1. Project Proposal Reference No.: **46S_BE_2828**

2. Project Proposal entitled- **DESIGN AND DEVELOPMENT OF HYBRID INDOOR SOLAR COOKER SYSTEM**

3. Name of the College & Department-

Vidyavardhaka College of Engineering, Mysuru

Department of Mechanical Engineering

4. Name of the students and Guides

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5. Keywords-

Solar cooker, solar radiation, ETC based tubes, Manifold, Temperature sensor, LPG cylinder

6. Introduction-

A solar cooker is a device which uses the energy of direct sunlight to heat, cook or pasteurize drink and other food materials. Many solar cookers currently in use are relatively inexpensive, low-tech devices, although some are as powerful or as expensive as traditional stoves and advanced, large scale solar cookers can cook for hundreds of people. Because they use no fuel and cost nothing to operate, many nonprofit organizations are promoting their useworldwide in order to help reduce fuel costs and air pollution, and to help slow down deforestation and desertification. In the existing traditional solar cookers, the cooking is performed near the collector which may be at an inconvenient location for cooking purposes. This paper proposes a hybrid solar cooking system where the solar energy is brought to the kitchen. The energy source is a combination of the solar thermal energy and the Liquefied Petroleum Gas (LPG) that is very common in kitchens. The solar thermal energy is

transferred to the kitchen by means of a circulating fluid like oil. The transfer of solar heat is a twofold process wherein the energy from the collector is transferred first to an intermediate energy storage tank and then the energy is subsequently transferred from the tank to the cooking load.

7. Objectives

The main objective of this work is to design and develop hybrid indoor solar cooking system that is environment friendly, economical, user friendly and easy to handle for people of all sectors and areas without any difficulty in cooking. To carry out, a comparative study between conventional and solar cooking system in order to find out the LPG savings and efficiency. The use of solar cookers offer a promising solution towards the problems related to the health, economy, environment and energy crisis to a considerable extent. Therefore, more efforts should be made in the direction of their popularization and in creating mass awareness for utilization of solar energy for cooking purpose. In the present work, an advanced solar thermal based cooking system suitable for indoor cooking with effective heat transfer method has been proposed and developed as per the specifications mentioned in the paper.

8. Methodology

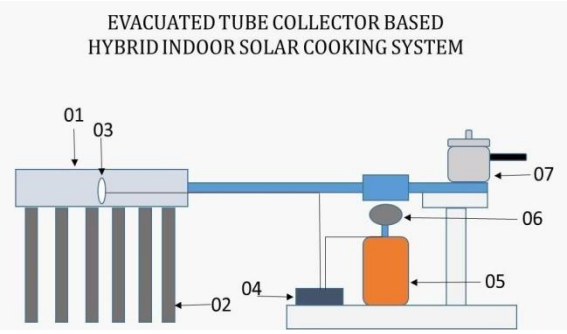

Figure 1- Represents the proposed sketch ETC based Hybrid Solar cooking system

Fig 2 Manifold- 1/2" fully insulated

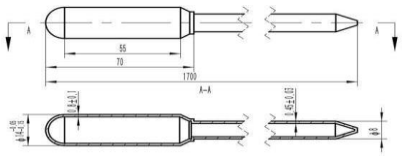

Figure 3- Copper heat pipes

Fig 4 Hybrid Solar cooking system

The main goal of the proposed system is to transfer heat from the solar collector to the cooking load. There are two levels of heat transfer with intermediate energy storage in a buffer tank. The heat is first transferred from the solar collector to the storage tank. The pump-I controls the fluid flow rate $\dot{q}_1$ to control the heat transfer from the collector to tank. At lower flow rates, temperature of the collector and outlet fluid is higher resulting in higher heat loss to ambient. Hence this causes lower It consists of an insulated outer and inner box, metallic cooking tray sat inside the box, double glass lid on the cooking tray, and two reflecting mirrors fitted to the two sides of the lid of the box and an adjustable stand. The cooking tray is insulated on the sides and bottom. The reflectors are inclined at an angle of 115 degree with the face of the box cover. The face of the cooker is to be placed perpendicular to beam radiation to collect the maximum energy. This perpendicular position can be easily achieved simply by the rotation of the cooker towards the sun with the help of caster wheels ,suitably attached at the bottom side of the cooker and by changing the inclination of the cooker by adjustable stand of the back side .But the position of the reflectors remain unchanged throughout the working period.

9. Results and Conclusions

$$\text{Effective Collector Efficiency} = \frac{\text{Effective Collected Power}}{\text{Input Solar Power}}$$

$$\eta_{coll} = \frac{P_u - P_{pump}}{P_{in}} \quad (1)$$

Savings is calculated like below:

- Place: Mysuru, Karnataka
- size: 15 tubes with 10 liters Cooker
- Time: 10-55am to 11-20am

- Total time: 25 minutes
- Quantity: 10 liters/10,000grams.
- Cold water temperature: 22°C
- After 25 minutes: 100°C
- Total energy produced: 780kcal
- 100-22=78. 78x10, 000=7,80,000.
- 7,80,000/1000=780
- 31.2kcal/minutes (780/25)
- 1872 KCal/h (31.2x60)
- 5616 KCal for 3 h/day(1872 x3)
- 1,68,480 KCal/month(5616x30)
- Savings of LPG: 1,68,480/11800=14.25KG/month
- (Note: calorific value of LPG is 11800 KCal/KG)

Conclusions

Scientists all over the world have made large number of efforts in developing different types of solar cookers for many decades. Although it can be one of the best alternatives for cooking,it is hardly accepted by the society. There are many reasons for that like lake of awareness, large size, bulky models, slow cooking, highly dependent on weather conditions, fixed cooking time etc. The hybrid solar cooker which can work for all time and can cook faster than the conventional solar cooker has being designed and developed which if commercialized can become competent. Solar energy is free, environmentally clean, and therefore is recognized as one of the most promising alternative energy recourses options. In supplying the needed energy, solar cookers can fully or partially replace the use of firewood for cooking in many developing regions. Solar cooking has regularly been viewed as a solution looking for a problem, or a technological solution developed without sensitivity to user needs.

10. Scope for future work

There are few ideas that we had in mind while working on this project. One idea that seemed interesting on paper was adding solar panels to store energy in batteries to our prototype. While this idea is extremely revolutionary to our design, it brings forward multiple financial and environmental issues to our idea. The creation process of batteries has proved to be extremely harmful and hazardous to our environment which is against our idea of creating an environmentally friendly solar cooker. In addition to that, adding solar panels brings forward a drastic increase to the financial side of the prototype, while requiring batteries to ensure its usefulness. Cooking with solar energy remains a fuel-saving technique, which can providedefinite help in situations of fuel scarcity. Food cooked in solar ovens retains its moisture and nutrients as it cooks slowly and does not burn as with other types of heat. Saves Greenhouse gas emission