Improved Bio-mass Cook Stove With TEG

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ABSTRACT

Almost 80% to 90% of energy used in rural household is for cooking and water heating of which 75% to 95% of energy is from "Wood" and "Charcoal". The indoor air pollution from use of traditional cook stove causes risk to health and even leads to premature death. It is essential to have Bio-mass cook stoves providing clean combustions and higher efficiency. Insufficient availability of electricity in rural areas leads to lack of development. Therefore to overcome this problem we are using a basic principle of "Seebeck Effect". The major application of this principle is thermo-electric generator (TEG). Therefore TEG module is an alternative to produce electrical energy with alliance with bio-mass cook stove. Improved cook stove can give more thermal efficiency than traditional cookstove. The cookstove is cost efficient as well as can be used for camping with the suitable portability.

Keywords :– Thermo electric generator (TEG), Cookstove, Biomass, Thermal efficiency, Burning rate

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1. INTRODUCTION

A stove that is heated by burning wood, charcoal, animal dung or crop residue. Cook stoves are the most common way of cooking and heating food in developing countries.

Nearly half of the world's population , approximately 3 billion people, use solid fuels such as coal, wood, animal dung, and crop residues for their domestic energy needs. The traditional method of cooking is on a three-stone cooking fire or on a mud stove. The three-stone fire is the cheapest stove to produce, requiring only three suitable stones of the same height on which a cooking pot can be balanced over a fire.

The new development in cookstove design have been made or better usage of sustainable energy and reducing the worse impact of climate change on environment. A cookstove is a combustion device which liberates lot of heat energy during cooking.

In the recent developed design of TEG integrated forced draft bio-mass cook stove, the liberated waste heat energy is utilized or generation of electricity with the help of a thermoelectric generator. A power of 5W is achieved through the thermoelectric generator. The generated electricity is stored in a Li-ion battery and used further for running a 12Vd.c. fan, lighting a LED light, and charging a mobile phone.

The novelty in charging a Li-ion battery is to run a fan for domestic biomass cookstove for cleaner combustion. The fan is also used or cooling one side of TEG through heat sink for improving electrical performance o TEG and thus improving the combustion of the cookstove. The cookstove has been deployed in the rural areas to check its usability, viability, electrical

1.1 Problem Statement :

To develop the improved multipurpose cook-stove integrated with thermo electric generator. Indoor air pollution has become major problem faced by the women of rural as well as urban area. Another major problem is inadequate availability of electricity. Hence the TEG based cookstove can become a helping hand for the rural residents to overcome the problems. The cookstove will make use of the concept based on Seebeck effect. It will be used to generate power and its utilization.

1.2 Objectives :

1) To improve traditional cook stove not only for cooking purposes but also for electricity generation.

2) To reduce health issues and make more use of renewable source of energy instead of conventional (non-renewable) source of energy .

3) Increase in production of improved cook stove will reduce the price, as price is reduce the consumption and demand will increase.

4) It is beneficial for development of country in technology and also in economical aspects.

5) It is also beneficial for environment as it reduces worst effect by traditional cook stove.

2. LITERATURE REVIEW:

Wood is the primary energy fuel in various thermal processes in developing countries. It is the oldest type of fuel which the man used for centuries after discovery of the fire itself. In most of the developing countries, household energy demand is meeting through tradition fuels as woody biomass, agricultural waste, animal dung, and charcoal, etc. Globally three billion people still rely on such traditional fuels. Nearly 75% of rural households in developing countries like India, still fulfill their cooking energy requirement through fuel wood in the traditional stoves. Cooking in many developing countries usually carried out by burning traditional biomass using traditional stoves or three stone configuration type stoves that are very inefficient because only 5–10% of the potential energy of the biomass fuel is utilized in the cooking process and usually emit high levels of pollutants.

The review paper "Improved biomass cook-stove for sustainable development: A review " by Sonam Mehetre,et.al is written with the aim to discuss about distinctive designs of improved cookstove, testing protocols, role of cook-stove in greenhouse gas mitigation, exergy analysis, global adaptation through different implementation programme, economic assessment, and recent advancements in biomass cookstove.

Improved cook-stove (ICS) are designed with the aim to get better cooking efficiency and release fewer pollutants. The improved cook-stove must meet the cooking energy demands of rural people of developing countries. It is the improved use of biomass in households which, leads to reduced fuel consumption.There are numbers of cookstove testing protocols are used in different countries to evaluate the thermal performance of cookstove in both laboratory and field conditions. The Water Boiling Test (WBT) is one of the principal lab test protocol widely used in the different countries in different manner. The actual cooking tests of cook-stove were conducted using different test protocols in the laboratory as well as in actual household conditions.

3. METHODOLOGY

The design of Improved Bio-mass Cook Stove With TEG. The following is a detailed analysis of each step

Step 1: **Input Study**

This is the first step and involves gathering and analyzing the information. It collects all relevant data and assembles it for evaluation and summarizing. The main sources of information are current market and trends. Complete, accurate data allows designers in identifying, finalizing the specifications required of the end product.

Step 2: **Data Analysis**

Analyzing all the data; the collected data was right or wrong. With the help of project guide and teachers and by others experts. Also looking for any problems arising in this process.

Step 3: **Model concept and Project design.**

Understand the data and model with the study of research papers. Consider the small things about project. There are various designing software but we preferred the solid work software and then make design the model in that software.

Step 4: **Design Analysis**

Designing of a model that has a practically implemented design and also satisfying the need of the project was to be made and analyzed if there were any problems in the design. Also if there were any changes that were to be suggested by the guide they were to be done.

Step 5: **Costing of the project and selection of proper material.**

After the finalization of the design we needed to look for the suitable material which would be satisfactory for the project and also which was cost effective and could be available in less amount of time in local area

Step 6: **Manufacturing of the Project**
Once the project material is finalized and available we start with the manufacturing phase of the project. All the worl is divide among the group members and the manufacturing part is started accordingly.

Step 7: **Testing**
After the manufacturing part is done then the project is ready to be tested for the actual condition of the customer requirement. It is important that the project satisfies the objectives of the project. The major is customer satisfaction and solving of problem after utilization of the project.

Step 8: **Documentation**
After all the manufacturing part and testing part we move to the documentation part such as the reports for the project.

4. CONSTRUCTION DIAGRAM:

The usable power output of a stove is the amount of thermal energy that is able to be applied towards heating or cooking over time. This attribute can be correlated to the idealized verses actual energy output of a thermodynamic system. There are many factors that affect the energy efficiency of a stove. This includes fuel selection, material selection in the stove as well as the cookware, condition of the stove in terms of maintenance, overall design. In the field of thermodynamics and heat transfer, a British Temperature Unit (BTU), is the amount of energy required to raise 1 pound of water 1 degree Fahrenheit.

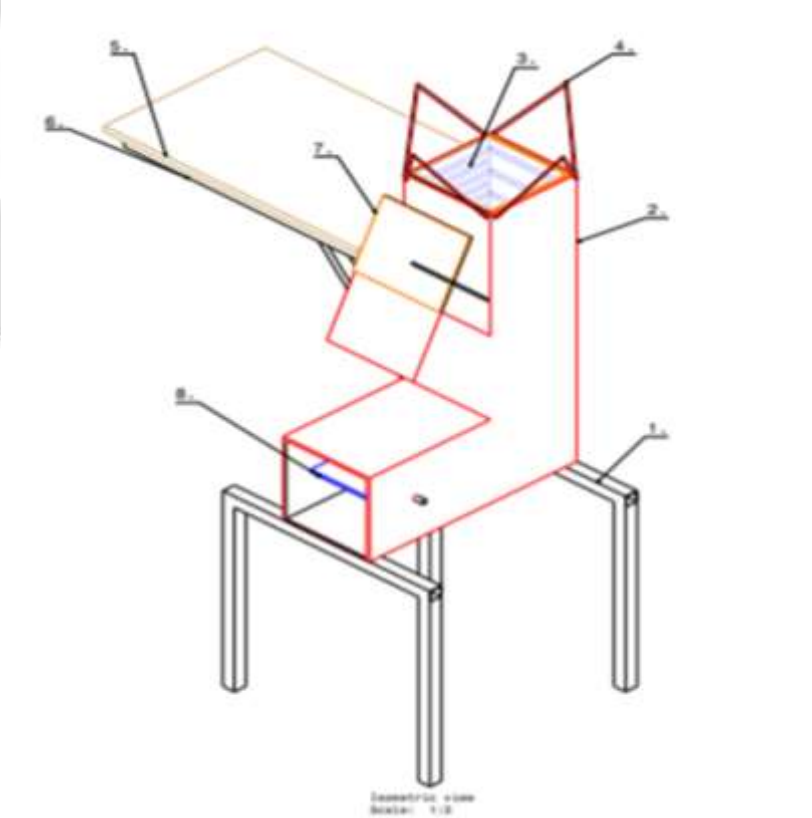

Fig. 4.1 Final Design

The component parts and their main functions are:

1) Frame: A frame is also used for holding cook stove and supporting cook stove.

2) Body: A Body of Furnace, Referred to as a heater is a heating unit used to heat up an entire building. Furnaces are mostly used as a major component of a central heating system. Body furnaces are permanently installed to provide heat to an interior space through intermediary fluid movement, which may be air, steam or hot water.

3) Copper Coil: Copper has many desirable properties for thermally efficient and durable heat exchangers. First and foremost, copper is an excellent conductor of heat. This means that copper's high thermal conductivity allows heat to pass through it quickly. Other desirable properties of copper in heat exchangers include its corrosion resistance, bio fouling resistance, maximum allowable stress and internal pressure, creep rupture strength, fatigue strength, hardness, thermal, expansion, specific heat, antimicrobial properties, tensile strength, yield strength, high melting point, alloy ability, ease of fabrication, and ease joining. Copper tube are devices that transfer heat to achieve desired heating or cooling.

4) Cooking Utensils holding Stand: The Cooking Utensils holding Stand is used for frying some cooking utensils or for roasting or cooking food.

5) Plywood: Plywood is used to hold ingredients or to hold certain items or for cooking.

6) Plywood Frame: It is also used for supporting to plywood during any work of cooking.

7) Plate: to cover the furnace when you put wood or cow dung or coal from the furnace chamber into the furnace, the plate is fitted to prevent fire or vapor from escaping through the furnace chamber.

8) Rotating Plate: Whenever we light a furnace, we put the wood in the furnace through coal or cow dung furnace chamber. So that time if burns wood etc. it becomes ash and a rotating plate is used to remove that ash through the below furnace chamber.

5. PERFORMANCE EVALUATION TEST

5.1 Performance Evaluation Test

Modified version of Water Boiling Test (WBT) and indoor air pollution measurement by Gas test tube method were followed to evaluate the performances of the cook stove.

5.1.1 Water Boiling Test

This test provides the stove designer with reliable information about the performance of wood burning stove models. The test consist soft three phases that determine the stove's ability. They are:

1. To bring water to a boil from a cold start;
2. To bring water to a boil when the stove is hot;
3. To maintain the water at simmering temperatures.

It is used to evaluate a series of stoves as they are being developed. The test cannot be used to compare stoves from different places because the different pots and wood used change there results.

The test is a simplified version of the University of California Berkeley(UCB)/Shell Foundation revision of the 1985 VITA International Standard Water Boiling Test. The wood used for boiling and simmering and the time to boil are found by simple subtraction. All calculation can be done by hand in the field.

5.1.2 Thermal efficiency (ɳ)

The amount of heat used to evaporate water is considered as useful heat input to the vessel since our primary interest is to compare stoves rather than derive an absolute number for cooking efficiency for any given stove. The burn rate and net corrected calorific value of wood are used in the calculation of thermal efficiency.

5.1.3 Burn rate

Burning rate is a measurement of the rate of fuel consumption of water to boil. The average burn in grate for cold start, hot start This is a measure of wood consumed per hour for boiling water from room temperature. It was calculated dividing the dry wood consumed per time for boiling water.

5.1.4 Specific Fuel Consumption

Specific fuel consumption indicates the amount of fuel required to vaporize certain amount of water usually 1 liter water. Specific fuel consumption was 85, 81 and 117g/liter for cold start, hot start and simmering respectively. As for hot run, fuel consumption was less because the stove remained warmer from preceding test run.

- **Advantages of Improved Bio-mass Cook Stove With TEG :**

1) Time saving
2) Reduce deforestation and local environment degradation
3) Reduce emission of "CO2" as well other harmful gases
4) Descend health issues
5) Depletion of Global warming

- **Limitations of Improved Bio-mass Cook Stove With TEG:**

Dangerous in open atmosphere & keep away from children's.

- **Applications**

1) Implementation of secondary energy for heating water.
2) Utilization of warm water for multipurpose tasks.
3) The stove can be best used for camping purpose with the provision of chopping/serving board.

6. CONCLUSION

TEG based Biomass Cook stove is the concept of the biomass cook stove which would convert the heat energy into electrical energy. The basic Moto of this project is to utilize this electrical form of energy for charging mobile, glowing bulb.

Summary of the literature papers are as follows:

•The test carried for the testing of cook stove is WBT (Water Boiling Test). In various papers the authors described the process and the results of the same.

•Another paper represented the basic idea of the design of the cook stove. Studying the design and analyzing the objective of the project we designed the cook stove. After analyzing it studying it modification were made according to the position and size of TEG.

•Thermal analysis, moisture content, burn rate analysis were studied.

7. REFERENCE PAPERS

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