

Design and Development Mobile Groundnut Decorticator

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Abstract—In India, Agriculture is the backbone of the country. Agriculture is widely practised in the rural areas. The groundnut is one of the major products across the fertile lands of India. But the major problems faced during agriculture are at the stage of processing the products due lack of machines and technologies. At the early days the groundnut was decorticated by workers which consume more money and less effective .hence there is a requirement of a groundnut decorticator. This paper describes about the design and development of cost effective groundnut decorticator with good decorticating efficiency. The development of agriculture with new technology will directly support the development of rural areas.

Keywords—Agriculture; design and development; groundnut decorticator

I. INTRODUCTION

In India nearly about 70-72% of the population are living in rural areas. Their occupation is farming, which is done with the help of traditional methods. Groundnuts are a high value crop that can be marketed with little processing but are extremely versatile and can be used in a wide range of products [1]. It contains 48-50% oil and 26-28% protein, and is a rich source of dietary fibres, minerals, and vitamins [2] [3]. The main aim of this paper is to develop a mobile groundnut decorticator using multiple power sources that is regenerative circuit in which electricity is produced and consumed simultaneously to adopt this machine for small application in rural areas. Apart from this, the machine is designed to have good decorticating efficiency and low percentage breakage of peanuts.

A. Motivation

Decortication of groundnut is a monotonous and time-consuming process [4]. The labours engaged in hand shelling of groundnut pods is time consuming, tedious and labour intensive[6]. One person can decorticate about 5kg of pod manually in one day [7]. It was also a boring work for the worker [9]. Considering the energy expenditure rate, using of regenerative circuit found to be less expensive and one-time investment. The use of high grade energy like electrical energy for decortication of groundnut results in low energy conversion ratio. This made the work to focus on the design and development of mobile Groundnut Decorticator. The machine has the more shelling capacity of groundnut per hour than that hand shelling and separating.

II. LITERATURE REVIEW

Arjun Vishwakarma, Tejas Tandale [5]: This paper deals with the work of design of an electrically powered groundnut shelling machine. The machine was fabricated using materials that were easily available. It can be used for both household and industrial purposes. The advantage to be derived from the use of this machine overcomes its shortcomings. This design gives major advantages in the case of power consumption. The required power for above stated capacity is 1 hp while 1.98 as for conventional machine. Our designed machine is light weight compact and slim in construction. It is easy to operate and transport from here to anywhere. The bearing is used to all four shafts. It does not require percent lubrication. But it is suggested to lubricate bearing by oil periodically. The self-lubricated bearing can be used for shafts, but it will increase cost

Kulbhusan M. Shejole, Nitin B. Borkar, and Abhijit M. Bobade [1]: This paper deals with the pedal operated groundnut decorticator machine is better option to use farmer instead of hand operated. The machine is pedal operated so that there is no energy consumption which will help to reduce the cost of productions. This machine also saves time and manpower. If we go on continuous work we got a higher output in very short time. The operating procedure of this system is very simple, so there is no skill labour required to operate a machine.

P.O. Ebunilo, E.K. Orhororo, E.J OVORUNURAYE and I.B. Owunna [3]: This work aims at the design and development of a low-cost groundnut decorticating machine for home and commercial use in Nigeria.4.36Kg of roasted groundnut was fed into the machine; this

produces an average mass of 3.43Kg of peeled roasted groundnut seeds, 0.462Kg of unpeeled groundnut seeds, 0.399Kg of partially peeled groundnut seed and 0.07Kg of broken groundnut seed. An average time of 488.8seconds and an average peeling efficiency of 78.46% was recorded. It was observed that the higher the mass of the roasted groundnut seeds the longer the time of peeling. The machine is cheap because the parts are locally fabricated. The technology could provide employment and at the same time make available quality roasted groundnut seeds at low cost for domestic and commercial use in Nigeria.

V.Thirupathi, R.Viswanathan, K.Thangavel [10]: In this research paper it is reported that based on the shelling action they can be divided into two categories. Hand operated and pedal operated, a hand operated groundnut decorticator 50-75 Kg per Hr. capacity was evaluated. Whereas a pedal operated groundnut decorticator was found to have capacity of 72 Kg/ Hr.

A.N. Gitau, P. Mboya, B.N.K. Njoroge, and M. Mbura [8]: From above research paper, we have studied the hand operated groundnut decorticator and reported that groundnut receives less power to be broken and it is a tiresome process. Another view we have taken that, the smaller the hole size of the sieve, the greater the pressure, thus most pods are broken, however, the size should not be so small that the kernels are broken in the process of shelling.

III. CONSTRUCTION AND WORKING

A. Construction

The machine contains parts like shafts, Cylinder, sieve plates, fan, motor, alternator, battery, wheels, belts etc. Outer cylinders with holes are used as a stator. Inside a stator, hallow cylinder is used as a rotor, which is hallow and thickness is 2mm which has strips as deshelling tool, in turn it is connected to shaft. Shaft is rotated by motor which is placed at one of its end axially through the gears, they are used to reduce the speed of shaft, 1:3 ratio gears is used to cut the rotational speed of shaft. Pulley is mounted on motor shaft itself and connected to alternator through a belt drive of 1:1 ratio. Another end of the shaft makes use of cams which converts rotary motion of shaft into translatory motion of linkages which are connected to sieve plates in order to produce vibrations. Solar panel is mounted at the top of the machine and it is connected to battery, this will give the energy source to charge the battery along with that alternator. Blower and sieve mechanism is provided to separate the husk from the peanut. Finally, whole machine is provided with wheels to make it portable.

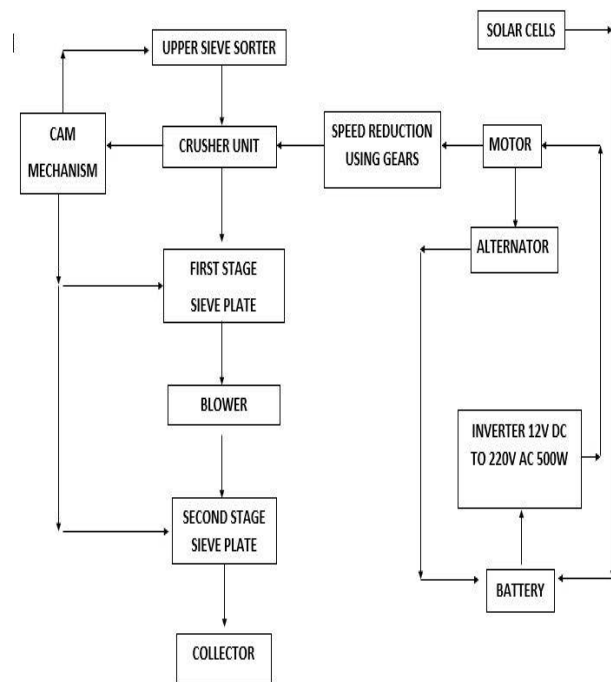
B. Working

Groundnuts are fed into top sieve plate which separates smaller and bigger peanuts and send to the crushing unit separately, now as the motor rotates inner cylinder also

rotates which is connected to shaft, as inner cylinder rotates strips provided on it tends to deshell the groundnut by the action when the groundnut entrapped in between the tool and the outer cylinder and it is forced through the provided outer cylinder's holes.

By supplying a sufficient air through the fan, due to less weight of the husks they were blown away from the machine, remaining mixtures are fall on the sieve plate due to gravity. Cam mechanism is provided to the Sieve plate for vibration which will separate groundnut and husks by acting as a sorter, and it is further sent to the next separation chamber for the same process to remove husk from groundnut completely and groundnut is collected through the bottom sieve plate which has minute holes to remove dust. Finally, groundnut is decorticated and collected in the collecting chamber.

Flow chart in the figure (1) will give details on the parts used and the sequence of their working respectively. This design is made on the basis of problems and parameters which are mentioned in the objective. Another problem in decortication is mixing of peanuts and deshelled husks after decortication and it is removed by using blower and sieve mechanism in two steps. Inverter is used to convert the DC source of battery into AC source for the motor input.



IV. TESTING AND RESULTS

A. Testing

A known weight of groundnut is taken and is fed into groundnut decorticator for shelling. The time taken for the operation is noted. The shells and unshelled pods collected in the shell outlet are separated manually and weighed. The

kernel, unshelled pods and shell which are collected in the kernel outlet are also separated and weighed.

Table I: Test result for shelling efficiency

SL.No	Mass of groundnut, kg	Mass of peeled groundnut, kg	Mass of unpeeled groundnut, kg	Mass of good peanuts, kg	Mass of scratched or broken peanuts, kg
1	0.5	0.5	0.01	0.30	0.15
2	1.0	1.0	0.001	0.75	0.20
3	1.5	1.5	0.0375	1	0.01

B. Performance Evaluation

1) Capacity:

$$C=W/t$$

Where: C= capacity of the machine, kg/h

W= weight of groundnut pods machine, kg

t= time taken for decortication, hr.

$$C= W/t$$

$$C= (1.5*60)/2.5 \quad C= 36 \text{ kg/hr.}$$

2) Decorticating Efficiency:

$$\text{Efficiency} = (1-W_u/w) * 100$$

Where: W_u = weight of unpeeled pods, kg

w = total weight of pods fed in the machine, kg

$$\text{Efficiency} = (1-W_u/w) * 100$$

$$= (1-0.01/1) * 100$$

$$\text{Efficiency} = 99 \%$$

3) Breakage:

$$\text{Breakage, percent} = \frac{W_b}{W_g+W_b} * 100$$

Where: W_b = weight of broken kernels,

W_g = weight of good kernels, kg.

$$\text{Breakage, percent} = \frac{W_b}{W_g+W_b} * 100$$

$$= (0.01*100) / (0.95+0.01)$$

$$\% \text{ Breakage} = 1 \%$$

Table II: Comparison of manual and machine operated groundnut stripping.

Sl.No	Parameters	Conventional shelling (Hand shelling)	Motor operated decorticator	Mobile Decorticator
01	Labour requirement, man hr/day	10	5	2
02	Unpeeled pods, %	Nil	Nil	0.1
03	Broken pods, %	Nil	10	1
04	Energy required, hp	Nil	1	1
05	Shelling efficiency, %	100	99.5	99

From Table II it could be seen that the performance of pedal operated groundnut stripper was relatively better compared manual stripping. The shelling efficiency of pedal operated groundnut stripper was found to be 99.75%. The pedal operated groundnut decorticator does not require high grade fuel like electrical energy for its operation.

V. ADVANTAGES, APPLICATIONS

A. Advantages

- 1) It reduces the dependency on regular power supply.
- 2) It can be taken to the working site since wheels are provided.
- 3) Better deshelling efficiency since shells are separated in three stages i.e., hopper, sieve plate and blower.
- 4) It gives the ownership to farmers.
- 5) It is economical and simple in design.

B. Applications

- 1) It can be used by small communities in villages.
- 2) It can be used in farms or oil extraction work.
- 3) It can be used when large number of groundnuts is to be shelled for agricultural purpose.
- 4) It can be used in small industries which produces the groundnut production.

VI. CONCLUSION

A decorticator to deshell the ground nut shells has been designed and developed. Performance test was conducted on the developed machine. There are several important conclusions have been observed,

1. The operation of this machine makes it a unique type compared to existing ones. The operation was performed automatically and did not require high skilled labour.
2. The developed decorticator unit can be successfully and efficiently used by farmers, to produce ground nut seeds thus resulting in great saving in time and effort.
3. It can be used for both household and industrial purposes.
4. Finally from numbers of experiments we can comment that semi atomizes machine is more economical and convenient option for farmers instead of hand driven machines.

As we know population and energy utilization are increasing to the peak and availability of energy is decreasing to the ground, non-conventional energy sources are what the world is looking forward to. And our paper is one step to exploring the new possibility and achieving it, where use of alternator and solar panel helps in producing the electricity continuously and also, we are using regular electric power for running motor. If anything happens to the

regular supply it can use battery source and vice versa. Either way can get the deal and also presence of wheels helps in taking the machine to the site place easily comparing to the other groundnut decorticator. This machine has better deshelling efficiency and better in separating the shells and peanuts. Mainly, it uses the conventional sources and reduces the dependency on the regular electricity. The test results show that the machine can decorticate a total of 30-36 kg of groundnut per hour. Considering the less fatigue of human operator and the high output, the mobile groundnut decorticator using multiple power sources may advantageously be used for decortication of groundnut.

It is portable and simple to operate. Every component of the machine was sourced locally thus giving a machine that is cheaper than the costly and complex imported heavy groundnut decorticators which are usually out of the reach of the common farmers and the local entrepreneurs.

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