Performance of Smart Cooking System using Thermic Fluid

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Abstract **- In today's era energy is the primary and universal measure of all kinds of work by human beings and nature. Cooking is an integral part of each and every human being as food is one of the basic necessities for living. An enormous amount of energy is thus expended regularly on cooking. Commonly used sources of energy for cooking are firewood, kerosene, electricity, liquefied petroleum gas and biogas. The major drawback with these energy sources is wastage of heat and safety. In order to overcome this drawback a smart cooking system is proposed. The smart cooking system utilizes any of the energy sources to heat the thermic fluid. The working fluid is then circulated around the vessel to supply the heat for cooking. The proposed method will reduce the risk of explosion and also reduce the loss of heat to the surroundings.**

Keywords:-Smart cooking system, thermic fluid

I. INTRODUCTION

In today's era, energy is the primary and most universal measure of all kinds of work by human beings and nature. Everything what happens in the world is the expression of flow of energy in one of its form. Energy is required as an input to all the machines also very large amount of energy is required for cooking purpose and that energy is extracted from conventional energy sources. The cooking energy demand in rural areas of developing countries is largely met with biofuels such as fuel wood, charcoal, agricultural residues and dung cakes, whereas LPG or electricity is predominantly used in urban areas. The major problem with cooking using these fuels are the wastage of energy and the risk of explosion (in case of LPG).

Introducing Smart Cooking System by using thermic fluid which may reduce the problems associated with the conventional cooking system. This thermic fluid can be heated by renewable or non-renewable energy sources. A thermic fluid is used for industrial heating purpose, where only heat transfers are desired instead of pressure. In this equipment, a thermic fluid is circulated in the entire system for heat transfers to the desired processes. Combustion process heats up the thermic fluid and this fluid carries and rejects this heat to the desired fluid for concluding the processes. After rejecting it, this fluid comes back again to the thermic fluid heater and this cycle goes on.

II. PROBLEM FORMULATION

Energy efficient cooking is the prime factor in the current years. Many of the conventional cooking systems are less efficient. Gas stoves are the most commonly used cooking systems in the recent years. The problem associated with this system is the wastage of heat directly to the atmosphere. Similarly, the solar cooking system requires the presence of solar radiation for efficient cooking. So, the usage of renewable energy sources for efficient cooking is a major challenge.

The objective of the present study is to develop the smart cooking system using thermic fluid and analyze the performance of the cooking system in comparison with the conventional cooking system.

III. METHODOLOGY

Primarily the research is carried about the performance of present conventional cooking systems, like electric stove, solar cooker, LPG, etc. Secondarily Studies are carried about renewable energy source used for cooking. After the studies, in order to overcome the drawbacks with the conventional cooking system, a smart cooking system is proposed. The materials are selected based on the requirements and the developed system is analyzed with the conventional cooking system.

Working Principle

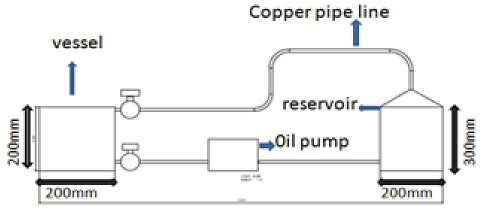

Fig 1: Proposed model of smart cooking system

Figure 1 shows the proposed cooking system. It is a modification of the conventional cooking system. It mainly consists of heat source which uses either conventional or non-conventional energy. The heating system uses the heat from the heat source to heat the working fluid. The temperature indicators are used to indicate the temperature of the working fluid. The hot working fluid is used for various cooking applications. The heat is extracted from the working fluid for cooking and it is recirculated back to the reservoir with the help of a pump and the working fluid continuously works in a cycle.

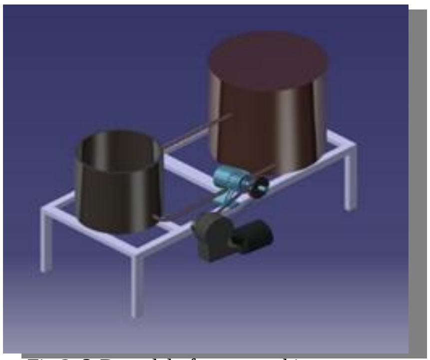

Fig 2: 3-D model of smart cooking system

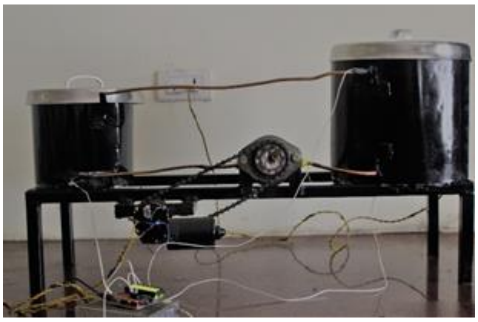

Fig 3: Developed model of smart cooking system

IV. MATERIAL SELECTION

The following table gives the information about the materials selected for the development of smart cooking system. The system mainly consists of a reservoir to store the thermic fluid, vessel for cooking, copper pipe to transfer the fluid from reservoir to vessel and pump to circulate the working fluid.

Table 1: Materials used for smart cooking system

Particulars	**Capacity**	**Material type**
Reservoir	13.8 liters	Stainless Steel
Vessel	5.387 liters	Stainless Steel
Copper Pipe	0.4241 liters	Copper
Pump	0.5 HP	Mild steel

V. RESULTS AND DISCUSSION

The developed system is used to cook the food with different insulating conditions. Three different foods are selected for cooking. Initially the test is carried without insulation of the system. The three different foods are cooked using the energy from LPG and electricity. The time required for cooking the foods are listed as shown in the table 2.

Later the system is insulated to avoid the loss of heat and the same foods are cooked using LPG and electric coil. The time required for the cooking after insulation is listed. The above results show that the time required to cook the food after insulating the system is reduced substantially.

Table 2: Time required for cooking the food under different conditions

Sl. No	Heating method	Cooking food	Temperature (ºC)	Time required for cooking (min)
1	Gas (Before insulation)	Water Boiling	150	50
		Onion frying	150	60
		Maggie	150	80
2	Electric coil (Before insulation)	Water Boiling	150	60
		Onion frying	150	65
		Maggie	150	75
3	Gas (After insulation)	Water Boiling	150	35
		Onion frying	150	40
		Maggie	150	65
4	Electric coil (After insulation)	Water Boiling	150	30
		Onion frying	150	38
		Maggie	150	68

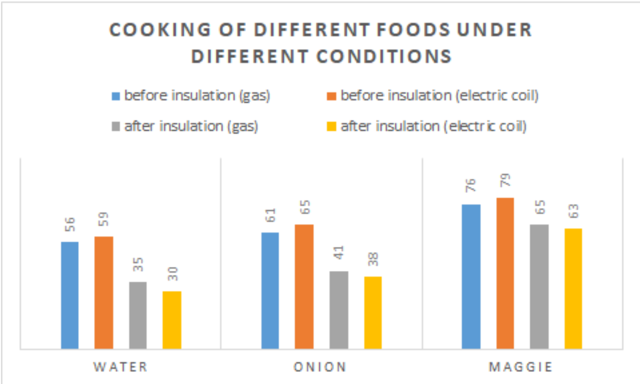

Fig 4: Comparison of cooking of different foods

The results shows from the figure 4 that the time required for cooking the water, maggie and frying the onion using gas as constant source of energy is less compared to electric coil. After insulation the time required for cooking the food substantially reduced in the case of water and onion. The insulation provided helped in reducing the heat loss and also reduced the time of cooking.

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