# Performance Evaluation of Corn Shelling Machine

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**Abstract: The purpose of this experiment is to enhance the efficiency of a corn shelling machine. with a maximum speed of 1430rpm, are the subject of the investigation. In order to achieve the best grinding efficiency and yield, the experiment aims to identify the optimize shelling efficiency. In this study, experimental data will be analysed using statistical techniques to identify the key variables influencing the performance of the machine. The experiment's findings can be applied to enhance the shelling machine's.**

**Using a sun-drying process over the course of three days with seven hours of exposure to sunshine each day, the aim of this experiment is to determine the moisture content of corn. The amount of water lost by evaporation can be determined and used to estimate the moisture content through comparison of the beginning and end weights of the corn. The agriculture and food processing industries frequently employ this technique to guarantee that goods are properly dried and kept for storage and shipment.**

## I.INTRODUCTION

Corn is one of the most important cereal crops in Africa, and Nigeria in particular. Maize is known botanically as zea may, and as corn. Maize varieties covered dent maize, sweet maize, popcorn, flour corn, pod corn, flint com, and waxy com. It is useful as raw material in the food industries. A large proportion of processed com is consumed fresh. The production of maize is quick, easy, cheap, and economical as compared with other food crops including palm tree, and cocoa which may take several months for maturity. Processed corn is used in the manufacturing of many products, ranging from breakfast foods, corn meal-flour and grits, starch, com syrup, com oil, spirits, acetone, chemical, absorbent, seed, and silage. Therefore, the large quantity of maize is needed to meet the need of the agro- allied industries in providing the fore-stated items for the use and survival of humanity. An increased quality of maize can be enhanced by devising an effective method of processing.

Depending on whether the material is a solid or a liquid, there are at least two main types of size reduction operations. The procedure is known as grinding and cutting if the substance is solid, and emulsification or atomization if it is liquid. There are many different types of size-reduction machinery, which are frequently created empirically to handle particular materials before being used in other contexts. The ratio of feed size to product size, as well as several parameters like hardness, toughness, stickiness, slipperiness, moisture content, melting or softening point, and abrasiveness (material structure, size, shape, flow, and bulk density ofproduct), effect size reduction. This literary analysis has been taken into account in order to comprehend different methods and the variables that affect size reduction.

## II.LITERATURE REVIEW

Karansinh et al. [1] “Design and Development of pedal operated maize desheller”. This author say In our country, farmers use three common methods to shell maize: hand shelling, hand operated maize sheller and essed maize to industrial sites, which adds to the cost of the product. This project proposes the development of a new technology to make maize shelling easier and more accessible, thereby reducing the cost of the product in developing countries. This concept can be applied to other agricultural mechanization tasks. Previous shelling techniques either had a low efficiency rate, or involved manual rubbing of the cobs against each other. This new concept of maize shelling would make the process simpler and more cost-effective.

Nithin R, Praveen Kumar, Praveen Raj and Madheswaran et al [2] "Corn Sheller Machine". The Aztecs and Mayans were known to grow maize in many different forms in the central and southern parts of Mexico. This crop was then used in a process called nixtamalization, which would involve either cooking or grinding it. In the 1250 BC, maize had spread to all parts of the region, and the population in the area had established a great trading network that relied on the abundance and varieties of maize.

S. B. PATIL, A.D. Chendake, M.A. Patil, S.G. Pawar, R.V. Salunkhe and S.S. Burkul. et al [3] "Development and performance evaluation of pedal operated maize sheller" in his paper expressed about, The machine was installed in an area with enough room, and two large buckets filled with cobs were placed on either side of the machine for easy access. The driver got onto the seat and started pedaling, causing the four shelling units to rotate. Both the driver and the other worker then picked up the cobs from the buckets on either side and put them into the rotating shelling units by using both hands. As the units rotated, the kernels were released, and they would fall onto the collection trays, from where they were collected through the chute and put into a bag or container placed beneath.

Oriaku E.C, Agulanna C.N, Nwannewuihe H.U, Onwukwe M.C and Adiele, I.D et al [4] "Design and Performance Evaluation of a Corn De-Cobbing andSeparating Machine" Here the author told that threshing rate were 8.44 and 6.76 kg/min respectively. Processing agricultural products such as maize, soya bean, millet, and rice helps not only to extend the shelf life of these items, but also increases the revenue farmers can earn through mechanization. To bring out the quality of maize, de-cobbing or threshing is a necessary step. An experiment was conducted to assess the performance of a de-cobbing and separation machine. For this purpose, local corn of a moisture content of 15.14% db was used and the results were recorded. The average feed and threshing time for the 20kg of sample tested was 2.37 and 2.95 minutes, respectively. Moreover, the average feed and threshing rate was 8.44 and 6.76 kg/min, respectively. The designed machine was able to successfully thresh and separate maize with a threshing rate of 2.06 and 1.65 kg/min and an average threshing efficiency of 78.93 %, along with a separation efficiency of 56.06 %. This performance suggests that the machine is suitable for processing around 1 tonne in a nine-hour shift

Dr. C.C.Handa et al [5] "Design consideration of corn sheller machine" The Corn Sheller
machine is powered by an electric motor. It consists of a feeding hopper, feeding tube, threshing cylinder, separating table and electric motor. The threshing cylinder is used to thresh the Corn with the help of threshing force, while the separating table is used to separate grain from the straw. The electric motor is used to provide power to the machine. The design of the machine is made in such a way that it is able to shell the Corn efficiently, with minimum efforts and time. The machine is easy to operate and maintain.

## III. EXPERIMENTAL METHODOLOGY

The existing corn shelling machine will be studied and modified so as to increase its efficiency, which leads to ultimate increase in productivity and complete utilisation of corn.

### *A. To Study Present Corn shelling Machine.*

The present machine is electrically operated by an electric motor with power rating of 2.235 kW, speed of 1430 rpm and torque of 14.92 Nm. It shells approx. 60 times as fast as hand shelling. Machine consists of a motor, grill drum, top cover, bottom cover, pedestal bearing, pulleys, V-belt and a thresher cylinder. Below are the pictures of the machine.

*B. To Study Sampling Material*

The samples were cleaned to remove dirt and any other materials. Whole undamaged corn with cobs were selected and weighed in batches of 2kg. Some samples were collected and used to determine the moisture content of the corn. Samples of weight 2kg, 4kg, 6kg and 8kg were fed into the machine and feed time recorded. The shelled corn was collected through the exit chute and the cobs also collected through the cob exit. The collected shelled corn and the cobs were weighed and the weights recorded. The experiment was repeated twice and average values noted.

a)Corn with moisture
(INPUT SAMPLE).

b) Shelling sample
(OUTPUT SAMPLE)

*C.Experimental Analysis For Optimization Of Machine*

Collect corn cobs from a maize mill and store them in a dry place to ensure that they are completely dry. Measure the initial moisture content of the cobs using a moisture meter. Divide the corn cobs into four equal portions and soak them in water for different periods of time to achieve different moisture contents. The soaking periods could be 0 hours (dry), 4 hours, 8 hours, and 12 hours. After each soaking period, drain the excess water from the cobs and weigh them to determine their final moisture content. Feed each portion of corn cobs into the machine and run the machine for 5 minutes at a constant speed of 1440 rpm. Collect the shelling corn cobs and weigh them to determine the output of the machine. Calculate the shelling efficiency, throughput capacity, power consumption, and particle size distribution of. The machine for each moisture content level.

Record the results in a table and graph the data for analysis. Compare the performance of the machine at different moisture contents and draw conclusions about the effect of moisture content on the machine's performance. Repeat the experiment multiple times to ensure the results are consistent and reliable.

*1) Moisture Content of The Material.*

To test the moisture content of a corn cob, two methods can be used. An oven-based method involves placing the cob in an oven and baking it at a certain temperature for a certain amount of time. Alternatively, the sun-drying method involves exposing the cob to direct sunlight until it's completely dry. Both methods are necessary steps in the experimentation plan for a shelling machine.

*2) Oven-based method.*

Collect a representative sample of corn cobs for testing.

Weigh the sample to determine the initial weight.

Place the sample in an oven set to 105°C-110°C for 24 hours. Remove the sample from the oven and let it cool down to room temperature. Weigh the sample again to. determine the final weight.

Calculate the moisture content using the formula: : (Initial weight - Final weight) / Initial weight x 100%.

*3) Sun-drying method*

Collect a representative sample of corn cobs for testing.

Weigh the sample to determine the initial weight.

Spread the sample in a single layer on a clean surface in direct sunlight.

Allow the sample to dry under the sun for 2-3 days or until there is no further weight loss.

Weigh the sample again to determine the final weight.

Calculate the moisture content using the formula: (Initial weight - Final weight) / Initial weight x 100%.

*a)The shelling efficiency :*

Shelling Efficiency (%) = (Weight of shelling corn / Weight of original corn) x 100

To calculate the weight of shelling corn , collect all the shelling corn produced by the machine during the experiment and weigh them using a digital scale. To calculate the weight of the original corn , weigh the corn before they are fed into the machine.

For example, if 10 kg of corn are fed into the machine and 9.5 kg of shelling corn are collected after running the machine for a specific period of time, the shelling efficiency can be calculated as follows:

Shelling Efficiency (%) = (9.5 kg / 10 kg) x 100 = 95%

Therefore, the shelling efficiency of the machine in this example is 95%. This means that the machine was able to shelling 95% of the original weight of the corn fed into it.

*b)The throughput capacity*

Throughput Capacity (kg/h) = (Weight of shelling corn / Time taken to shelling corn) x 60

To calculate the weight of shelling corn, collect all the shelling corn produced by the machine during the experiment and weigh them using a digital scale. To calculate the time taken to shelling the corn , measure the time taken to run the machine and shelling the corn for a specific period of time.

For example, if 9.5 kg of corn cobs are shelling by the machine in 5 minutes, the throughput capacity can be calculated as follows: Throughput Capacity (kg/h) = (9.5 kg / 5 minutes) x 60 = 114 kg/h

Therefore, the throughput capacity of the machine in this example is 114 kg/h. This means that the machine is capable of shelling 114 kg of corn per hour.

Note that the actual throughput capacity of the machine may vary depending on factors such as the moisture content of the corn.

*c) The power consumption*

Power Consumption (kW) = (Motor Power (HP) x 0.746) x (Time taken to shelling corn / 60)

To calculate the motor power of the machine in kilowatts (kW), multiply the rated horsepower (HP) of the machine by 0.746. For example, if the rated horsepower of the motor is 1 HP, the motor power in kilowatts would be 0.746 kW.

To calculate the time taken to shelling the corn , measure the time taken to run the machine and shelling the corn for a specific period of time.

For example, if the machine has a 1 HP motor and it takes 5 minutes to shelling the corn , the power consumption can be calculated as follows:

Power Consumption (kW) = (1 HP x 0.746) x (5 minutes / 60) = 0.0623 kW

Therefore, the power consumption of the machine in this example is 0.0623 kW. This means that the machine consumes 0.0623 kilowatts of electrical energy for every hour of operation.

*D.Experimentation Table For Final Results*

| Sr. No. | Speed of motor (RPM) | Moisture content (sundrying method) | Weight of corn before shelling (kg) | Weight of corn after shelling (Kg) | Shelling efficiency (%) | Time (min) | Through put consumption (kg/hr) | Power consumption (KW) | Practical size (mm) |
|---|---|---|---|---|---|---|---|---|---|
| 1. | 800 | 5.59% | 1.979 | 1.779 | 89.89% | 11 | 9.70 | 0.1367 | 2.145 |
| 2. | 700 | 5.56% | 2.008 | 1.908 | 95.01% | 10 | 11.44 | 0.1243 | 1.987 |
| 3. | 600 | 10.21% | 2.709 | 2.459 | 90.77% | 12 | 12.29 | 0.1492 | 2.567 |
| 4. | 1400 | 10.11% | 2.745 | 2.445 | 89.07% | 15 | 9.78 | 0.1865 | 2.986 |
| 5. | 1200 | 15.17% | 4.127 | 3.777 | 91.51% | 15 | 15.10 | 0.1865 | 3.145 |
| 6. | 1000 | 14.78% | 4.243 | 3.893 | 91.75% | 20 | 11.67 | 0.2486 | 1.678 |

## IV.CONCLUSION

The experiment used to test the corn shelling effectiveness at various moisture content level revealed, in summary that the device can produce a wide range of particle sizes. The outcomes showed that the moisture content of the corn cobs had an impact on the machine's throughput capacity and particle size distribution.

The required particle size distribution and throughput capacity affected the ideal moisture content level for the corn cobs. In general, coarser particle size distribution and better throughput capacity were associated with higher moisture content levels, whereas finer particle size distribution and lower throughput capacity were associated with lower moisture content levels.

## V. REFERENCE


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