Design and Construction of Potato Slicing Machine

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Abstract – In the production process for potato chips manufacturing industry, the concept of potato chips cutter is utilized for the fulfilment of the modern process. The production of potato is more in the rural area of Myanmar. The small industries are based on such type of activities which requires some skills for increased rate of cutting of chips with the minimum effort. The electrically operated device is designed to cut the raw potatoes into thin slices of thickness 3 mm approximately, suitable for frying and baking as potato chips. From the experiment, the capacity of mechanism is 4.3 kg of potato per minute. Locally and easily available materials like cast iron, mild steel and stainless steel are used for the construction of potato slicing machine. This machine allows in its simplicity of design and modest cost with the ability to generate thin uniform slices of the potatoes for the chips manufacturer with the help of electric power system.

Indexed Terms – capacity, minimum effort, potato chips, rural area, thickness.

I. INTRODUCTION

The king of the vegetable potato contains about 20% dry matter is a starchy and 80% water, which is having semi perishable in nature. Due to dry matter and proteins contain in it, is considered as nutritional vegetable. It is cultivated in 23 states in India. During 1993-2020, demand for potato is expected to rise by 40 per cent worldwide [1]. Due to this the prospects related with is can capture the huge domestic as well as international market.

Processing of potato is very advantageous because it makes storage easier due to the reduction in bulkiness and due to increase in its shelf life. It adds value to potatoes and therefore gives better return. Subsequently processing has been an integral part of the utilization. The production of potatoes in India was 40,476.30 thousand metric tonnes in 2010-2011 from a total area of 1893.90 thousand hectare. Potato is the only crop that can make an impact on the highly populated Indian nation for feeding the people. India ranks fourth in area and third in global potato production. It produces around 8 % of the world's total produce [2].

The simplest mode of processing the potato is conversion into chips. Potato slicing machines are either manually or electrically powered. In any of the cases, the machine consists of a knife or set of knives arranged in a particular pattern to meet the need of the operations it is intended to perform. In the previous method (manual cutting), process is tedious and time consuming, while in the later method, equipment save cutting time but the cost of these equipment, the energy required for their operation & their large size makes them insignificant for their use in small scale industries. Improved processing requires use of tools and techniques that are reliable, efficient, labor saving, safe, simple, and cost effective. The potato slicing machine is simple workable and efficient machine, which can be adopted to reduce mechanical energy input in potato processing and also to improve product quality. The potato of size 2 to 3cm cut by the slicing wheel operated by electric motor when the force is applied on the potato.

II. METHOD AND MATERIALS

The main components of potato slicing machine are
1) Tunnel section
2) Rotating cutting blade
3) Primary cutting blade
4) Shaft and pulleys
5) Belt
6) Frame and cover.

The design of various components of potato slicing machine is mainly based on the functional and structural strength. Different types of potato of size 5 to 7 cm are put into the tunnel section manually. Potatoes are pushed towards the slicing wheel by gravity. Slicing wheel is mounted on the shaft rotating by electric motor of power 1.1 kW with the help of belt pulley mechanisms. Cutting involves principally the application of shearing force on potato with the help of a blade. When the potatoes come in contact with cutting blade of slicing wheel, they are cut into thin slices of thickness 3 mm approximately. The following design criteria were used for the construction of potato slicing machine and materials used for the different parts of potato slicing machine are shown in TABLE I.

1) Local availability and cost of material
2) Mechanical properties, which include strength, rigidity, toughness and ductility.
3) Machinability or formability

TABLE I MATERIALS USED FOR DIFFERENT PARTS OF POTATO SLICING MACHINE

Sr. No.	Parts	Material Used
1	Tunnel section	Mild steel
2	Slicing wheel	Aluminium alloy
3	Cutting blade	Mild steel
4	Shaft	Steel
5	Pulleys	Cast iron
5	Belt	Rubber
6	Frame	Mild steel

Figure.1 Raw Materials and Equipment

III. Parts of the Potato Slicing Machine

A. Tunnel Section

Tunnel section is a circular pipe like structure use to travel the potato to slicing wheel. Initially potato comes from circular tunnel to the rotating cutting blade by gravitational force.

Figure.2 Tunnel Section

B. Slicing Wheel

A circular plate is use as a slicing wheel that has two cutting blades to cut the potatoes. It is made of aluminum alloy to maintain hygiene and to avoid chemical reaction. Blades are mounted on the wheel at an angle of 180 degree. The cutting edge of blade is sharped to reduce shearing force. It cuts two slices of potato in a single revolution. The diameter of slicing wheel is 275 mm and its thickness is 4 mm. The dimension of cutting blade is 92×10 mm. They are shown in Figure.1 and 2.

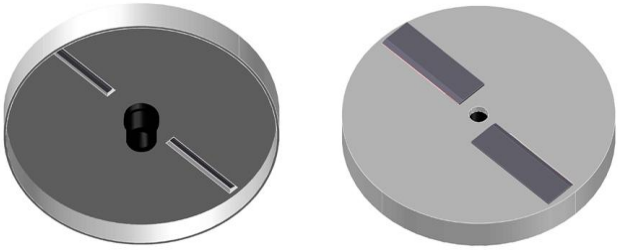

Figure.3 Isometric View of Rotating Slicing Wheel

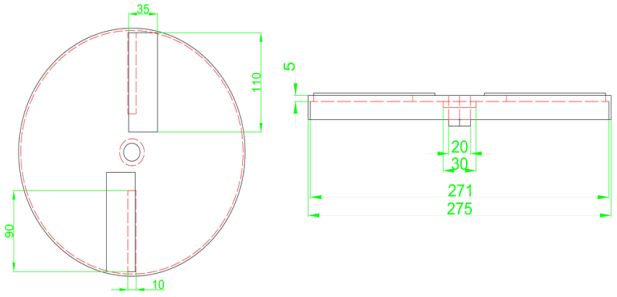

Figure.4 Dimensions of Slicing Wheel and Cutting Blade

C. Power Transmission System

The main source of power for potato slicing machine is got from the electric motor through transmission system. One pulley is mounted on the motor shaft and the another pulley is mounted on the driven shaft where the slicing wheel is mounted. Driven shaft are supported by two pedestal bearings on the frame. Power is transmitted from the electric motor by using V-belt and pulleys. The diameter of driver pulley is 75 mm and the diameter of driven pulley is 235 mm. The diameter of the shaft is 20 mm. The specification of electric motor is 230V, 50Hz, 1.1 kW small AC motor. The peed of motor is 1400 rpm.

Figure.5 Motor and Pulley

Figure.6 Shaft, Pulley and Belt

IV. Results and Discussion

Efforts have been made to design and construct this semi-automated potato slicing machine. The results also have been discussed in the light of theories and with the literature support to the possible extent.

Figure.7 Reducing the Thickness of Cutting Blade in a Lathe

Figure.8 Foundation Frame

Figure.9 Making the Cover of the Machine

Figure.10 Potato Slicing Machine Without Cover

Figure.11 Potato Slicing Machine With Cover

Figure.12 Potato Slicing Machine After Painting

Based on the design, the whole model is first drawn in the 3D design software and then it is constructed with local materials. For finding out the performance of this potato slicing machine, the following parameter is considered.

$$\text{Capacity} = \frac{(\text{weight of potatoes sliced by the machine})}{(\text{time taken to slice the potatoes})}$$

TABLE II RESULT TABLE FOR PERFORMANCE TEST

No	Weight (g)	Elapsed Time (s)	Capacity (kg/min) (Theo-retical)	Capacity (kg/min) (Exp-eriment)	Efficiency
1	330	7	7	2.8	85%
2	390	6	7	3.9	83%
3	360	5	7	4.3	88%
4	350	6	7	3.5	82%
5	345	5	7	4.1	79%

From the performance test, 4.3 kg/min capacity of potato slices is motorized by 1.1 kW power motor in 5 second. The thickness of potato slice is 3 mm and so the efficiency of the machine is over 88%. The dimension of this potato slicing machine is 40 mm in length, 77 mm in width and 96 mm in height.

Figure.13 Weighing Raw Potatoes and Well-sliced Chips

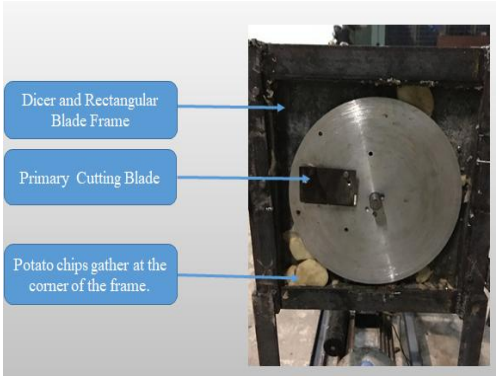

Figure.12 Performance Testing

V. Conclusion

The design of the potato slicing machine is based on the technical idea of the rotary motion produced by the electric motor. The blade angle and the rotation of the slicing wheel provide required slice thickness. To determine the maximum shear force for potato cut into slices, we have produced the laboratory equipment. This machine allows in its simplicity of design and modest cost with the ability to generate thin uniform slices. The capacity of machine is 4.3 kg/min and 3 mm thickness of chips, which meets the requirements of small scale processing unit.

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