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Experimental Optimization of Pulverizer Machine

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Abstract: ***The purpose of this experiment is to enhance the efficiency of a corn cob-grinding machine. Four distinct blade diameters, 350mm, 300mm, 200mm, and 150mm, with a maximum speed of 2880, are the subject of the investigation. In order to achieve the best grinding efficiency and yield, the experiment aims to identify the ideal blade diameter and speed combination. 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 pulverizer machine's functionality and design for grinding maize cobs.***

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 cobs. 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 cobs. The agriculture and food processing industries frequently employ this technique to guarantee that goods are properly dried and kept for storage and shipment.

Sun-dried corn cobs have been pulverised as part of the experiment in the pulverizer machine. The goal of the study is to determine the blade speed and diameter that will grind corn cobs most effectively. The findings of this study can be applied to enhance the functionality and design of corn cob pulverizer machines.

I. INTRODUCTION

The process of reducing big solid unit masses, such as vegetables or chemical substances, into smaller unit masses, such as coarse or fine particles, is known as size reduction. Size reduction is a common technique in the pharmaceutical sector. It is the method of breaking down large solid objects into smaller ones. Comminution and grinding are other names for the process of reducing particle size. Milling is the process of mechanically reducing the particle size of substances. Pharmaceutical powders are polydisperse, meaning they contain particles of different sizes, which makes it very difficult to produce dosage forms. For medicinal purposes, mono-size, or particles of same size, are optimal. reduction in size as well as size.

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 of product), 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

In the beginning the corns were separated from its cobs by the workers. They simply de- cob the corn by their hands and separate the corn from its cob. The output get from this method, was very low and it does not fulfill the market demand because it was very time-consuming process.

Introduction gives knowledge that the traditional method is not a sufficient method for separating the corn. Due to this manual process, identify some major problem & to over- come this problem some idea or concepts generates. According to generated ideas deciding objective of project. Following are the problem:-

Problem Identification Number of machines were developed for corn pulverizer. ,They either worked manually or power driven. Many more machines were fabricated on the above by previous batches without carrying any experimentation. To optimize the performance of present corn pulverizer machine, experimentation is essential and hence we have decided to carry out the experimentation on the present machine for optimization.

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III. EXPERIMENTAL METHODOLOGY

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

A. To Study Present Pulverizer Machine

A pulverizer machine is a mechanical tool used to crush and grind various materials into smaller pieces. Four blades on the machine in this case has sizes of 350mm, 300mm, 200mm, and 150mm. In order to reduce various materials to tiny particles, the blades are utilised.The machine contains a single-phase 1 HP motor, which allows it to produce power of up to 1 horsepower. The materials are ground and the blades are driven by this motor.With a maximum speed of 2880 RPM, the machine's blades may spin up to 2880 times per minute. The machine can swiftly and effectively crush and grind materials thanks to its high speed.

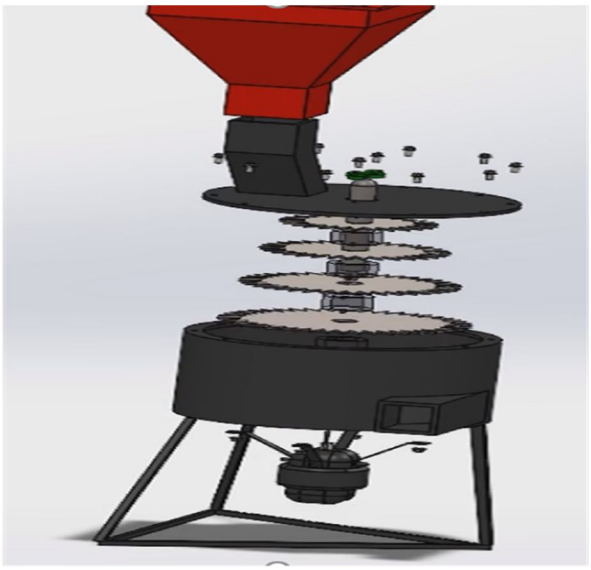
1) Induction Motor
- Single phase 1HP motor
- Maximum 2880 rpm with regulator to control speed
- Used for small load

2) Blades
- 4 blades of 350mm,300mm,200mm and 150mm diameters
- Align in concentrically pattern inside the drum

3) Shaft
- Height of the shaft is 400mm
- Upper diameter of the shaft is 40mm
- Lower bottom diameter of the shaft is 20mm

4) Bush
- Inner diameter of bush is 20mm
- Outer diameter of bush is 30mm
- Height of the bush is 20mm
- Improve efficiency and reduce noise
- Act like a shock absorber

5) Pedestal Bearing
- Bearing No. P205



(EXPLODED VIEW OF 3D CAD MODEL)

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B. To Study Sampling Material

You will consider a variety of factors while developing a sampling strategy for corn cobs in order to determine their moisture content and particle size. These factors include the quantity and variety of corn cobs, the desired level of measurement precision and accuracy, and the tools available for sampling and analysis.

Usage of desired output samples are.

As a diluent, carrier, or filler in pharmaceuticals, agrochemicals, veterinary formulations, vitamin premixes, and other goods for the health of animals, among other uses. when used as a safe disposal method for liquid and solid effluents in environmental control. In horticulture, as a soil conditioner and water retention.

Corns with moisture

(Actual Experimental Machine)

Corns-Cobs with desired moisture contain (INPUT SAMPLES)

Pulverized 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. Set up the three-blade corn cob pulverizer machine according to the manufacturer's instructions. Feed each portion of corn cobs into the machine and run the machine for 5 minutes at a constant speed of 2880 rpm. Collect the pulverized corn cobs and weigh them to determine the output of the machine. Calculate the pulverizing 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

Testing the moisture content of the corn cob is an important step in the experimentation plan for pulvizer machine. To test the moisture content, you can use either an oven-based method or a sun-drying method. Here are the steps for each method:

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 pulverizing efficiency -As of by Dr.V.Bharathi, et al [01]*

Pulverizing Efficiency (%) = (Weight of pulverized corn cobs / Weight of original corn cobs) x 100

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

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

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

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

b) *The throughput capacity -As of by Anilkumar.H.Ingle, et al [02]*

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

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

For example, if 9.5 kg of corn cobs are pulverized 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 pulverizing 114 kg of corn cobs per hour.
Note that the actual throughput capacity of the machine may vary depending on factors such as the moisture content of the corn cobs, the type of corn cobs, the blade speed, and the blade configuration.

c) *The power consumption - As of by Ram Vaidya 1, et al [03]*
Power Consumption (kW) = (Motor Power (HP) x 0.746) x (Time taken to pulverize corn cobs / 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 pulverize the corn cobs, measure the time taken to run the machine and pulverize the corn cobs for a specific period of time.
For example, if the machine has a 1 HP motor and it takes 5 minutes to pulverize the corn cobs, 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 contains (sun drying method)	Weight of corn cob before pulverized (kg)	Weight Corn Cobs after pulverized (Kg)	Pulvarizing efficiency (%)	Time (min)	Throughput consumption (kg/hr)	Power consumption (KW)	Practical size (mm)
1.	2000	5.59%	1.979	1.779	89.89%	11	9.70	0.1367	2.145
2.	1800	5.56%	2.008	1.908	95.01%	10	11.44	0.1243	1.987
3.	1600	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 four-corn cob pulverizer's effectiveness at various moisture content levels 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.

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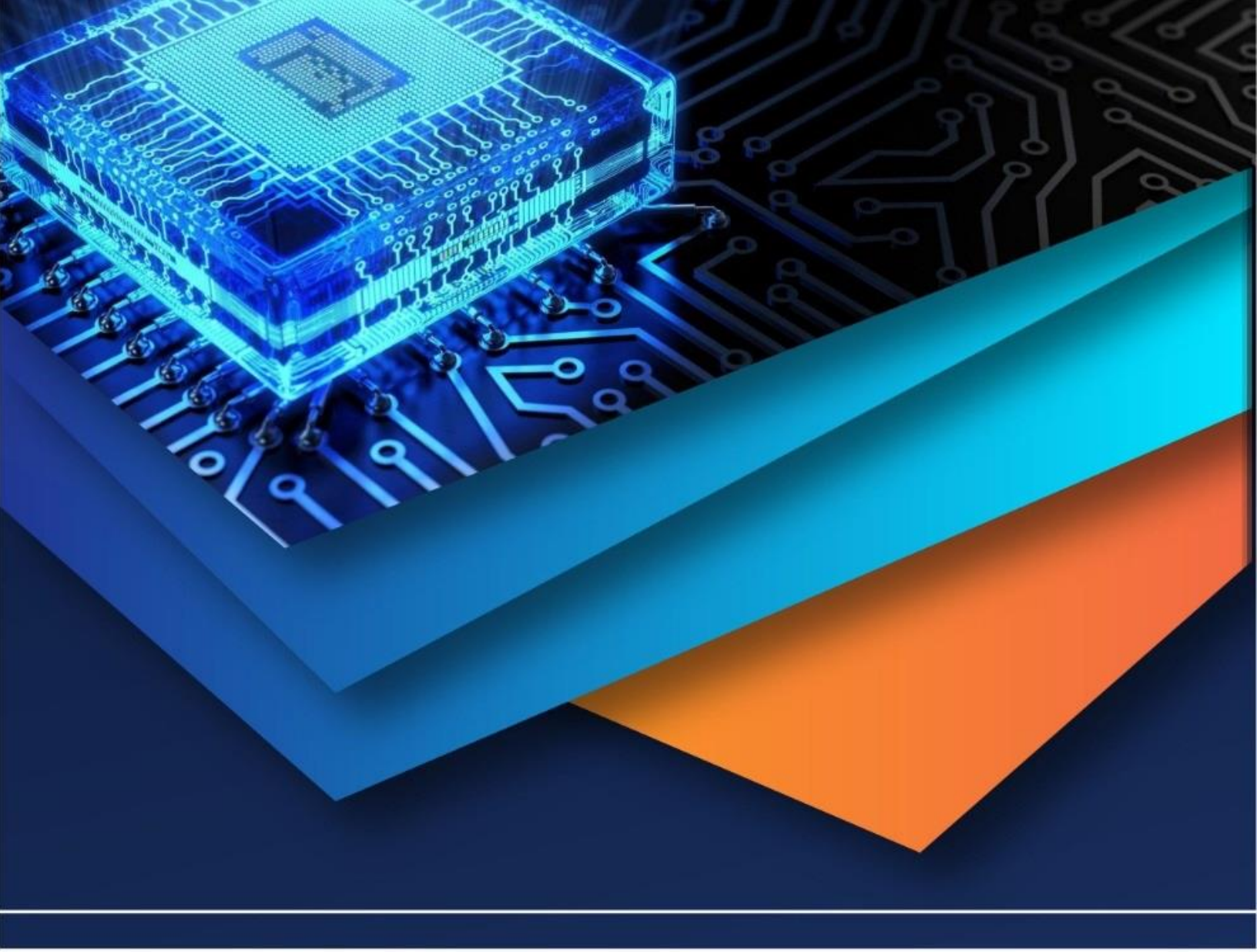

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