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# **Design & Development of Hand Operated Peanut Shell Removing Machine**

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**ABSTRACT:** Manual peanut shelling is a laborious and time-consuming process. This project addresses this challenge by introducing a hand-operated peanut shell removing machine. This device utilizes a crank mechanism for efficient shelling, significantly increasing processing speed compared to traditional hand shelling. The report details the design and construction of the machine, focusing on its functionality, capacity, and user benefits. Key advantages include reduced workload, minimized nut damage, and affordability. The report also explores potential applications for small-scale peanut farming, home use, and even vending stalls. Overall, this project demonstrates the effectiveness of a hand operated peanut Sheller as a practical solution for efficient peanut processing.

**KEYWORDS:** Peanut, Shell Removing, Hand Operated, Design & Development, Shell Removing Machine.

## **I. INTRODUCTION**

A Peanuts, also known as groundnuts, are a valuable legume crop cultivated worldwide. They are a versatile food source, rich in protein, healthy fats, and essential nutrients. However, before consumption, peanuts require the removal of their outer shells, a process traditionally done by hand. This manual shelling is a laborious and time-consuming task, especially when dealing with larger quantities. It can be physically demanding and result in inconsistent shelling efficiency, with potential damage to the valuable peanut kernels. This project aims to address this challenge by introducing a novel solution: a hand-operated peanut shell removing machine. This innovative device utilizes a user-friendly crank mechanism to efficiently remove peanut shells. Compared to traditional hand shelling, this machine offers significant advantages.

This project delves into the design and fabrication of the hand-operated peanut Sheller. It explores the materials used, the functionality of the mechanism, and the overall capacity of the machine. Furthermore, the report discusses the potential applications of this technology, particularly for small-scale peanut farming, home use for peanut enthusiasts, and even for vendors selling peanuts. By analysing the benefits and potential limitations of the hand-operated peanut Sheller, this project aims to demonstrate its effectiveness as a practical and efficient solution for peanut processing.

We understand the importance of convenience, which is why this shelling machine is designed to be compact and portable. Its lightweight construction allows for easy transportation and storage, making it ideal for both home use and on-the-go nut processing. Whether you're shelling nuts in your backyard or at a farmer's market, this machine is your perfect companion. Safety is our top priority, and this shelling machine is built with that in mind. It features a sturdy construction and a secure grip handle, ensuring stability and preventing accidents during operation. You can have peace of mind knowing that this machine is designed to provide a safe and reliable shelling experience.

In addition to its exceptional functionality, this Hand Operated Groundnut Peanut Shelling Machine is also built to last. Crafted from high-quality materials, it is durable and resistant to wear and tear. This means you can rely on this machine to deliver consistent performance for years to come, making it a smart investment for any nut enthusiast or small-scale nut processing business.

Additionally, only 1-2 kg of groundnuts are produced every worker hour. Different shelling techniques and machinery have been developed and used to shell a wide range of crops under various circumstances. Due of their high cost and complexity in usage and maintenance, farmers cannot afford these devices. Additional requirements included training

the operator and importing spare parts. These elements raise the total cost of production, which is unjustified from the farmer's perspective. Locally, a concave or semi-rotary hand-operated shelling machine is extensively utilised. Since it lacked an expelling unit, separation was only possible through winnowing. A simple hand-operated groundnut Sheller has a screen that is closed on both sides of a semi-cylindrical shape. In the middle of the semi-cylinder is a fixed shaft with a lever at one end. A pair of plates with shoes or beater bars that have blunts on the bottom are attached to the lever. The operator must stand by the side of the machine, hold the working lever (handle), and swing it back and forth to exert shelling pressure on the shoes assembly. The shoes' semi-rotary motion shells the pods against the monitor. This machine's main flaw is that it requires a lot of labour and takes a long time. 60 to 80 kilogram are produced every hour. All of those flaws are fixed by this particular design, which is also more effective. hopper, crushing chamber, separating chamber, and the blower apparatus. Additionally, it is electrically operated, which saves time and has a much improved shelling capacity. Additionally, lightweight, simple to use and maintain, the machine also has nearby access to spare components.

## II. OBJECTIVES

- To Increased Processing Speed.
- To Reduced Workload.
- To Minimized Nut Damage.
- To offer Affordability.

## III. METHODOLOGY

**Research and Analysis:** Conduct thorough research on existing peanut shell removal methods and machines. Analyse the requirements, constraints, and challenges associated with peanut processing, particularly in small-scale farming or household settings.

**Conceptual Design:** Generate multiple conceptual designs based on the research findings. Evaluate each design based on criteria such as simplicity, efficiency, cost-effectiveness, and ease of use. Select the most promising design concept for further development.

**Detailed Design:** Develop detailed engineering drawings and specifications for the selected design. Incorporate feedback from stakeholders and experts to refine the design. Ensure that the design meets safety standards and ergonomic considerations.

**Prototyping:** Fabricate a prototype of the hand-operated peanut shell opener machine based on the detailed design. Test the prototype under controlled conditions to evaluate its performance, durability, and usability. Identify any design flaws or performance issues and make necessary adjustments.

**Iterative Improvement:** Iterate on the design and prototype based on testing feedback and user input. Implement improvements to enhance functionality, efficiency, and user experience. Continue testing and refinement until the machine meets the desired performance standards.

**Documentation and Reporting:** Document the design process, including design iterations, testing results, and improvements made. Prepare comprehensive reports and documentation for future reference and dissemination. Present the project findings and outcomes to stakeholders, collaborators, and the broader engineering community.

**Implementation and Deployment:** Develop plans for manufacturing, distribution, and deployment of the hand-operated peanut shell opener machine. Collaborate with manufacturers, suppliers, and distributors to scale up production and make the machine accessible to target users. Provide training and support to users on how to operate and maintain the machine effectively.

#### IV. DESIGN & CALCULATION

Project undergone following steps: Problem Statement and Requirements Analysis, Concept Generation, Preliminary Design Selection, Detailed Design Development, Mechanical Analysis and Simulation, Component Selection and Sourcing, Prototype Fabrication, Testing and Validation.

Model Design -

- Product Type: Peanut Shell Opener Machine.
- Brand: Generic (Made in India)
- Production Capacity: 20 Kg Per Hour
- Automation Grade: Manual
- Body Material: Mild Steel
- Dimension (H x L x W): 35 x 18 x 8 inch
- Weight: 8 Kg (Approx.)

Shaft calculations:

We have diameter of solid w shaft as follows

Outer diameter= 20mm

The shaft experienced with two moments bending moment as well as twisting moment.

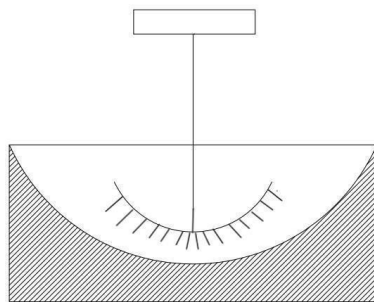


Figure 1: Design Model



Figure 2: Half Completed Model

$$T/J = \tau/R$$

We know that,

$$T = 3.27 \text{ N-m} = 3270 \text{ N-mm}$$

$$J = \frac{\pi}{32} ((D_0)^4 - (D_1)^4)$$

$$= \frac{\pi}{32} ((40)^4 - (38)^4)$$

$$= 46619.7 \text{ mm}^4$$

$$= 3270 / 46619.7 = \tau / 20$$

$$\tau_{\text{shaft}} = 3270 \times 20 / 46619.7$$

$$= 1.4 \text{ N/mm}^2 \text{ Bending stress}$$

$$= M/I$$

$$= \sigma/Y$$

Bending stress due to self-weight = 5kg Weight

$$= 5 \times 9.81$$

$$= 49.1 \text{ N}$$

$$\text{Stress}(\sigma) = P/A$$

$$= 49.1 / (\pi/4) ((40)^2 - (38)^2)$$

$$= 0.4 \text{ N/mm}^2$$

For circular shaft:

$$I = \frac{\pi}{64} ((D_0)^4 - (D_1)^4)$$

$$= \frac{\pi}{64} ((40)^4 - (38)^4)$$

$$= 23309.83 \text{ mm}^4$$

$$\text{Bending moment (M)} = (\sigma \times I) / Y$$

$$= (0.4 \times 23309.83) / 20$$

$$= 466.197 \text{ N-mm}$$

Shaft subjected to combined torsion and bending:

$$\begin{aligned}\tau_{\max} &= (16 \times d_0 / \pi ((d_0)^4 - (d_i)^4)) \sqrt{(M)^2 + (T)^2} \\ &= (16 \times 40 \times 3303.1) / \pi ((40)^4 - (38)^4) \\ &= 1.41 \text{ N/mm}^2 \\ \sigma_{\max} &= (16 \times d_0 / \pi ((d_0)^4 - (d_i)^4)) (M + \sqrt{(M)^2 + (T)^2}) \\ &= 16 \times 40 \times (3769.3) / \pi ((40)^4 - (38)^4) \\ &= 1.62 \text{ N/mm}^2\end{aligned}$$

## V. OPERATIONAL PRINCIPLE

A hand-operated peanut shell removing machine offers a simple and manual way to separate peanuts from their shells.

**Construction:** Frame Made from sturdy materials like metal or wood, it provides the base for the machine. Hopper is funnel-shaped container at the top holds the peanuts to be shelled. Shelling Chamber is enclosed space houses the mechanism that cracks the shells. There are two main designs: Impact Shelling, which is a rotating shaft with beaters or paddles impacts the peanuts against a fixed surface, breaking the shells. Pinch Shelling: Two textured surfaces, one moving and one fixed, pinch the peanuts, cracking the shells. Separator can be a screen or grid that allows the shelled peanuts to fall through, while the shells are collected elsewhere. Handle is a crank or lever allows the operator to manually apply force to rotate the shelling mechanism.

**Working Principle:** Feeding: Peanuts are poured into the hopper. Shelling: As the operator turns the handle, the shelling mechanism inside the chamber cracks the peanut shells. In Impact Shelling, the beaters or paddles hit the peanuts against a fixed surface, applying force to break the shells. In Pinch Shelling, the peanuts are squeezed between the moving and fixed textured surfaces, cracking the shells. Separation: The cracked peanuts fall onto the separator. Collection: The shelled peanuts fall through the openings in the separator and are collected in a container below. The shells are typically collected separately.

**Detailed Operation:** Initialization: The operator ensures that the machine is properly set up and ready for operation. Loading: A batch of unshelled peanuts is poured into the loading tray, ensuring an even distribution. Cranking: The operator grips the crank handle and begins rotating it in a clockwise direction. Activation of Shell Opening Mechanism: As the crank mechanism moves, it activates the shell opening mechanism, causing the blades and rollers to engage with the peanut shells. Cracking Process: The rotating blades cut into the shells, while the rollers apply pressure to crack them open along predetermined lines. Separation of Shells and Kernels: As the cracked shells and kernels move through the machine, they are separated by gravity or mechanical means, with the kernels falling into the collection tray below.

Continuous Operation: The operator continues cranking the handle until all the peanuts in the loading tray have been processed. Shutdown: Once the operation is complete, the operator stops cranking and removes any remaining unshelled peanuts from the loading tray. Clean-up: Any residual peanut shells or debris are removed from the machine, and it is reset for the next batch of peanuts.



Figure 3: Fully Finished Model



Figure 4: Working Model

## VI. RESULTS AND DISCUSSIONS

The sample is brought from market. It is sun dried for one day to remove moisture content. Sample contains unshelled groundnut and some soil adhered to shell. In testing table following parameters are mentioned like, wt. of sample, wt. of shelled nuts and time required to shelled groundnut. The testing of the system was done and the following results were observed:

Sr. No	Total Wt. of Groundnut in gms. (Qt)	Wt. of Shelled Groundnut in gms. (Qs)	Wt. of Undamaged Groundnut Seed in gms. (Qu)	Wt. of Damage Groundnut Seed in gms. (Qd)	Time To Shelling Operation In Sec.
1	250	220	132	88	190
2	250	230	149.5	80.5	220
3	250	239	164.91	74.09	232
4	250	225	157.5	67.5	197
Total	1000	914	603.91	310.09	839
Mean	250	228.5	150.97	77.52	209.75

(1) Shelling efficiency (%)

$$= [Qs / Qt] \times 100$$

$$= (228.5/250) \times 100$$

$$= 91.2 \%$$

(2) Material efficiency (%)

$$= [Qu / (Qu + Qd)] \times 100$$

$$= 66.1 \%$$

(3) Mechanical damage (%)

$$= [Qd / (Qu + Qd)] \times 100$$

$$= 33.9 \%$$

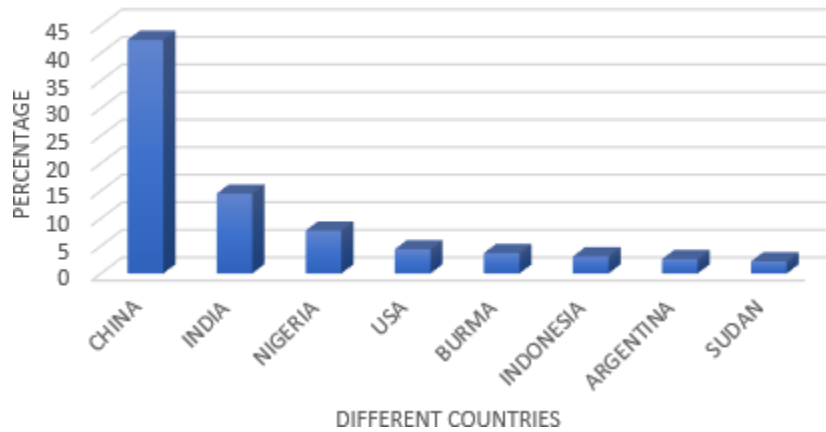
(4) Throughput capacity(kg/h)

$$= [Qs/Tm]$$

$$= 228.5/209.75$$

$$= 1.089 \text{ kg/hrs}$$

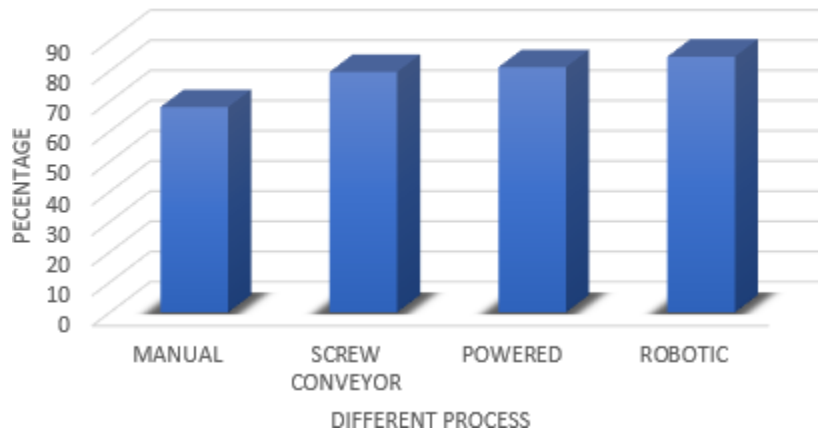
**PRODUCTION RATE (%)**



Graph 1: Production Rate

The above graph shows that the production rate of groundnuts is more in China compared to the remaining countries in the world. India ranks 2nd in the world.

**EFFICIENCY OF THE MACHINES**



Graph 2: Machine Efficiency

**VII. COST EXPENDITURE**

Materials Cost		
Sr. No.	Particulars	Cost in Rs
1	Net	1000
2	Square Pipe	1000
3	Fabrication	500
Total		2,500/-

**VIII. ADVANTAGES, DISADVANTAGES AND APPLICATION**

Advantages:

- Simple and Low-Cost.

- Easy to Operate and Maintain.
- No Electricity Required.
- Suitable for Small-Scale Shelling.
- Potentially Eco-Friendly.

**Disadvantages:**

- Lower Shelling Capacity.
- Limited Functionality.

**Applications:**

- Shelling peanuts for personal consumption.
- Small-scale peanut processing.
- Removing peanut shells for peanuts used in baking and cooking.
- Shelling peanuts for peanut butter production.

## IX. CONCLUSION

The development and implementation of a hand-operated peanut shell opener machine project in mechanical engineering offer significant benefits and opportunities. This project not only addresses the technical challenge of designing an efficient and user-friendly machine but also contributes to various practical applications.

Through this project, mechanical engineers can gain valuable experience in the design, prototyping, and optimization of machines for agricultural processing. The project fosters innovation and problem-solving skills as engineers work to improve the efficiency, reliability, and affordability of the machine.

Furthermore, the hand-operated peanut shell opener machine has diverse applications ranging from small-scale farming and household use to community cooperatives, educational institutions, and even research laboratories. Its versatility makes it a valuable tool for promoting agricultural productivity, rural development, and food security initiatives.

By incorporating principles of sustainability, affordability, and user-friendliness into the design, mechanical engineers can make a tangible impact on agricultural practices and socio-economic development, especially in rural areas where peanut farming is prevalent.

Overall, the hand-operated peanut shell opener machine project in mechanical engineering represents a meaningful contribution to both the field of engineering and the communities it serves, offering practical solutions to real-world challenges in peanut processing and beyond.

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