Research Article

Design and Fabrication of Automatic Flour Filter

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Abstract: *The "Design and Fabrication of an Automatic Flour Filter" project is focused on developing a machine that will reduce the amount of power needed to filter flour, which is used in many kitchen operations. Due to the strainer's small surface area, the filtering process must be repeated until all the flour is filtered, inspiring this project's conception among those working in food-related SMEs. Filtering the flour takes a significant amount of time. The goals of this project, on the other hand, are to develop an automatic flour filter using the "SolidWorks" software, fabricate a flour filter, and study how the strainer is rotated using the power window. The strainer in this product can be moved horizontally due to a power window coupled to a circular plate. Additionally, a converter is included for switching between DC and AC power. This project uses the mechanical engineering principle of power window rotation.*

Keywords: Flour filter; SolidWorks; Design

1. INTRODUCTION

As our industry evolves to IR 5.0, numerous new technologies and solutions can help any work more efficiently (Adel, A. 2022). However, several technologies and machinery are primarily targeted at large companies due to their size, price range, and significant maintenance expenses. As a result, the technologies are unsuitable for those who own small enterprises or work from home. Those who work in small and medium-sized businesses (SMIs) and associated industries anticipate that new technology will make their tasks easier, as one of their responsibilities is to prepare a significant volume of food for their clients. To be sure, completing the work requires considerable effort.

There are many reasons the small–scale industry cannot afford to buy a big machine due to its cost, size, and cost of maintenance. Besides that, the place where the business is run is not suitable to put a big machine for example, in a house or small space. So, to filter the flour, the only method that can use is by using a hand flour filter which required a lot of energy and time consumption to accomplish the job. It is because a small-scale industry always deals with a huge quantity of flour to filter. This will require a machine that can filter the flour in less time and a lot of flour can be filtered at one time without having to do the same process continuously. Developing a machine that can filter flour in huge quantities at one time can give an advantage to people working in small–scale industries.

2. METHOD & MATERIAL

A process flow chart illustrates how the operation should be carried out when the project is being carried out. The first step in completing this project is to draw any design, after which we will use "SolidWorks" to decide which concepts are the most promising to move forward with. The finalized design will be used for the process of selecting the appropriate materials. People who work in small-scale industries (SME) and are consistently dealing with the quantity of flour are the people who are intended to buy this prototype. Therefore, the material choice that will be utilized for the construction of this prototype will either be aluminum or stainless steel. Because these materials are resistant to corrosion, the food they are used with will not become contaminated, which will keep food illness at bay. The procedure continues with the fabrication phase, which comprises drilling, cutting, and welding to produce the prototype. After sketching and selecting the materials, the process begins with the fabrication process. After the prototype has been completed, it must, without a doubt, be put through a series of tests to establish whether it can perform the purpose for which it was designed. On the other hand, if there are issues, such as the prototype not performing well, modification is required to address it until the function of the prototype can run smoothly. This is necessary until the problem has been resolved.

3. FINDINGS

There are several findings from this prototype.

3. 1 Engineering calculation

Calculations involved in this project are the torque of the rotating shaft that is produced by the motor, the power from the motor, and lastly, the velocity of the connector while rotating.

Angular speed of rotation, rad/sec

$\omega = 2\pi N/60$

$\omega = 2\pi(100)/60 = 10.472$ rad/s

Torque, Nm

$T = \pi DN/60$

$T = \pi(0.08)(100)/60$

$T = 0.414$Nm

3.2 Engineering Analysis

The Von Mises stress is a value that is required in the process of determining whether a certain material will yield or fracture. Most of the time, it is used for ductile materials like metals. According to the von Mises yield criteria, a material will yield if the von Mises stress that the material is experiencing while it is being loaded is equal to or greater than the yield limit that the material is experiencing when it is being subjected to simple tension. According to the other definition, the von Mises yield criterion, which is also known as the maximum distortion energy criterion, suggests that

the yielding of a ductile material begins when the second deviatoric stress invariant reaches a critical value. This definition is because the von Mises yield criterion is also known as the maximum distortion energy criterion. It is a component of the plasticity concept that applies to ductile materials, such as some metals, to the best of its ability. A material's reaction can be expected to be either linear or non-linear elastic before it yields, depending on the situation. The von Mises yield criteria may also be defined in terms of the von Mises stressor equivalent tensile stress in the field of materials science and engineering. This is one of the many ways that this criterion can be expressed. The findings of tensile stress are used as input for the von Mises stress, which is used to determine the yielding of materials under complicated loading conditions. When two stress states have the same amount of distortion energy, then those stress states will have an equal amount of von Mises stress. This characteristic is satisfied by the von Mises stress. When a body in equilibrium or undeformed is exposed to a body force or surface force, it deforms until it achieves a new mechanical equilibrium or deformed condition. Inner body forces come from a force field, like gravity, while surface body forces come from body contact. Stress refers to external forces, whereas strain involves bodily deformation. "Stress-strain relations" describes them. These connections describe bodily materials.

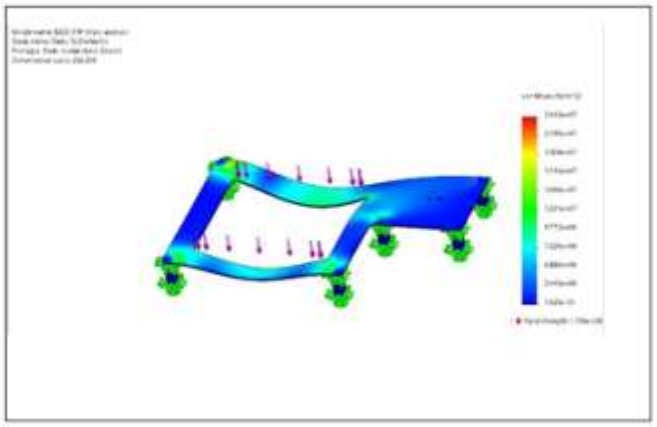

Figure 1. Lower body frame

3.3 Complete Prototype

Figure 2 shows the complete prototype for this project. Table 1 shows the prototype's final specification.

Figure 2. Complete Prototype

Table 1. Prototype final specification

Types	Specifications
Frame	- Aluminium hollow bar - 0.3mm aluminum flat sheet - PVC connector
Power source	12V DC Battery
Moving mechanism	Power window motor
The quantity of flour can filter	Approximately 1kg
Machine weight	15kg
Market price	RM300
Purpose of project	Filter the flour
Dimension	(600 x 400 x 260) mm
Material of mesh	Stainless steel 304 wire mesh (30 x 30cm
Mesh size	- 20 Mesh - 30 Mesh

4. DISCUSSION

The development of an automatic flour filter will help people who work in SME eases the job. By filtering flour, it will filter any other things in the flour that can cause food poisoning. At the same time, the quality of the product will be secured from any problem. Besides that, the employees who work in this industry are very limited due to saving the cost and it is very different with big industry. Related, having an automatic flour filter will help to reduce manpower for the filtering process because it can filter a huge amount of flour at one time and the process is very different when using the hand flour filter where the amount of flour to be filtered is very small and need to do the process continuously until all the flour has been filtered.

Maintenance is the most essential thing to do on any machine or equipment. It is to ensure that the machine can operate smoothly without any problems. Clean up the strainer is important because the filtering process is removing any foreign materials that are contained in the flour before it was filtered. To perform this, there is the opener on the strainer that can open to clean up the strainer with water. It can be done by doing it daily.

Second, the maintenance for this prototype is ensuring that the connector relates to the strainer. It must perform daily because the rotating part would damage if the connector is not connected properly. On the other hand, the filtering process also can't perform efficiently.

For this prototype, the critical parts are the slot of the connector. It is because the slot will attach to the power window motor. When the prototype always operates, the slot will dent and cause a fracture because the load on the slot is large.

5. CONCLUSION

The target market for this product is to help people in small-scale industries, called SME, ease the filtering process that takes time if the process is done using a hand sifter. It is because the repetition of the process will make the worker tired, and the process will take time for the required period. To complete this project, however, the design of an automatic flour filter was completed using SolidWorks, as was the fabrication process. Besides that, the main part of this project is the rotating part where the connector and the strainer are connected. The second objective for this project was also achieved because it seems that the rotation of the power window will produce a movement that can lead the strainer to move horizontally. Thus, the importance of this project is to secure the quality of the final food product, from any problems that can lead to food poisoning. It will also reduce manpower for the filtering process and energy to accomplish the required process.

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