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## Analysis of Experimental Setup of a Small Solar Chimney Power Plant

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### Abstract

The paper details the analysis of solar power generating unit in which a solar collector and solar chimney is used to generate a solar induced air flow which drives turbine to generate electricity. Paper presents formulation of mathematical model for experimental setup of a small chimney power plant. Prototype plant is built on the top hill of the Institute which covers almost 250 Sq. ft. area has a UV Reinforced Plastic, Crystalline Plastic, Polycarbonate each of thickness 2 mm and glass as the collector. The base of collector is covered with sand on the ground layer of brick and concrete. The tower is made of PVC pipe of 8 inch of 20 feet height. The experimental results show the average power output varies from 10 to 25 watts as relatively low because of the lacking of solar intensity as the experimentation is taken in winter the month of November 2017 from the experimental setup of small chimney plant. The setup has a low initial cost and absolutely no operating cost. Thus using of less costly components enables making of a small economical plant.

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*Keywords:* Solar chimney, collector, turbine, experimental setup, tower

### 1. Introduction

The amount of electricity generated is a critical issue over the world. The global warming is another critical issue. Currently, renewable energy sources are ones of most important solutions to deal with these critical issues. Vidharbha region is one of the hottest cities in the world. This climate conditions makes the city an ideal place for solar chimney power plant to generate electricity[1,2]. In this paper, study of a small model of chimney height of 12 feet, collector diameter of 15 feet and chimney diameter of 0.66 feet is installed. The mathematical model based on the dimension of the setup, thermodynamic analysis of the flow and other atmospheric condition is used to predict its performance. This model is used to predict the output power of the solar power plant of similar type. The solar thermal power plants have many advantages, the priorities of consistent power output. It is help in global electricity production. In 1982, the first pilot plant of the solar power plant was built in Spain, since then many prototypes of the solar power plant had been built by the experts in various countries. The present study aims to measure and predict the performance of an experimental setup of solar power plant with the collector, chimney and turbine located inside at the base of the chimney on the top of collector sheets, which is sloped at 15 degrees[3-6].

### 2. Experimental Setup

Figure 1 show the experimental setup of solar chimney power plant. The power plant is a natural driven power generating system. It converts solar energy first into thermal energy then into kinetic energy finally into electrical power [7]. It combines the concept of solar air collectors and a central updraft chimney to generate a solar induced convective flow which drives turbines to produce electricity. It consists of a greenhouse roof collector and updraft chimney that is located at the centre of the greenhouse roof collector.

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A solar chimney power generator has three major parts.

- i. A circular solar collector (Greenhouse)
- ii. A tall cylinder in the centre of the solar collector- solar chimney
- iii. Air turbine to generate electricity around the bottom of the solar chimney.
- iv. Figure 2 show the schematic of the experimental setup. As shown in figure 1 and figure 2, a large area is covered by the transparent collector which is slightly sloped being highest at middle. The air heated by sun is trapped trying to go up. Hot air finds way up through the chimney. So it flows through the chimney driving the turbine situated at the chimney entrance thus generates power [8].



Fig. 1. Experimental setup of Solar Chimney Plant

In the present paper, the power generated is less. Therefore, the factors influencing the solar power plant have been identified, so as to improve the power generation capacity of the experimental model. The generalized mathematical model has been formulated using theories of experimentation for the power produce from the present setup. Therefore, present approach will find the most influencing variables in the design of the experimental setup of solar chimney power plant which will enhance the performance of the power plant. Based on the design in which dependent and independent variables of an solar chimney power plant is indentified and compared for the improving the power generation capacity of the experimental setup[9-12].

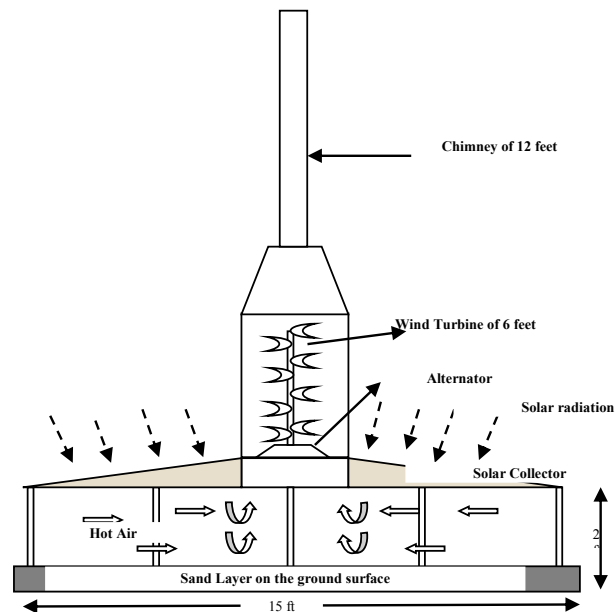


Fig. 2. Schematic diagram of the experimental setup

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