Vol. XVII & Issue No. 09 September - 2024
INDUSTRIAL ENGINEERING JOURNAL

DESIGN AND DEVELOPMENT OF MANUAL PEA DEPODING MACHINE

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Abstract

Food industry is one of the major industries in the world. Green Peas (Matar) is important gradient in various food products. But it is present in the pedals and removing green peas from pedals is time consuming and tedious work. To overcome the time consuming and laborious work, simple machine is necessity of common people. Pea depoding machines present in the market is electric power driven and costly which are not economical for small farmer, small scale food industry persons and common home makers. This pea depoding machine is designed and fabricated considering objective of economy, efficiency and unavailability of electric power. It is working on the friction mechanism developed by two rollers moving in opposite direction. It is simple in construction and very helpful to fulfill the demand of green pea removal in less time, lower cost, higher efficiency and without electric power.

Keywords: Green Peas (matar), Depoding machine, friction mechanism.

1. INTRODUCTION

Peas (matar) are one of the major crops cultivated in many areas of central and north India. India is one of the important green pea cultivators. Green pea (matar) cultivation is carried over 4,34,000 hectares in India which yields green peas in 38,69,000 tons. [1] We know the presence of protein, amino acid, vitamins, calcium, carbohydrates, iron and phosphorous in the green peas as per dietitians. Green peas in natural and dried form are important element in Indian kitchen and abroad. It has important role in many vegetarian and non-vegetarian foods.

Role of mechanization in agricultural is increasing day by day to perform various farm operations with higher efficiency and speed. For small farmers and small scale industries, manual depoding of green pods are arduous, energy and time consuming. To overcome theses depoding problems small manual pea depoding machine is required.

2. LITERATURE REVIEW

Kumar Ashish et al. [1] have developed small scale manually operated green pea depoding machine. Working principal of this machine is the friction developed in between pea pods and hammer pads along with inner surface of sieve frame. It has capacity to depode green pea pods in terms of 15.47 kg/hour

Sonboier K. et al. [2] developed pea depoding machine with depoding efficiency 93.50 % and 6.53 % damage pea as well as 7.25 % undepod peas. Capacity of machine was 14.88 kg/h powered by 0.5 HP motor containing two adjustable rollers with adjusting screw for maintaining the gap in between them which is used for shelling the green pea.

Kamboj P et al. [3] designed and developed pea depoding machine in which relative motion among blades with the pea pods developed friction. This machine was designed by using CAD software. Machine has pea depoding capacity of 30 kilogram per hour.

Prem M et al. [4] analyzed various green pea pod depoding machines present in the market in terms of materials and different techniques used for shelling purpose.

Sharma S. K. [5] developed pea depoding machine by applying friction in among punched tin sheet surface, cycle tyre treads and gunny bag.

Senapati A. K. et al. [6] measured the physical dimensions of green peas like mean length, width, thickness, arithmetic mean diameter, geometric mean diameter and spheric which are used in selecting and developing techniques in design and development of machines used for processing green pea pods.

Khobragade H. M. et al. [7] have developed small green pea pod depoding machine having 61.01 % depoding efficiency with 1650 rpm.as speed of roller and 2 mm as clearance in both rollers.

Selvan M [12] developed vertical free-standing unit which has capacity to depode green pea pods up to 113Kg/hour with efficiency 96.75%.

Table 1 shows the long history for the development of pea depoding machine from year 1987 to 2020 in India with respect to name of the paper in which it was published, year of the publication, use of mode of power that is whether it is electric or

human operated, depoding capacity and depoding efficiency.

Table 1: History of development of pea depoding machine

Sr. No.	Name of paper	Year	Power mode	Depoding capacity	Depoding efficiency
1	Power operated green pea shelling machine [14]	1987	Electric	50Kg/hour	96%
2	Development and evaluation of green pea peeler [8]	1988	Manual		92.7%
3	Testing and evaluation of power operated pea shelling machine [9]	2003	Electric		98.94%
4	Development of pea depoding machine [10]	2006	Manual		69.5%
5	Design and development of small scale pea depoding machine by using CAD software [3]	2012	Electric	30Kg/hour	
6	Design and Development of Green Pea Depoding Machine [2]	2018	Electric	14.88 Kg/hour	93.53%
7	Development of Power Operated Pea Sheller[11]	2020	Electric	4.002 Kg/hour	95.8%
8	Development of power operated continuous feed green pea sheller [12]	2020	Electric	113 Kg/hour	97.5%
9	Performance evaluation of green pea depoder machine [1]	2021	Electric	15.47 Kg/ hour	96.75%

3. PROBLEM STATEMENT

Human Capacity for depoding green peas has limitation due to it's arduous nature and it consumes more time. Human being can depod up to 3.4 to 3.6 Kg green peas in 1 hour [5]. It is very difficult to store the green peas in natural condition for long time to maintain their rich protein values. To overcome the time consuming and tedious nature of human pea depoding, it is essential to develop the pea depoding machine. Some pea depoding machines are available in the market but they are facing some problems regarding their efficiency, higher cost and requirement of electric power. Small farmers and small-scale food industries are facing the unavailability of efficient, economical and human driven pea depoding machine. To solve these problems, it is required to design and fabricate the efficient, economical and human operated pea depoding machine.

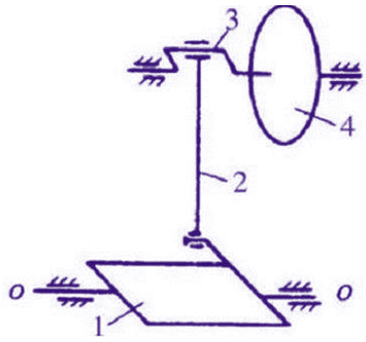
4. METHODOLOGY AND MATERIALS

Pea depoding machine available in the market is electricity driven. To attain the objective of economical, manual and efficient pea depoding machine, new machine was designed. To develop the new manual pea depoding machine three factors were considered. These are mechanism for depoding, size and shape of pea pods, feed rate of pea pods.

a. Selection of mechanism

To select proper mechanism, many manual machines were studied. Major stress was given on foot pedal power transmission mechanism of the sewing machine (Figure1) which converts reciprocating motion to rotational machine. It consists of four parts like foot pedal (1), connecting rod (2) crankshaft (3) and belt pulley (4). This mechanism is shown in the Figure 1. Such manual machine will replace the present available machine and also full fill the necessities of costumers like Indian farmers. It is going to decrease the depoding period of pea pods which is going help to improve the profit margin.

Figure1. Foot pedal power transmission mechanism of the sewing machine



During operation of the sewing machine the foot pedal is pressed by foot so that the pedal swings backward and forward about fixed axis O-O. This pedal is connected to connecting rod 2 which rotates the crankshaft 3 and finally sewing machine is driven by belt pulley arrangement 4 through the belt for sewing operations. Pea depoding machine consists of two grooved rollers having the gap in between them. One is driver and other is driven. This gap is adjusted as per size of pea pods. Driver roller is connected to the belt pulley.

b. Size and shape of pea pods

Green pea pods samples were selected to measure their size & shape. Sixty four samples were selected to measure the shape and size of pods. Dimensions were measured with the help of vernier caliper. Stress was given on measurement of pods to set the gap in between the two rollers. The size and shape of pod will determine the width of slots fitted on the tray and gap among rollers [13]. Different seeds diameters were measured to obtain the average value. Different diameters are measured like 7.44mm, 9.81mm, 8.0mm, 10.8mm, 6.0mm, 9.7mm, 4.67 mm, 7.22mm etc. with average 7.95 mm. Similar technique is used for the width of pea pods. These are 14.0mm, 11.96mm, 13.04mm, 14.16mm, 13.2mm, 13.4mm, etc. with average 13.29mm.

5. WORKING PRINCIPLE AND MECHANISM OF MACHINE

In this depoding machine, rolling of two rollers are occurred in opposite direction and passing green pea pod in between these rollers causes the generation of friction in rollers and pea pod which leads to depoding of those pea pods. These rollers are operated by foot pedal power transmission mechanism of the sewing machine. For proper operation of machine the required mechanisms are,

A. **Foot pedal power transmission mechanism of the sewing machine:** Foot pedal power transmission mechanism is operated by foot pedal for translating reciprocating motion into rotating. It provides power to the machine.

B. **Vibration Mechanism:** The tray is vibrated using a wooden strip which is connected to the pedal of the treadle mechanism. As

the pedal moves up and down the wooden strip connected to it also start moving up and down. Due to this the feeding tray gets motion i.e. vibration as the end of the wooden strip is connected to the tray. To depode seeds from pea pods there should be proper friction developed between rollers and pea pods.

6. DESIGN OF MACHINE AND CREO MODELING:

Computer Aided Design was used to design the Machine for using for proper visualization of machine. CREO software plays important role in future development of machine to modify the designed work later by providing new facilities. Now day, CREO software has wide scope in agricultural field, therefore Creo software was used for designing the pea depoding machine. Figure 2 shows CREO Model of Pea Depoding Machine and Figure 3 shows it's side view.

Figure 2. CREO Model of Pea Depoding Machine

Figure 3. Side View

7. CONSTRUCTION

Ergonomics, space and cost as well as human efforts were considered to develop the pea depoding machine. Hand pulley, two rollers, two shafts, two gears, tray, etc. are the elements of the machine with objective of simple in construction.

Rollers are made hollow to decrease the weight of machine which is made up of SAE 1030. Upper roller is plain with diameter 6cm and length 34.29cm. Lower roller was made threaded with 5.5 cm diameter and length 34.29 cm. Objective of threaded roller was to generate sufficient friction with pea pods.

Shafts of material as steel (SAE1030) are used. The rollers, gears, and pulley are fitted on a shaft. Shaft has length 48.3 cm with maintaining distance among shafts is 5.9 cm.

Rolling of mating rollers with opposite direction is used to create necessary friction. Gears having dissimilar number of teeth are purposefully separated by required distance between two rollers. Tachometer was used to calculate the speed of the gears. Both of the gears are having speed 407 rpm and 367 rpm respectively.

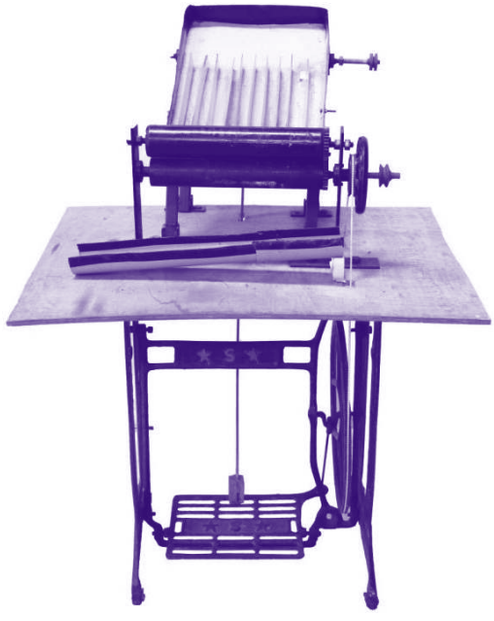
Foot paddle power transmission mechanism in sewing machine is a lever device pressed by the foot for driving a machine. This mechanism is used for translating reciprocating motion into rotating motion. It is going to replace electric energy with human labor to run the machine. When the pedal is pressed by foot or feet rocking motion is developed which ran the foot paddle power transmission mechanism. This rocking motion causes a motion to a large crankshaft which helps to drive hand pulley which acts as flywheel.

8. WORKING

Hand pulley fixed on lower shaft and acts as fly wheel is initially manually operated by hand to rotate the crank shaft and the Foot pedal power transmission mechanism gets started. It supplies power to another gear. This gear is started rotating in the opposite direction. Clockwise rotation of lower roller causes antilock wise motion to upper roller and vice versa. The rollers are attached to the both lower and upper gear. The movements of gears provide motion to the rollers which causes to introduce pea pods in between the rollers. Friction in between rollers and pea pods removes green pea seeds from the pea pods.

Feeding tray was mounted on one side of the roller. Machine has to be run by the operator from other side. For collection of green peas, proper distance (gap) among vibrating tray with roller was kept for collecting green pea seeds at collecting chamber. Collection of kernels is to be done at other roller side. For vibration, cam mechanism was used. Figure 4 shows Pea Depoding Machine.

Figure 4: Green Pea Depoding Machine



9. RESULT

Evaluation of the working of pea depoding machine was carried in the form of efficiency and mass of pea depoded per minute by the machine. Depoding efficiency was calculated in terms of the ratio of mass of the pea pods actually depoded to the total mass of pea pods before Depoding. The pea depoding efficiency was calculated as 85.39%. After comparing previous machines, this pea depoding machine was proved to be more efficient and more cheap to run as it is run without electricity.

10. CONCLUSION

Pea depoding machine is relatively less complex in designing and construction. It's working is established on friction developed in among rollers. It has capacity to extract larger quantity of peas economically and within shorter time period. It will play important role in depoding of green peas in small scale food industries and farmers without use of electricity. Working of this machine is controlled by legs, therefore both hands can be used to regulate input of the pea pods for the machine.

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