DEVELOPMENT OF A SEMI-AUTO MIXING MACHINE

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ABSTRACT

The manufacturing technologies keep changing from time to time with the latest technology such as automated system. Therefore, a Small and Medium or SME industries also looking for the automated or semi-automated system, which to compete in their business. Currently, there are a manual, semi-auto and fully-auto method implemented for the mixing process. Furthermore, a pH value is an increase during the filling process, where, the material exposed to the environment. But, pH value also needs to maintain at less than 4 in order to prolong the life of the product. In controlling a temperature, traditionally method difficult to maintain the temperature above 70°C. Therefore, the development of this project is to develop a semi-auto mixer for making any mixing food. The concept used, based on the mechanical principles and electrical control for cooking, mixing and temperature control to maintain temperature. Hence, the project controlled by PLC (Programmable Logic Controller) and Proportional controller for controlling a temperature, the speed of the motor and timing of the heating element in order to maintain the temperature above 70°C. The bowl of the mixer made by the good quality of material, which is stainless steel with food grade. Furthermore, the filling method is also developed in order to maintain a pH value due to human error or environmental exposure. This design is capable to overcome the production in large quantity up to 150 litres for each process.

Keywords: Mixing machine, pH value, PLC

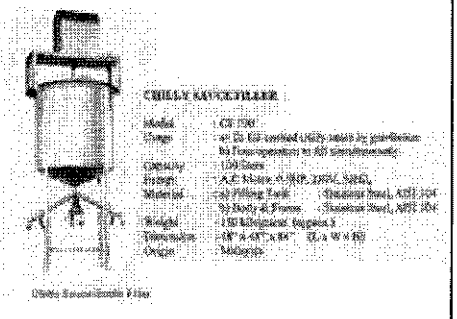
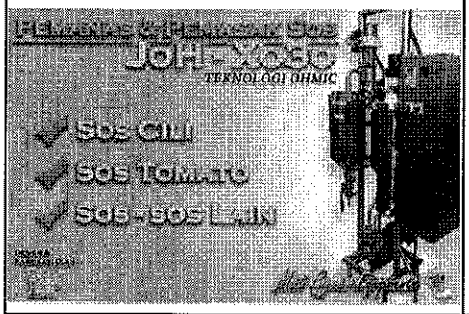
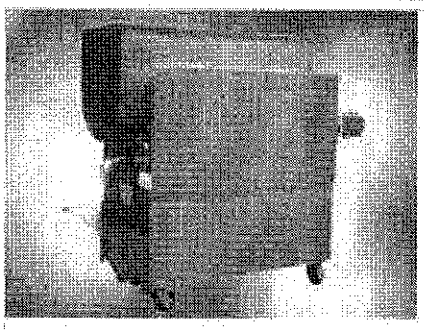
1. INTRODUCTION

Currently, a manual method is implemented for mixing processes. A pH value is increased during the filling process, where, the material is exposed to the environment. But, pH value also needs to be maintained at below 4 in order to prolong product life. Furthermore, the current method is difficult to maintain a temperature at 70°C to 80°C. For that reason, as a solution method is introducing a mixing, heating and filling device for making any paste of the food to be solved. This machine is designed to overcome the production in large quantities to control temperature, maintain pH value, and filling method. Also, a semi-auto controller is implemented to control a process. Hence, the mixing affects various process parameters including heat and mass transfer rates, process operating time, cost and safety, as well as product quality (Ghanem et al., 2014).

This project focuses on mixing and heating element with a capacity of 150 liters. PID controller is used for controlling temperature, speed and motor. While PLC is used to control the sequence of the process. On the other hand, the quality and the packaging of the product are not taken into account.

1.1 Comparing Existing Machine In Market

Fig. 1: Machine Comparison

	Characteristic	Machine Design	Operation	References
	- Stand alone - Capacity up to 100 Liters - Fixed system controller (not able to integrate with other system) - Only for filling and mixing process - No heating element	Vertical	Manual	http:// rcmesinmakanan. com
	- Stand alone - Capacity up to 30 Liters - Fixed system controller (not able to integrate with other system) - For Filling, Mixing and Cooking	Vertical	Semi-Auto	http:// mgequipments. miiduu.com
	- Stand alone - Capacity up to 100 Liters - Fixed system controller (not able to integrate with other system) - For Filling, Mixing and Cooking - Not be able control temperature and expensive.	Horizontal	Semi-Auto	http://ms.365gbo. com

2. METHODOLOGY

In this paper, there are some solutions (Fig. 2) for mixing, cooking and filling process, which include design, fabrication, installation, testing and commissioning:

- Stainless for mixer stirrer, outside body and inside of the vessel.
- System controller (PLC, PID)
- Hard wiring system
- Motor and motor controller
- Pneumatics system for filling process
- Heating element for maintaining temperature inside hopper
- Speed of mixer stirrer can be controlled

Fig. 2: Machine Components

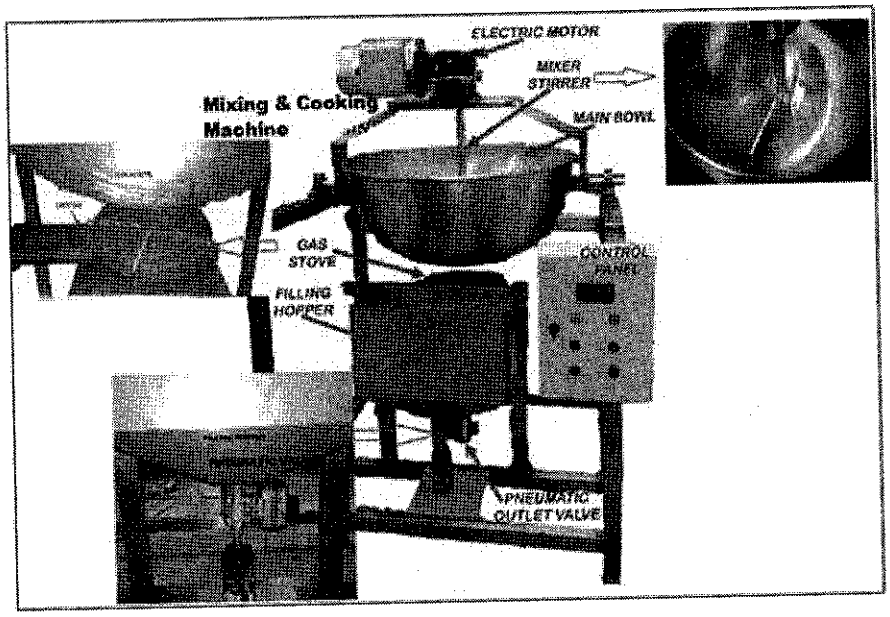
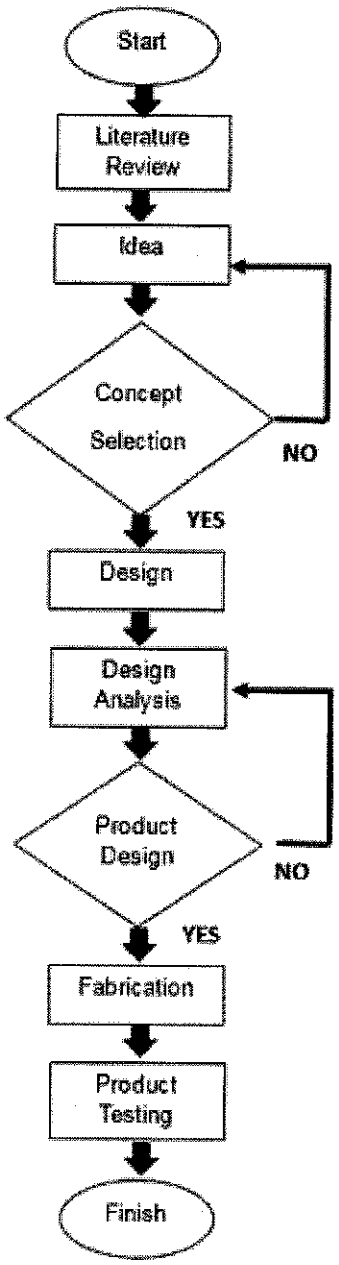


Figure 3 shows the flow chart of product development, starting with literature review up to product testing. The product is designed using 2D AUTOCAD software with complete dimension. Furthermore, the design is analyzed to identify the suitable process, such as fabrication and joining process. TIG welding is used for all joining process for stainless material.

The criteria of the product must meet the specification, requirements, flow of process and standard (Beitz, W., & Pahl, G., 1995), including geometry, design, materials, market and ergonomics. This design criteria has been taken into account for machine development.

Fig. 3: The Flow of Project Development

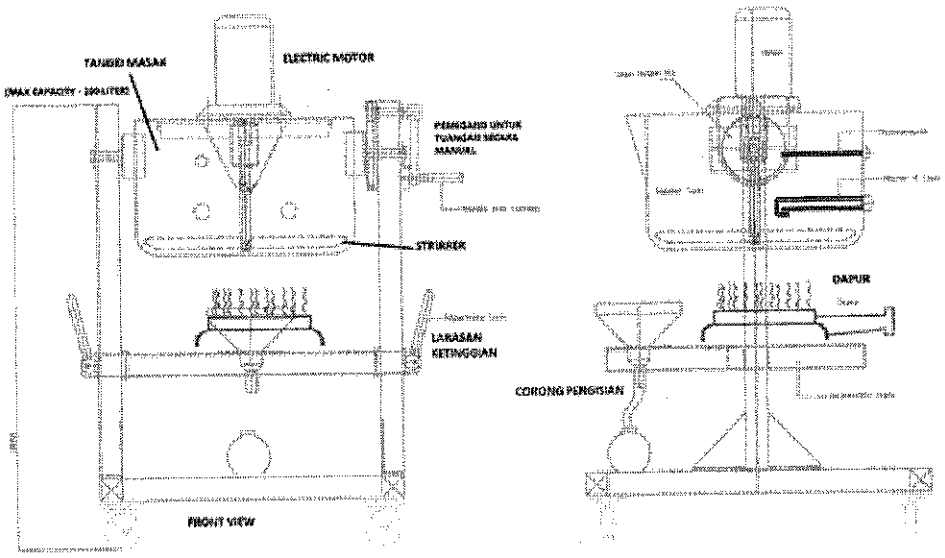


There are some fixtures of the machine:

- Introducing a new method and controlling of mixing machine as in Figure 2, for mixing various ingredients and cooking for producing a good quality and quantity of product.
- The mechanism consists of a heating system with gas, mixer stirrer (operated by electrical motor), controller (PLC and PID) for controlling start/stop, heating process (maintain 80°C), timing and motor.
- It can be a continuous or step process.
- This process is estimated to be capable of producing 150 Liters per process for one hour with closed vessel compared to the current process with open vessel.
- After completing a process, this machine is able to transfer curry paste to other containers or filling process through outlet valve (through ball screw) without opening the top of the vessel.
- For cleaning process without dissembling the mixer stirrer.
- Flexible system means that, it can be integrated with other equipment easily through PLC (Programmable Logic Controller).

A model of the machine was designed and fabricated through CAD drawing as shown in Figure 4. The real machine was developed based on design.

Fig. 4: Machine Design



3. RESULTS AND DISCUSSIONS

Results and benefit of the machine can be summarised in table 1. It can be seen that, the developed machines have more advantages compared to the existing machines, which combine three functions in one machine. Therefore, it offers a quality and large quantity of the product. It is easy to maintain temperatures at 70°C to 80°C for lifespan of the product. While, by introducing a new method of filling process through a pneumatic valve, it guarantees a faster time compared to conventional method. Through the mixing process, it has an excellent mixing effects on various process parameters including heat and mass transfer rates, process operating time, cost and safety, as well as product quality.

Table 1: The Benefits of the Mixing Machine

Benefits	Conventional current method	Proposed method
Controlling a temperature	The use of current method does not permit the temperature to be controlled at 70°C.	The use of PSA method has enabled the machine to maintain the temperature at 70°C.
Production /Capacity	The use of current machine has limited production about 50 litres.	Capable to produce 150 Litres per process. *(triple production)*
Filling method	To transfer to other containers or filling process through conventional method.	To transfer to other containers or filling process through outlet valve of the external hopper.
Mixing processes	Less excellent mixing affects various process parameters including heat and mass transfer rates, process operating time, cost and safety, as well as product quality.	Excellent mixing affects various process parameters including heat and mass transfer rates, process operating time, cost and safety, as well as product quality.

The machine specifications are as follows:

Heating Element
Max Temperature: 1000C
Heating Media: Gas Stove
Heater: K-Type Heater and Thermocouple

Motor:
Max speed: 1410 r/min
Input: 220 – 230 Volt, 50 Hz.
Output Power: 1100 Watt
Output Current: 6.76 A

Table 2 shows, the performance of machine has been tested by the industry and it is proven that the machine developed has a good potential to be commercialised in future.

Table 2: The Performance of Mixing Machine

	Current Method	New Method
Productivity	200 liters	Increase up to 1200 liters
Cost (raw material)	RM 200 per 50 Liters	RM 300 per 150 liters
Time Saving	50 liters in every 2 hours	150 liters in every 1 hours
Quality	Below 1 years lifespan of product	More than 1 years lifespan of product

4. CONCLUSION

This developed machine able to help industry increased their product by introducing a mixing, cooking and filling machine method of a curry paste. Therefore, it can be one of the solutions in food industries processes. In future, it may have a positive impact in increasing the quantity of the production due to the semi-automated system compared to the current method, which operates manually. It is hoped that this product meets industrial food processing requirements.

ACKNOWLEDGEMENT

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