total	**14,05**	**11,58**	**10,35**

Commissioning in 2001
Power: 400 MW
Running hours: 7445 h/a
Yearly energy: 2978 GWh

Own investment 1/3 at 13,5%
External investment 2/3 at 8%
Total interest rate: 10,67%
Tax rate: 30%

Fig. 3. Cost of various power plant.

b) SOLAR CELL TEMPERATURE

The graph shows variation of solar cell temperature between design “A” & “B”. Both as design make an angle of 45 degrees with horizontal line. System “A” with inbuilt glass cover gained a temperature of 67 degrees Celsius at 12 noon. Hence, glass cover helps to boost the temperature of air over solar collector.

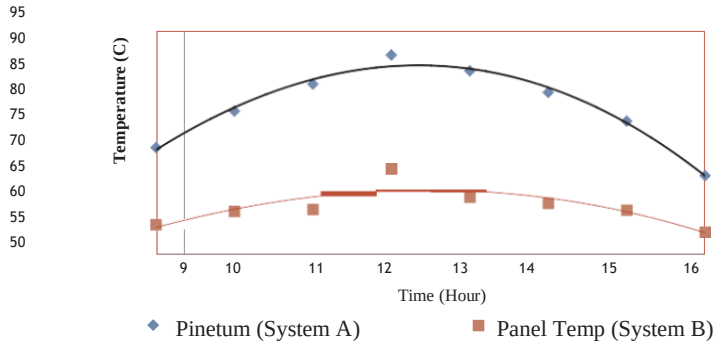

Fig. 4. Temperature difference of system A&B.

c) AIR VELOCITY

The average velocity diagram shows a positive trend with time, the outlet air temperature reached its minimum value due to reduction in absorption. These trends are common in chemical chimney. The diagram confirms that speed level in “A’ was greater than system “B”. This conclusion is used for determining the optimum location of wind turbine.

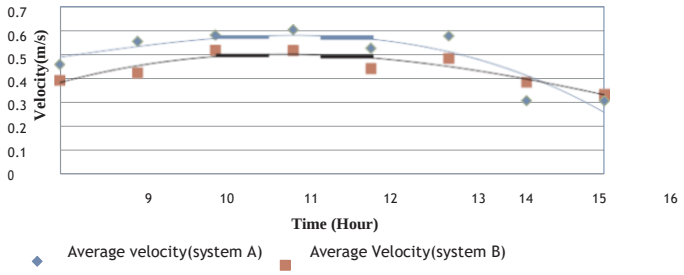

Fig. 5. Variation of average air velocity for two systems during the day.

d) ELECTRIC POWER

Electric power depends upon the solar radiation and heat gain. The electric power generated also tends to drops when the temperature of the panel becomes higher than that of the design temperature.

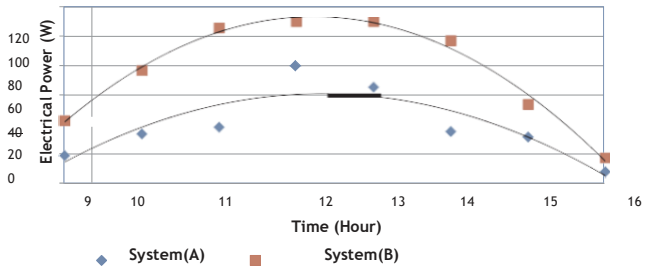

Fig. 6. The variation of electrical power produced from the two systems.

VII. CONCLUSION

The Hybrid chimney design is a substitute method for generating energy as dependency on fossil fuels might lead to a catastrophic future for upcoming generation.

The initial cost of the plant to more as compared to other system. But the operation is much more economic than existing methods of power generation. The review discusses about basic concepts, working and components of power plants. This paper also includes various aspects of the solar chimney power plant.

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