International Journal of Advances in Engineering and Management (IJAEM)
Volume 4, Issue 5 May 2022, pp: 376-379 www.ijaem.net ISSN: 2395-5252

Design and Development of Semi-Automatic Chapati Maker

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Submitted: 01-05-2022 Revised: 04-05-2022 Accepted: 08-05-2022

ABSTRACT—To design and manufacture semi-automatic Chapatti Making Machine to impart much of the relief to the workers in the preparation of the meals in various Departments of Institutes, Hospitals, Schools & College Hostels, Industrial Canteens and Railway & Defense Establishments. Our chapatti making machines helps in making home-like chapattis in most efficient and hygienic manner.

I. INTRODUCTION

To develop a semi-automatic chapati maker. The main objective is to build a prototype machine that can be suitable for any home cooking, bachelors and other users for an easy way to cook food at home. So, Large-scale production of this machine can serve many canteens/gurudwara langar's, any mega kitchens, etc. The second objective is to make this machine cheap, efficient, and reliable. Solutions for automatic roti makers in the market already exist but there is a gap in its working, affordability, level of automation, and ergonomics. We want to build a product that can fill these gaps and may have the potential to become the next home appliance for common people.

Efforts have been made to make the design compact & user friendly.

II. LITERATURE REVIEW

- K. Venkateshmurthy Department of Food Engineering, Feb 2008 in International Journal of design and manufacturing Technology. He studied heat transfer equipment for production of Indian traditional foods. In his study he explained about needs of new technology for making chapati since as traditional staple foods in India, Chapati stand next only to cooked rice. The successful operation of chapati making machine depends largely on the kinematics of machines. The heat transfer across the hot plate of the machine such as stainless steel, aluminium plate etc.
- T. R. Gupta in Imperial Journal of Interdisciplinary Research, page no 1050. He Investigated Specific heat of Indian unleavened flat bread (chapati) at various stages of cooking. In case a device is made available for making Chapati, from dough mixing to baking/frying, would result in reduction in labor and difficult to cater to large number of people in short time in serving Chapati of uniform quality.
- Arun Kulamarva in International Journal of Manufacturing, page no 759.He studied some rheological and thermal properties of chapati. Chapati is a gluten free cereal and forms the staple diet of a majority of the populations living in the fully-arid tropics dough.
- N.D. Amosb studied compilation of correlation parameters for predicting the enthalpy and thermal conductivity of solid foods within the temperature range of -400C to +400C. He presented thermal conductivity data for 40 foods, enthalpy data for 58 foods and products.

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III. METHODOLOGY

Design Considerations and Machine Components

In constructing and fabricating the flour mixing machine, feasibility studies were carried out on the availability, strength, machinability, and the economic considerations on the materials required for the designing of the machine.

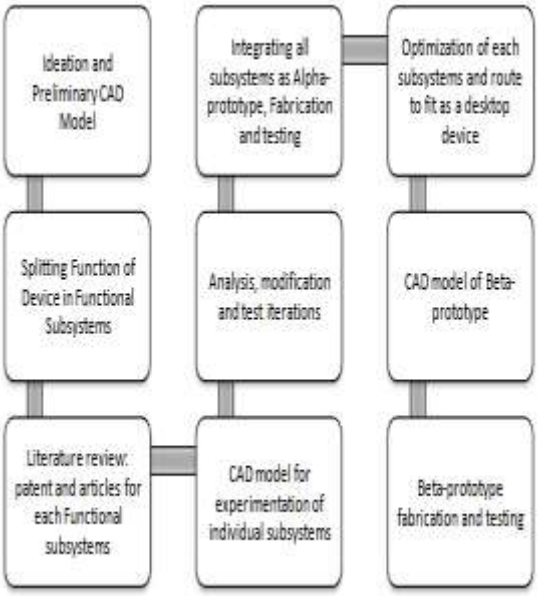

Figure 01. Flowchart of methodology

IV. DESIGN CONCEPT

Design assumptions

- The acceleration due to gravity (g) is 9.81m/s2
- The density of stainless steel is 7880 kg/m3
- The density of mild steel is 7850kg/m3
- The volume of flour to be mixed should not be more than 2/3 of the total volume of the mixing chamber;
- 1.5hp electric motor with high speed (1800rpm)
- Capacity of the machine 100kg/hr.
- Density of flour 0.820g/cc

Steps involved in making a Chapati/Roti

Figure 02. Basic steps in Chapati making

Kneading requires three components:

- Flour cartridge
- Water dispenser
- Mixing Hub

Detailed design of **Flour Cartridge** and measurement system

- Flour Container has a size of 32X32X65 cc &25Kg Wheat carrying capacity
- Flour Collected at Bottom of hopper structure is dispensed at required rate and amount by screw conveyer mechanism
- System is removable from main system for cleaning purpose, and this is made possible by spur gear coupling.
- Sensor Feedback when hoper part gets empty

Figure 03. Flour Cartridge System

Detailed design of Water Cartridge, flow regulation and measurement system

- Water container is about half volume of Flour Container as for Roti Flour: Water = 2:1
- Water Container is of size 20X20X50 cc &3Kg of Water holding capacity
- Water flow if measured by separate device at end of discharge elbow.
- Water flow can be controlled by action of normal closed solenoid valve.
- Half inch diameter pipe from valve is directly mounted at container with washer-nut arrangement.

Figure 04. Water Cartridge System

Detailed design of **Mixing Hub**

- Flour Container of cylindrical size radius 27 cm and height 50cm.
- 1kg Flour needs 650 ml of water to prepare dough.
- 2/3rd volume is used by flour and water to be mixed and rest volume is covered by air to let the dough breathe and mix properly.

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- System is removable from structure for cleaning purpose.

Figure 05. Mixing Hub

Rolling requires three components:

- Rolling plate
- Rolling pin
- Rolling base

Detailed design of **Roll Press**

- Rolling pin of size 1.5 cm radius and rolling plate radius 7.2 cm.
- Dough ball is collected at center of rolling plate and roll pressed with hand to make a circular chapatti of 14 cm diameter.
- System is removable from structure for cleaning purpose.

Figure 06. Roll Press

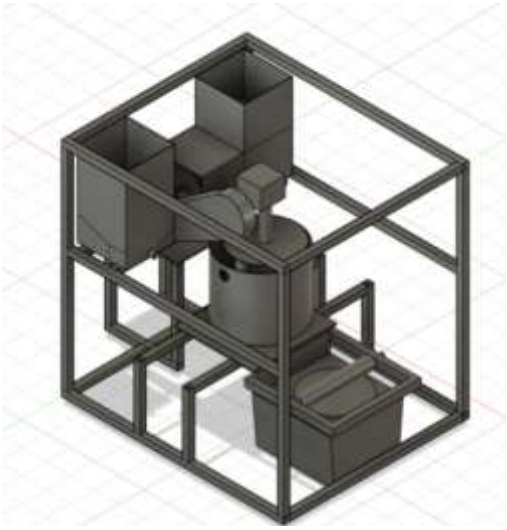

Figure 06.3D Model of Roti Maker

V. WORKING

- Task1: Ingredient storage and evaluation of required volume for mixing: Ingredients: flour and water. Water to pump in mixing hub is analysed with flow meter. Flour passes to mixing hub through a helical transporting mechanism with volume measurement
- Task 2: Mixing and dough kneading: ingredients will be mixed thoroughly by motorized fork/whisk with accurate position encoder for calculating cycle and torque measurement to ensure dough is prepared.
- Task 3: Make dough balls by hand after the dough has prepared in mixing hub.
- Task 4: switch on the Roll-pressing machine. place dough balls between rolling pin and on rolling plate.
- Task 5: Dough ball are roll-pressed between rolling pin and rolling plate. Roll-pressing makes it possible to make round smooth roti/chapati.
- Task 6: Transfer the roti/chapati on gas or heat plate and flip the roti to cook it properly using hand.
- Task 7: Puffing on gas or heat plate to puff the roti. Roti gets fully cooked and puffed.

VI. CONCLUSION

A semi-automatic chapati maker machine for domestic and commercial consumers is designed. This machine gives more hygienic roti/chapati and eliminates the indigenous process of preparing the dough by kneading with hand and rolling the chapati with a rolling pin. The improvement and automation of the machine can form dough and from dough to chapati demonstrates that such food processing equipment helps to producing large quantities of roti and keeps costs under control. The flour mixing machine is fast and reduces wastage. The machine is designed for commercial food industry or places where large number of roti are needed.

Bread-making industry and restaurant usage, in other to improve a healthy and hygienic condition of an individual. It is expected that an average consumer can afford this machine.

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