PERFORMANCE ANALYSIS OF GRAPHITE ROD FOR COOKING APPLICATIONS

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Abstract: One of the main problems we are facing today is the scarcity of cooking gas. The alternative method is the use of electricity for cooking purpose. But it has a drawback of high operating cost and many other related problems. This paper deals with a novel method of cooking using graphite as a heating element. Our system is powered using solar hence it is energy and cost efficient. Also, we are using a battery for storage purpose. Another aim we focused on is safety in cooking. Specific features like reduced operating cost, less energy consumption and reliability are incorporated in our system and are user-friendly.

Index terms: Graphite cooktop, solar, renewable energy, buck converter, solar-based system, graphite heating.

I. INTRODUCTION

Graphite is an indispensable natural resource. Graphite forms the quintessential part in refractory applications. Since graphite is an essential component used, there is a need to extend its application to different fields and promotes its usage. This universal element is critical to the needs of the present generation and reaching out globally.

The use of ferromagnetic materials and metals in induction cooker and the solar cooker is the foremost crisis ever confronted due to high power and instantaneous heating changes. Another area susceptible to the cooking application is in mass dwellings where peoples rely upon fuel consuming conventional gas stoves for their daily routines.

This project deals with the conservation of fuel and energy by introducing a Solar Powered Graphite Stove for daily household cooking as well as for commercial users. Graphite heating and exploitation of solar power are the two main techniques used. This system can be employed in food industries and domestic potable cooking systems.

For domestic applications, continuous use is made possible with this proposed technique. Heating of the graphite coil can be done using a DC source. For environmental considerations, the proposed system employs a solar panel for heating the graphite coil.

II. SYSTEM DESCRIPTION

The system is simple and easy to install. The Figure 1shows the functional Block diagram of our proposed system.

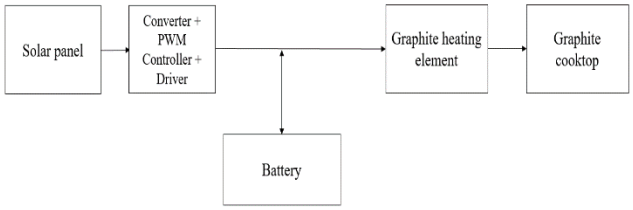

Figure 1: Block Diagram

A. Solar Panel

Solar panel is a compiled and connected assembly of photovoltaic cells that transmutes solar energy into electrical energy [1]. Here we use a solar panel of power rating 250Watt. Its open circuit voltage is 43V and short circuit current is 7.75A. Our required voltage and current ratings are 20V and 10A respectively, hence we require a DC-DC converter.

B. Buck Converter

DC-DC converters are widely used in a vast range of electrical and electronic systems, with changing power levels. The main role of DC-DC converters is to convert the unregulated input voltage into a different controlled level of dc output voltage. In general, a DC-DC converter can be described as an analog power processing device that contains a number of passive components combined with semiconductor devices (diodes and electronics switches) to produce a regulated DC output voltage that has a different magnitude from the DC input voltage [2]. Here we are using a converter to step down the voltage to the desired value and also it helps in better voltage regulation.

C. Battery

A Storage battery is an ilk of the electrical battery. It is a genre of energy accumulators comprising more than one electrochemical cells [3]. Rechargeable batteries are used. The excess energy is stored during day time and can be used at night. The battery supplies power irrespective whether it is night or day.

D. **Graphite Cooktop**

The cooktop using the graphite rod as the heating element is used. It must be perfectly sealed to avoid the presence of air. It is Eco-Friendly and safe to use.

E. Control Circuit

Here we use PIC 16F877A to control the process such as monitoring, charging, etc. The name PIC is the abbreviation of "Programmable Interface Controller". We are also using a current sensor in order to avoid overheating and system damage. The current sensor used here is 20A- ACS712.

III. GRAPHITE HEATING

Graphite can be heated up to 3000°C and more and is indeed used as the heating element in some high -temperature furnaces. Moreover, it is also used as susceptor in induction furnaces, reaching 3000°C without a problem. But for doing so, it must be protected against oxidation, as it remains an organic material. In other words, it is prone to burn if exposed to oxygen. There is no problem for heating graphite in a stream of highly pure nitrogen up to 1000°C. Above 1000°C, you have to use argon, as carbon and nitrogen react together at very high temperature[4].

In this project, we are using the principle of graphite heating. Graphite is used as a heating element in our cooktop. For this purpose, we conducted different experiments on the graphite rod. Experiments conducted and results are shown below.

IV. EXPERIMENTAL ANALYSIS

In this project, we chose graphite as our heating element by conducting different experiments on a graphite rod. First, we conducted an experiment on a single graphite rod powered using a DC source(30V,2A) kept in an open atmosphere and founded it break due to its reaction with air. Secondly, we kept the graphite rod in a glass tube and is covered both ends using M-Seal and current is allowed to flow and about 190°C heat is obtained after a few minutes. The obtained result is shown in Table 1 below.

Table 1
RESULTS

Sl.no	Voltage (V)	Current (A)	Resistance (Ohms)	Temperature (Degree)
1	0	0	0	30
2	3.8	0.186	20.43	30
3	5	0.35	14.28	30.1
4	5.4	0.575	9.39	30.4
5	7	0.772	9.06	32
6	7.6	0.848	8.963	34.6
7	8.3	1.1	7.545	34.9
8	8	2	4	164
9	9.8	2	4.9	190

Table 1 shows the results obtained while doing the experiment mentioned above. From the table, we can conclude that heat produced is increased when voltage and current are increased and maximum heat is obtained at a voltage of 9.8 and a current of 4.9. The experimental setup is shown in Figure:2

Figure: 2

Again experiment is conducted on graphite rod kept on a galvanized iron rod which ends are covered using Plaster of Paris and powered using two DC sources(30V,2A)which are connected in parallel and noted the results. Table 2 shows the results obtained.

Table 2
RESULTS

Sl.no	Current (A)	Voltage (V)	Temperature (degree)
1	2	10.2	157
2	4	10.2	350

From the table, we can conclude that the heat produced will increase as the current increases. The experimental setup is shown below in Figure:3

Figure: 3

From the above-conducted experiments, we come to an end that the graphite rod is suitable as per our requirement for cooking purpose. So we chose graphite as our heating element.

CONCLUSION

Our proposed system will be the best alternative to the existing cooking methods. It is solar powered hence it is cost and energy efficient. The product will ensure better safety and hence it is user-friendly. It has no adverse effect on environment.

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