EXPERIMENTAL ANALYSIS MODELLING OF TOWER SOLAR CHIMNEY

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***Abstract*— Solar Tower Chimney (STC) is one of the sustainable sources. The aim of the experiment is to study the effect of different air temperatures (ambient temperature) on the airflow inside the chimney as well as on the power generated by (STC) during the summer period and the possibility of installing tower solar Cchimney in Basrah region. The experiment result shown that the power produced by the chimney will increase per hour, when the outside temperature increases. In the present work, different values of the air velocity inside the chimney (height 7.2 m) were measured, the maximum was reached at 2:00 pm (2.9 m/s) afternoon when the ambient temperature was 45.8 C°. The absorbing surface effect is discussed. It was noted that the high level of humidity and the excessively flying dust in most days of the year are considered to be the most important determinants of this type of systems. The present study included developing a simplified mathematical model depending on the conservation of energy and mass for the present solar chimney.**

***Keywords*— Solar Cchimney; experiment; thermal energy; air velocity; power output; convection, tower.**

I. INTRODUCTION

There are more designs concept of a renewable energy power plants for generating electricity from low-temperature solar heat. Air is heated under a very wide covered collector structure, resembling a greenhouse, surrounding the central base of a tall Chimney Tower (Figure 1). Mostly the solar chimney is insulated to prevent heat exchange between the air inside chimney and its out surrounding [1]. The resulting convection causes an upward flow of hot air in the cooling tower due to the chimney effect. This airflow drives the wind turbines placed in the flue updraft or around the base of the flue to generate electricity [2]. Thermal energy of air is converting to mechanical energy by a turbine to generate electricity. There are many researchers interested in experimental design to improve (STC), and how to receive the highest efficiency. Nowadays, many types of research are developed to study solar chimney in order to produce electricity. The first Solar Chimney Power plant was in Spain in 1983 [3,4]. Azeemuddin et al. predicted that the parameter to increase the system power output is to increase its size. Their study deals with simulation work to validate results of pilot plant and include the effects of waste heat from a gas turbine power plant in the system and the effects show continuous night operation, lead to increase in power global solar irradiation at daytime and also lead to increase in overall efficiency [5]. Md. Sakir, et al, presented theoretical and experience for making a small and less expensive prototype plant which can be built on rooftops of residential buildings, the experimental results showed that the average power output varies from 3 to 20 watts and the efficiency was maximum 0.11% [6]. A. Shyaa et al. investigated experimentally and numerically, the reduction area of solar collector and they performed numerical study using ANSYS Fluent, they focus on study the effect of change the height of reduction area to the design velocity [7]. A. Bejalwar and P. Belkhode analysis solar power generating unit in which a solar collector and solar chimney was used to generate a solar induced air flow which drives turbine to generate electricity, they presented formulation of mathematical model for experimental setup of a small chimney [8].

Iraq southern cities are ideal to generate electricity by (STC) technology due to the very height temperature degrees.

The aim of the study is to create experiment model (in Basrah) of a solar chimney to study temperature differences, velocities and airflow (in collector, ground and chimney) per day. The main measurements were to analyze of different parameters which are affected on power output. It was noted that the high level of humidity and the excessively flying dust in most days of the year are considered to be the most important determinants of this type of systems. The present study included developing a simplified mathematical model depending on the conservation of energy and mass for the present solar chimney.

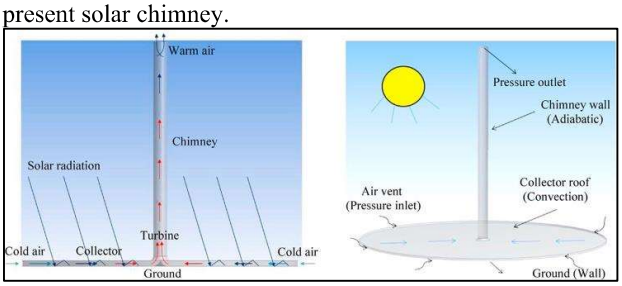

Fig.1. Principle of tower solar chimney

II. MATHMALTICAL MODELING

The principle of the conservation of energy and mass of the present solar chimney Fig (1). There are three unknown temperatures T_{co}, T_g, $T_{air,\ out,\ collector}$ and air mass flow rate can be determined by solving eenergy balance equations. Air flow inside Solar Chimney and between collector and ground is