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Design and Fabrication of Automatic Fruit Peeling Machine

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Abstract: The purpose of this research is to design, fabricate, test, and evaluate the prototype of a semi-automatic all fruits peeling machine. The design concept is that fruit peeling is accomplished by placing fruits between the rotating fruit holders which are placed horizontally. The machine parts contacting edible parts of the fruit are made of food-grade stainless steel. In operation, a fruit is placed in between the rotating fruit supporting holders which are designed to hold the fruit and cutting tool is fed slowly which is mounted on the screw rod and cut the upper skin of fruit without damaging fruit.This type of machine is used for the business purpose it has high cutting speed at very low input power.

Keywords: Parts of Machine are Pulley, Dc Motor, Gears, Shaft, and Cutting Tool.

I. INTRODUCTION

Peeling of fruit consists of separating the skin which normally protects the fruit from the flesh or pulp thereof. Traditionally, this operation is performed by means of an appropriately sharpened knife, with the edge of the blade applying high pressure to the boundary region between the pulp and the skin, thereby separating them. Different types of fruits have different shapes and sizes. Thus, several different machines are provided to separately process each of the fruit. Therefore, processing of a particular fruit, such as removing the skin from an orange, is usually performed by a particular machine, for maximizing the processing speed of the system. A peeler would peel the rind (and invariably some flesh) from the fruit. It is well known in the art of peeling machine to employ a machine having two opposing ends that secure and rotate an average sized spheroid fruit. Devices suitable to peel fruits like apples, pears, etc., on industrial machines are known for a long time and they are of different kinds. Fruit peeling machines available in the market nowadays are for peeling fruits with smooth skin structure such as oranges and watermelons.

For small and medium-sized fruit peeler, a fruit or vegetable is held at its both ends between a revolving support and a rootstock and is rotated by a motor. A revolving blade is held by a support arm and is rotated by the same motor. Furthermore, the revolving blade is movable along the surface of the fruit/vegetable by the arm and the revolving blade is brought into contact with the surface of the fruit/vegetable. That type of fruit and vegetable peeler is designed to peel and chop fruits without cutting its ends. The user needs to remove the ends manually using a knife and it may require additional labour work. It is more practical to include, a pair of end cutting blade to cut the fruit ends after the peeling process completes without the need of removing the fruit in order to cut the ends. Furthermore, this type of peeler does not comprise any grating devices to specifically remove fruit skin with some special structure on it. An exotic type of fruit that is becoming popular nowadays is dragon fruit or pitaya. This type of fruit has a scaly structure on its skin which cannot be easily removed using the existing peelers in the market. Since this type of fruit starts to attract consumers' attention, hence, the processing of this fruit is now becoming popular in fruit and beverages processing industry. Hence, a suitable peeler is required, which enables the grating and peeling process of dragon fruit skin.

II. BILL OF MATERIALS

1. 1/2 HP 220v 900 rpm AC motor without a clutch.
2. Screw rod 24 diameter of 600mm length.
3. 2" A type pulley.
4. 16" A type pulley.
5. M.S rod of diameter 50 and 370mm length.
6. M.S rod of 70 diameters and 300mm length.
7. M.S plate 230*180mm of 2no.
8. M.S rod 50 diameter and length 60mm.
9. M.S plate 210*110mm of 2no.
10. S.S rod 50mm diameter and 305mm length.
11. S.S square rod 0f 25mmand length 305mm.
12. Ball and Roller Bearings UCF212.
13. Ball and Roller Bearing UCF207.
14. Ball and Roller Bearing UCFL204 of 2no.
15. Ball bearings 6204-2Z of 2no.
16. Gear of 58mm diameter and gear teeth thickness of 18mm.
17. Gear of 224mm diameter and gear teeth thickness 25mm.
18. Wedges of 8 in number.
19. Motor bearings 2no.
20. M.S square rod of 25mm thickness.

III. PARTS OF MACHINE

1. Motor

We used an AC Motor of 1/2 HP which runs at 960 rpm and without a clutch. As we had to reduce the speed of the motor we took a motor of 960 rpm which was the motor with least rpm available in the market. We the motor without clutch so that we can change the direction and can have the rotary motion in both the directions. i.e. Clockwise and Anti Clockwise direction.

To have forward and reverse movement of the screw rod we are using a limit switch so that the cutting tool can be moved to the required position is reached. By using the limit switch we can change the direction of rotation of the motor and can have the tool movement in forwarding and backward directions.

The motor shaft we got was 20mm diameter. We had to mount pulley over the shaft. So we performed turning operations on the shaft as per the design.

We performed turning operation for the 60mm length of the shaft from its end point. We reduced the diameter from 20mm to 17mm diameter for 60mm length. Then we reduce diameter from 17mm to 16mm diameter for a length of 38mm.

The motor is positioned at the top of the machine and pulley is mounted on the shaft of the motor. A keyway of 6*3 mm dimension is made on the edge of the shaft for a length of 38mm and diameter 16mm.

2. PULLEY

We used 2 A type pulleys, which are 16 inches and 2 inches. We had 900 rpm at the motor. For peeling of fruits, we need to reduce rpm. The 2" pulley which was rotating at 900 hundred rpm was reduced to 112 rpm using a 16" pulley. A51 belt is used to drive the pulleys. ID of the 16" pulley is 50 and is mounted on the shaft and ID of the 2" pulley is 16 and is mounted on the motor shaft.

3. BEARINGS

In this project, we used 4 ball and roller bearings and 2 ball bearings. The purpose of using bearings is to reduce rotational friction and support radial and axial loads. It achieves this by using at least two races to contain the balls and transmit the loads through the balls. The bearing UCF212 and UCF207 support the shaft and allow it to rotate freely. Two bearings UCFL204 support the screw rod and allows it to rotate.

4. GEARS

In our project, we used spur gears. We used two gears in our project. We used this gears to rotate the screw rod so as to have linear movement in the cutting tool and also to reduce the speed of travel of the cutting tool on the screw rod. From 112 rpm on the larger pulley by mounting a gear of diameter 224mm on the shaft and is meshed with a gear of diameter 58mm mounted on the screw rod it is reduced to 29rpm. The inner diameter of the bigger gear is 58mm and smaller gear is 25mm.

5. CUTTING TOOL

We have used stainless steel for the cutting tool. The tool is mounted on a block which is thereby connected to the screw rod. The cutting tool and be adjusted according to the dimensions of the fruit.

6. MILD STEEL

Mild steel is a material which is universally used, especially in developing countries. Mild steel refers to low carbon steel; typically the American Iron and Steel Institute (AISI) grades 1005 through 1025, which are usually used for structural applications (Wagner, 2003). The numerous successful uses of mild steel in critical components in all sectors of industry highlight its versatility and suggest many additional applications, hence the need to investigate its behaviour in various environments becomes imperative. This research investigated the effect of the environment (Air conditioned room, open air, and inside environments) on the mechanical properties of mild steel.

Mild steel has become one of the most used materials in the field of engineering all over the world. It is used widely in the construction of roads, railways and in other infrastructures, appliances, and buildings. Most large modern structures such as stadia and skyscrapers, bridges and airports are supported by a steel skeleton. Despite growth in usage of aluminium, mild steel is still the main material for car bodies, steel is used in other variety of other construction materials such as bolts, nails, and screws, other common applications include shipbuilding, pipeline transport, mining, offshore construction, aerospace, washing machine, also new equipment such as bulldozers, office furniture, steel wood tools and armour in the form of personal vests or vehicle amour (better known as rolled homogenous armour in this role). However, the rate at which structures are collapsing as a result of failure is a course for concern by all the stakeholders in the use of steel products.

In this project, **a mild steel shaft** has been used which was initially of diameter **25 mm.**

The shaft was given the stepped structure using the turning and boring operations to get steps of diameter **18 mm, 19mm, 19.5 mm** respectively.

Later a key slot of 6X3 was cut and an M8X25 taper was also made in the shaft.

The bearings are mounted on the **19.5 mm** portion of the shaft.

The total length of the shaft is 518 **mm.**

IV. WORKING PROCEDURE

The fruit is mounted within the holders. The tailstock is adjusted until the fruit is held firmly. The tool is feeded towards the fruit at the desired position. Now the motor is switched on and the peeling operation is accomplished.

V. CALCULATIONS

Ratio of larger pulley diameter to smaller pulley diameter = 16"/2" = 8:1.
So the rpm which is 900 will be reduced to
900/8= 112rpm
The fruit will be rotating at 112 rpm.
The ratio of bigger gear to smaller gear = 224/58 =3.86.
So the rpm which is 112 will be reduced
112/3.86 = 29 rpm.
So the screw rod will be rotating at 29 rpm.
Pitch of the screw rod is 3mm. So the movement of the tool linearly per revolution of screw rod is 3mm.

So in 1 minute, the tool will move 3*29= 87mm distance.

VI. ADVANTAGES

1. Made of superior stainless steel, attractive appearance, safety, and sanitation.
2. Totally automatically operated
3. High peeling rate, peel thickness is adjustable, low flesh loss.
4. Short the production cycle, reduce labour, greatly improve the labour productivity.
5. Stable and reliable performance, high quality, easy to operate and clean.

VII. DISADVANTAGES

1. Fruits like jackfruit are difficult to peel
2. Fruits whose diameter less than 50mm can't be peeled
3. Fruits whose skin thickness is less than 1mm can't be peeled
4. Fruits whose shape is oval can only be peeled.

VIII. EXPERIMENTAL TESTING

1. Fruits

Fruits such as pineapple watermelon were purchased from the local market These fruits are peeled. The performance of the peeler (in this context is peeling blade) was evaluated.

2. Size of Samples

The size of each sample was determined in terms of height (cm) and diameter (cm).

DETERMINATION OF FRUIT PEELING

The fruits selected were peeled using the apparatus to determine the peeling time of each sample. Manual peeling has also been performed using a knife in order to compare the peeling time between the two methods. All reported values of peeling time indices were means of three determinations.

MACHINE TESTING

The fruits machine was tested for the peeling processes.

RESULTS AND DISCUSSION

This is machine also automatically peel the fruits/vegetables that are round (spherical) or oval shapes. The results of the test carried out to determine the peeling time of the apparatus are shown in the test carried out using this apparatus indicated up to 94% (reduction in peeling time of the selected samples when compared to manual peeling. This is useful to enhance the performance of fruits and vegetables processing operation. However, the peeling time is depending on the size and the texture of the skin. Smaller fruits can be peeled faster than the larger ones. For instance, peeling of potato was faster than orange because of the smaller size.

CONCLUSION

An apparatus peeling fruits was designed and fabricated. The unit was tested and found capable of peeling fruits of small and medium size, i.e., apple, orange, cucumber, papaya and Potato Peeling using this apparatus was found to satisfactorily peel the selected fruits, however, and improvements are still required in several aspects of the machine such as adding a sensor for cutting process. Further modifications and improvements would definitely open a new potential of this apparatus to be commercialized as a versatile grater and peeler that helps improves the fruit processing operation. This newly designed apparatus is also suitable for domestic use and food dispensing business such as hotels, due to its small-sized and lightweight.

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