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Experimental Optimization of Corn Shelling Machine -A Review

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Abstract: ***Farmers in developing nations, such as India, cultivate small-scale maize. It is sold on the cob, and the individual kernels cost around twice as much as the cob. Therefore, if farmers can de-husk the corn and sell the kernels on the market, they can generate more income. The issue is that there are not enough affordable, manually operated, and efficient maize shellers in the country. This is a major problem in India for maize production. Maize first emerged in the Americas, and by 1250 BC it had spread to all areas of the region. As populations increased, a trading network developed, based on surplus and varieties of maize. They tend to sell the corn with the cob attached, but doing so leads to an average kernel price that is twice the price of the cob. If farmers decorticated the corn and sold the kernels separately, they could generate more income. The challenge is that there is a lack of inexpensive, manual and efficient corn Shellers, making it difficult for farmers to process their corn. This is a major problem facing corn production, particularly in India. Examine the factors that determine the performance of the maize sheller and identify the design elements that have the greatest impact on its operational efficiency.***
Keywords: maize, Sheller Machine, Moisture content, Performance evaluation.

I. INTRODUCTION

Corn is an extremely significant cereal crop in Africa, particularly in Nigeria. Botanically, maize is referred to as zea mays, and also as corn. Varieties of maize include dent maize, sweet maize, popcorn, flour corn, pod corn, flint corn, and waxy corn. It is a beneficial raw material for the food industry. A large amount of processed corn is eaten fresh. Maize production is considerably faster, more cost-effective, and easier than that of other food crops, including palm trees and cocoa, which can take several months to reach maturity. The resulting processed corn is used in the production of a wide range of items, including breakfast foods, corn meal-flour and grits, starch, corn syrup, corn oil, spirits, acetone, chemicals, absorbents, seed, and silage. To meet the demands of the agro-allied industries, large amounts of maize are needed; to improve quality, an efficient method of processing must be devised. The processing of corn requires several steps, from harvesting to milling. These processes can prove costly for rural farmers, but the use of appropriate technology can help to maximize the profits of their produce. Shelling, which involves the removal of corn kernels from the cob, is one of the most important steps in the process. This can be done manually or using a machine, and the difficulty of the task depends on the variety of corn and its moisture content and maturity.

II. LITERATURE REVIEW

1) Dr. C. C. Handa and Dr. C. C. Hand et al "Literature Review of Corn Sheller Machine"

Farmers in developing countries like India often grow corn on a small scale, which is sold with the cob attached. The average price of a kernel is double the price of the cob, so farmers can make more money if they separate the kernels from the cob. To do this, they need a cheap and efficient corn Sheller. A lack of these machines is a major issue with corn production in India. A recent study developed and tested a corn Sheller, which includes a feed hopper with a flow rate control device, shelling unit, separating unit, and power system. Tests were conducted to measure its throughput capacity, shelling efficiency, material efficiency, and mechanical damage. Regression models were developed to determine the relationships between the Sheller's performance, moisture content, and feed rate.

2) Igbinoba J.O, Unuigbe A.I. I, Akhere F.I, Ibhahe .G.U & Gbadamose V.I et al "Design and Fabrication of a Corn Sheller".

This paper presents a dry corn shelling machine which is designed to efficiently separate corn from the cob. The components of the device include a body casing, drum, shelling unit, grain and cob discharge unit, machine frame, hopper (Feeding chute), bearing, and a 2Hp electric motor which is connected to the shelling unit via a belt drive. Additionally, a blower, which is powered by a separate electric motor, is connected to the discharge unit and helps to eliminate any unwanted particles from the shelled corn.

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After testing, the designed machine was found to be 79% efficient with a capacity of 63.95kg/hr. It is also more cost effective, simpler, and more portable than imported products with similar capacities.

3) *Merga Workesa Dula et al "Review on Development and Performance Evaluation of Maize Sheller"*

This paper has focused on exploring the development and performance of maize shelling machines. Maize threshing is a critical process in post-harvest maize production and often requires motorized, tractor/power tiller operated machines. Hand-operated maize shellers exist, but they are limited in their capacity to shell one cob at a time and can't be used for extended periods. As a result, this research aims to analyze the design features of current maize shelling machines, in addition to evaluating the performance parameters that are most influential to their operation.

4) *Pradip V. Kadam, Mr. Deepak S. Patil, Mr. Mahamadsad D. Jamadar, Mr. Pramod N. Shinde, Mr. Prajyot D. Sidwadkar, Mr. Pramod D. Salunkhe et al "A REVIEW ON DESIGN AND DEVELOPMENT OF CORN PEELING AND SHELLING MACHINE"*

This paper proposes an idea for a machine that can peel and shell corn while maintaining a high production rate and a compact size. The machine is designed to collect cobs and seeds without damaging them and is easy to use and accessible to all farmers. It can process both peeling and shelling with a single feed or separately.

5) *Nithin R, Praveen Kumar S, Praveen Raj R, Madheswaran S et al "CORN SHELLER MACHINE"*

Maize, better known as corn in many English-speaking countries, is a grain that was first domesticated by indigenous people during prehistoric times. The Aztecs and Mayans cultivated various types of it across central and southern Mexico and used it for cooking and grinding in a process called nixtamalization. By 1250 BC, the crop had spread to all parts of the Americas, and any densely populated areas developed a vast trade network based upon surplus and different varieties of maize. When Europeans made contact with the Americas in the late 15th and early 16th centuries, they brought maize back to Europe, thus introducing it to other countries through trade. Its popularity and ability to grow in various climates allowed maize to spread to the rest of the world. In India, however, the current methods of corn de-husking used in agriculture, such as manually breaking the grains or using large machinery for deseeding, are not effective due to the lack of money for investment by farmers. Therefore, there is a need for an innovative and cost-effective product or idea that would be safe, productive, and feasible for Indian farmers.

6) *Adewole, C. A., Babajide T. M, Oke, A. M., Babajide, N. A. Aremu, D. O. and Ogunlade, C. A. et al "Critical Evaluation of Locally Fabricated Maize Shelling Machine".*

The research conducted evaluated locally fabricated maize shelling machines at Odo-Oba market along the Oyo-Ogbomoso road in Oyo State, Nigeria. Structured questionnaires were used to assess the design features and challenges faced when using the machines, while mathematical relations were used to evaluate them in accordance with Nigerian Industrial Standard. It was found that petrol engines were mainly used as the power source, with an average fuel consumption rate of 0.015 lit/min. The shelling efficiency ranged from 85.9 to 89.7%, with an average of 88%, and the throughput capacity averaged 360.8 kg/h. Common problems included corrosion of machine parts, separating kernels from cobs, packaging of kernels and cobs into bags and flying over of maize cobs. The machines were found to be economically useful and highly efficient, although no prior design parameters were established. Engineers must now undertake research and develop protocols for the design and maintenance of these machines.

7) *Kedar Patil, Shamuvuel Pandit, Gajendra Pol , Sunil Kadam, Avdhut Jadhav et al "Design and Fabrication of Corn Shelling and Threshing Machine".*

The production of agricultural products into more marketable forms can extend their longevity as well as increase the amount of profit farmers make from them. This project focused on demand-oriented design, which required understanding the requirements of farmers and creating an adequate system that meets their needs. Maize is a popular crop, but many farmers are unable to purchase costly imported threshing machines. Therefore, they resort to manual threshing, which is inefficient, leads to considerable waste, and requires a lot of effort. This machine was designed to shell maize and separate the cob from the grains.

8) *D.O Aremu I.O. Adewumi J.A. Ijadunola et al "Design, Fabrication and Performance Evaluation of a Motorized".*

The fabrication of a power-operated maize shelling machine was conducted in the engineering workshop of Allamit Nigeria Limited in Odo-ona, Ibadan and the Federal College of Agriculture Moor Plantation in Ibadan, Oyo State, Nigeria.

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This machine is 830mm in length, 605mm in width, and 950mm in height, and can be easily transported with a vehicle to a farm. The performance evaluation was done using the NIS standard, which involved varying the shaft shelling speed from 623rpm to 823rpm to 886rpm at different moisture content of maize cobs, such as 13%, 15%, and 17%, respectively. The results showed that the shelling efficiency, cleaning efficiency, grain recovery efficiency, and output capacity achieved their highest values at 13% moisture content and 886rpm shelling speed, with values of 87.08%, 95.89%, and 623.99kg/hr, respectively. Thus, shelling of maize at 13% moisture content dry basis using 886rpm shelling speed. Results showed that the machine had a higher shelling efficiency and productivity compared to manual shelling. The machine also had higher cleanliness of grain, fewer fines, and better overall grain quality.

9) *Adewale Sedara, Emmanuel Odediran, Seth Manuwa Et Al "Design And Fabrication Of An Improved Motorized Maize Sheller/Threshing Machine".*

One of the most essential steps in maize processing is the shelling of the grain. Shelling is vital for producing a higher quality of maize which can extend its shelf life, as well as increasing the profit farmers can make from its mechanization. As maize is a widely consumed grain across the globe, this operation is particularly important. The machine was designed and constructed with several components, such as a frame, hopper, transmission shaft, cylinder with spikes and blower, concave with sieve, power source, pulley, and bearings. Its portability ensures that farmers can use it to shell their maize grains on the farm, rather than having to transport them elsewhere.

10) *Sharmistha Sahu, Geetanjali Dhupal and Jogendra Soren et al "Design and Fabrication of a Hand Operated Small Scale Maize Sheller".*

Maize is a major crop in India, often referred to as the "king of fodder" and "queen of cereals" for its significance in both human and animal diets. Previously, shelling maize was a labor-intensive process that required people to rub the cobs together or on a hard surface. This method was not only time-consuming, but also caused physical strain. This study was done to survey the shelling methods used by small and marginal farmers in order to provide them with an efficient and cost-effective hand-operated maize sheller. The small scale maize sheller is composed of a rubber tire on a frame with a shaft attached beneath it, along with a concave. Sundried maize, with a moisture content between 10-20%, can be fed into the gap between the tire and the concave, where it is then shelled due to the friction between these two parts. The clearance between the tire and the concave is adjustable, allowing for any size of maize to be used. Comparisons between manual and hand-operated shelling show that the hand-operated method is more productive. Additionally, the shelling efficiency decreases as the moisture content increases and increases as the rotational speed increases.

11) *Karansinh R.Chitoda, Kalpak V.Doshi, Sourabh A.Dugad, Nitin T.Kadam, Design And Development Of Pedal Operated Maize Desheller- A Review".*

This paper provides information on the design, fabrication, and evaluation of the performance of a Corn Sheller. The evaluation focused on the throughput capacity, shelling efficiency, material efficiency, and mechanical damage. Additionally, regression models were established to express the correlation between the Sheller performance indices, pod moisture content, and feed rate. The research described in the paper includes a detailed analysis of the various components of the Maize Sheller machine, with different methods used for the design. The machine could be operated continuously for a comparatively long time with high shelling rate without causing damage to kernels. Four shelling units can be provided for shelling of maize cobs and operated with the chain and sprocket arrangement. The results revealed that the machine was easy to operate with an average kernel shelling rate of 110 kg/hr when operated by two persons with no any kernel damage. Overall, this paper involves study of different processes like design, fabrication and assembling of different components etc.

12) *Pavasiya Uttam N., Patel Hardik, Patel Krupesh, Sumant Mandar Mukundrav and Sutariya Hiren R et al "Design & Fabrication of a Motorized Maize Shelling Machine".*

The focus of this project was to create a design that addressed the needs of farmers while considering the cost of production. This design focused on demand-led development, which involved understanding farmers' needs and building a system to meet them. As many farmers grow maize but cannot afford the cost of imported threshing machines, manual threshing methods are used. This leads to low efficiency, high wastage, and a lot of labor.

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The machine was designed to shell maize and separate the cobs from the grains, in order to make the process more efficient, reduce wastage, and decrease the amount of labor required. Not only does this process increase the longevity of agricultural products, but it also increases the net profit farmers can make.

13) *S.B. Patil, A.D. Chendake, M.A. Patil, S.G. Pawar, R.V. Salunkhe and S.S. Burkul et al "Development and performance evaluation of pedal operated maize sheller".*

Before beginning the shelling process, the machine was set up in an area with sufficient space. Two large buckets filled with cobs were placed on either side of the machine for easy access to both workers. The driver of the machine sat on the seat provided and started pedaling, causing the four shelling units to rotate. The driver and the other worker took turns picking the cobs from the buckets and inserting them into the rotating shelling units with both hands. The motion of the shelling units then shelled out the kernels, which fell onto the collection trays. The kernels were then collected through the collection chute into a bag or container placed below.

14) *Oriaku E.C, Agulanna C.N, Nwannewuihe H.U, Onwukwe M.C and Adiele, I.D et al "Design and Performance Evaluation of a Corn De-Cobbing andSeparating Machine"*

The results showed that the de-cobbing rate was 8.44 kg/min and the threshing rate was 6.76 kg/min. Thperformance of a de-cobbing and separation machine was tested to assess its efficiency in processing agricultural products such as maize, soya bean, millet, and rice. This not only aids in extending the shelf life of these items, but also increases the potential earnings of farmers through mechanization. The trial revealed that the de-cobbing rate was 8.44 kg/min and the threshing rate was 6.76 kg/min. Thus, the experiment successfully demonstrated the potential of the machine to generate a better quality of maize. the selected maize was 15.14% db moisture content. After 20kg of sample was tested, the average feed and threshing time was 2.37 and 2.95 minutes respectively, with a feed and threshing rate of 8.44 and 6.76 kg/min. The ability of the machine to thresh and separate maize with a rate of 2.06 and 1.65 kg/min, plus an average threshing efficiency of 78.93% and a separation efficiency of 56.06%, proves it is suitable for processing approximately 1 tonne in a nine-hour shift.

15) *T.M. Azeez, I.D. Uchegbu ,S.A. Babalola, O.O. Odediran et al "Performance Evaluation of a Developed Maize Sheller".*

This paper focuses on evaluating the performance characteristics of the maize shelling machine that was constructed using an engineering design approach and computer software (Autodesk Inventor). The machine is powered by an electric motor with a power rating of 2.235 kW, a speed of 1430 rpm and a torque of 14.92 Nm. It is capable of shelling maize quickly and separating the cob from the grains with a negligible amount of kernel loss and damage. The machine has an average shelling capacity of 55 kg/hr, a shelling efficiency of 91.29 % and breakage at a minimum. It is much faster than hand shelling and can help to reduce the time, labor and stress involved in the shelling process. This machine is expected to help address the long-term problem of maize shelling, especially for rural farmers.

III. CONCLUSION

There is a need for an automatic, efficient and affordable Maize Sheller machine for the poor and marginalized farmers in developing countries. The performance of the Sheller machine is based on the moisture content, rate of material feeding, and speed of the blade. The design of the Sheller takes into account the physical and mechanical properties of Maize. This design procedure has been adopted in the fabrication of an Automatic Corn Sheller machine which is durable, efficient, and can be used to generate high profits, while reducing human fatigue. After the entire process is complete, the shelling operation will provide a better understanding of the fabrication and design that was involved in this project.

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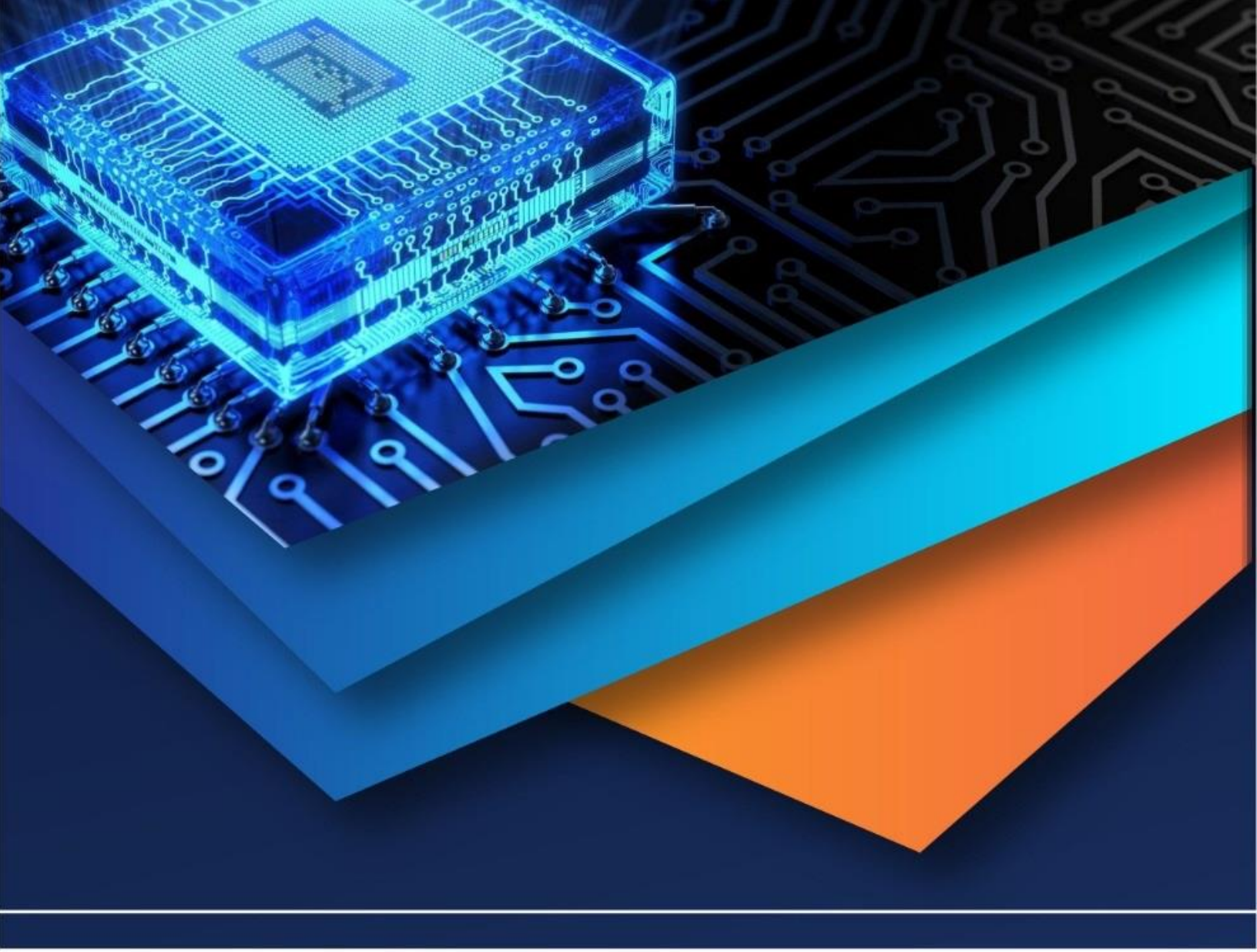
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