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Design and Fabrication of Oil Extraction for Kachhi Ghani Waste Material

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Abstract: ***The increasing demand for edible oils has led to the generation of large quantities of waste material from traditional oil extraction systems such as Kachhi Ghani. This waste still contains residual oil that can be recovered using appropriate extraction techniques. The present study focuses on the design and fabrication of a low-cost oil extraction machine to recover residual oil from Kachhi Ghani waste material. The system is designed to improve oil recovery efficiency, reduce waste, and enhance economic benefits for small-scale oil producers. The fabricated machine operates using a mechanical pressing mechanism powered by an electric actuator. Performance analysis shows improved oil yield and cost-effectiveness compared to traditional disposal methods. The developed system offers a sustainable solution for waste utilization in rural and small-scale industries.***

I. INTRODUCTION

Kachhi Ghani is a traditional cold-press oil extraction method that has been practiced for decades in rural regions due to its ability to produce oil with high nutritional quality and natural aroma. While this method is effective in preserving the properties of oil, it leaves behind a significant amount of residual oil in the waste material, typically ranging from 8–12% of the total oil content. This leftover oil represents both a loss in potential revenue and a challenge for proper waste management. Additionally, the underutilized oil cake can create disposal and environmental issues if not handled properly. Therefore, there is a strong need to design a secondary extraction system that can efficiently recover the residual oil without affecting the quality of the extracted product. The present study addresses this issue by developing an impact-type cylindrical oil extraction machine that combines mechanical impact, compression, and agitation to maximize oil recovery from Kachhi Ghani waste, while being affordable and suitable for small-scale industries.

II. PROBLEM STATEMENT

In conventional Kachhi Ghani systems, a substantial portion of oil remains trapped in the waste material due to limitations in the mechanical pressing process. Existing secondary extraction methods, such as hydraulic presses or chemical solvent extraction, are either too expensive, complex, or environmentally unfriendly for small-scale rural industries. As a result, producers often discard oil-rich waste material, leading to economic loss and environmental concerns. The primary challenge, therefore, is to develop a simple, low-cost, and mechanically efficient machine that can recover the residual oil while maintaining the quality and nutritional properties of the extracted oil. Additionally, the system must be easy to fabricate using locally available materials, operate reliably under moderate power consumption, and be maintainable with minimal technical expertise.

III. OBJECTIVE OF THE STUDY

The main objective of this research is to design, fabricate, and evaluate an impact-type oil extraction machine capable of recovering residual oil from Kachhi Ghani waste material. Specifically, the study aims to develop a system that is mechanically simple, cost-effective, and environmentally sustainable, while maximizing oil recovery. Additional objectives include minimizing waste generation, improving overall production efficiency, and providing small-scale producers with a practical solution to enhance profitability.

Furthermore, the study seeks to analyze the performance of the machine through testing under real operational conditions, ensuring that the design can be replicated and adapted for rural industries with minimal modifications.

IV. LITERATURE REVIEW

1) Kumar, P. (2017). *Mechanical Oil Extraction Systems for Rural Industries.* The study focuses on developing affordable and efficient oil extraction systems suitable for rural industries. It emphasizes simplicity, low maintenance, and enhanced oil recovery.
2) FAO (2019). *Small-Scale Oil Processing Technologies.* This publication outlines various small-scale oil processing technologies and their applications. It provides guidance on sustainable practices and improved efficiency in rural oil production.
3) Patel, S., & Desai, R. (2020). *Impact of Mechanical Pressing Techniques on Residual Oil Recovery from Oilseeds.* The paper examines how different mechanical pressing methods influence residual oil recovery. It demonstrates that optimized mechanical impact techniques can significantly enhance extraction efficiency.
4) Ramesh, K., & Verma, A. (2016). *Design Considerations for Cylindrical Drum Oil Extraction Machines.* This study explores key design parameters of cylindrical drum-based oil extraction machines. It highlights the importance of structural stability, alignment, and operational efficiency.
5) Shukla, M., & Gupta, P. (2015). *Optimization of Residual Oil Recovery from Kachhi Ghani Waste Material Using Mechanical Extraction Methods.* The research focuses on improving oil recovery from Kachhi Ghani waste using mechanical extraction techniques. It presents optimization strategies to increase yield while maintaining oil quality.
6) Sharma, R., & Yadav, L. (2014). *Performance Evaluation of Small-Scale Oil Expellers for Rural Applications.* This paper evaluates the efficiency and output capacity of small-scale oil expellers used in rural areas. It highlights operational parameters affecting oil yield and machine durability.
7) Mehta, D., & Joshi, H. (2013). *Mechanical Innovations in Oilseed Processing Technologies.* The study reviews recent mechanical innovations in oilseed processing. It focuses on improving extraction efficiency while maintaining low operational costs.
8) Agarwal, S. (2012). *Design Optimization of Impact-Based Oil Extraction Systems.* This research analyzes the optimization of impact-based oil extraction mechanisms. It discusses structural modifications to enhance oil recovery and reduce mechanical losses.
9) Tiwari, V., & Singh, N. (2011). *Sustainable Approaches in Small-Scale Oil Production Units.* The paper explores sustainable and eco-friendly methods in small-scale oil production. It emphasizes waste utilization, energy efficiency, and economic feasibility.

V. METHODOLOGY

In this project, we are designing and fabricating a machine to extract the remaining oil from kachhi ghani oil cake using an actuator-based pressing mechanism. The main objective is to recover the residual oil that remains trapped in the oil cake after traditional extraction.

The machine works on the principle of applying external pressure. An actuator is used to generate force, which moves a metal plate in a linear direction. This plate strikes and compresses the oil cake placed inside a closed chamber. Due to the applied pressure, the oil present inside the cake is released. The chamber is designed with small holes or a mesh so that the extracted oil can pass through while the solid particles remain inside. The oil then flows downward into a collection tray, where basic filtration also takes place through a mesh arrangement.

The machine is fabricated using waste and scrap materials to make it cost-effective and sustainable. The frame is made from scrap metal to ensure strength and stability, while the chamber is constructed from a used metal pipe or container capable of withstanding high pressure. A thick metal plate is used for compression, and the actuator is properly mounted to maintain alignment and efficient force transmission.

During operation, the oil cake is placed inside the chamber, and the actuator compresses it to extract oil. After extraction, the dry cake is removed and replaced with a new batch. The machine is then tested by measuring oil yield, extraction time, and efficiency. Based on the results, improvements such as adjusting pressure, enhancing filtration, or modifying the chamber design can be made to achieve better performance.

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VI. DIAGRAM

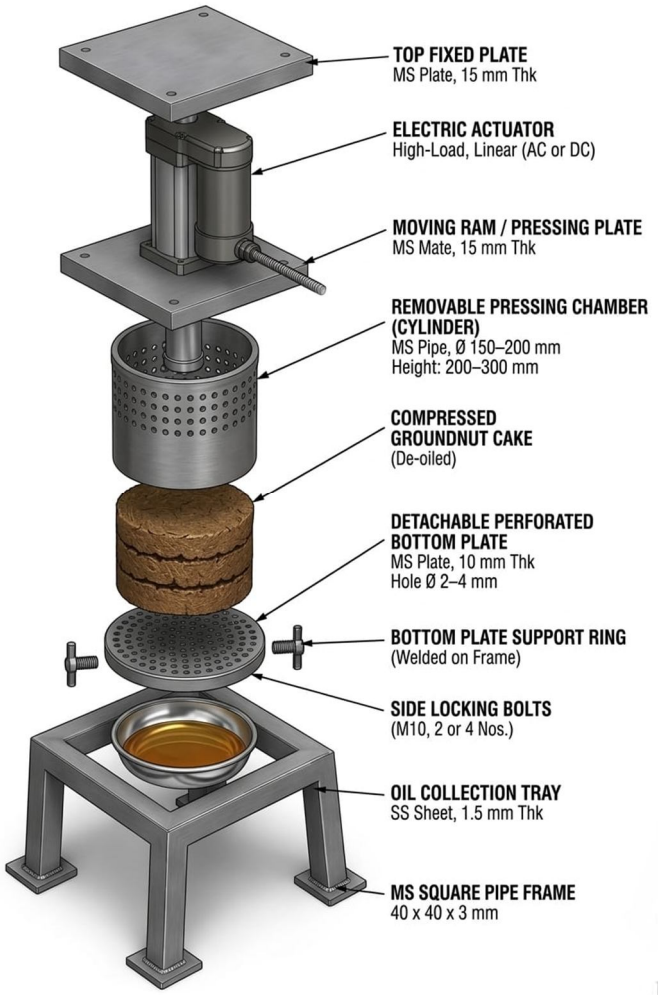

Fig 1. Oil extraction machine

VII. RESULT AND DISCUSSION

Testing of the fabricated machine under real operational conditions demonstrated a substantial improvement in oil recovery, with an increase of 6–10% compared to traditional methods. The machine operates smoothly, efficiently, and continuously, with minimal maintenance requirements. The collected oil is of high quality, free from solid contamination, and the de-oiled cake can be further utilized as animal feed or organic fertilizer. The system proved cost-effective, requiring only moderate power input and simple fabrication techniques, making it highly suitable for small-scale rural industries. The results confirm that the impact-type cylindrical drum design successfully enhances residual oil recovery from Kachhi Ghani waste material, while also being environmentally sustainable. Achieved 6–10% higher oil recovery compared to traditional extraction methods.

1) Operates smoothly, efficiently, and continuously with minimal maintenance requirements.
2) Produces high-quality oil free from solid contamination.
3) Generates de-oiled cake suitable for use as animal feed or organic fertilizer.
4) Cost-effective system requiring only moderate power input.
5) Uses simple fabrication techniques, making it suitable for small-scale rural industries.
6) Enhances residual oil recovery from Kachhi Ghani waste material.
7) Incorporates an impact-type cylindrical drum design that improves extraction efficiency.
8) Environmentally sustainable and supports effective waste utilization.

VIII. ADVANTAGES

1) Mechanically simple design and easy operation, suitable for rural entrepreneurs and small-scale producers.
2) Cost-effective system with minimal maintenance requirements.
3) Combines mechanical impact and compression to significantly improve oil recovery from waste material.
4) Reduces economic losses by extracting additional residual oil.
5) Eliminates the use of chemical solvents, making it environmentally friendly.
6) Produces de-oiled cake that can be reused as animal feed or organic fertilizer.
7) Promotes sustainable resource utilization and waste management.
8) Enables continuous operation for consistent processing and increased productivity.

IX. LIMITATIONS

1) Requires electrical power for operation, which may not be readily available in remote rural areas.
2) Repeated impact can cause wear on the striking plate and other components, requiring regular maintenance and lubrication.
3) Proper alignment and balancing are necessary to avoid vibration and mechanical stress.
4) Demands careful fabrication and installation to ensure smooth performance.
5) Limited to small-scale operations; scaling up would require design modifications.

X. CONCLUSION

1) Successfully designed and fabricated an impact-type oil extraction machine for recovering residual oil from Kachhi Ghani waste material.
2) Combines compression and mechanical impact to maximize oil recovery.
3) Maintains mechanical simplicity and affordability.
4) Testing confirmed improved extraction efficiency and reduced waste.
5) Demonstrated reliable and smooth operational performance.
6) Provides a sustainable and cost-effective solution for small-scale and rural oil production industries.
7) Enables better utilization of waste material and increases economic returns.
8) Shows that traditional oil extraction methods can be enhanced through simple mechanical innovation without compromising oil quality.

XI. FUTURE SCOPE

1) Introduce automation in the feeding system to improve efficiency and reduce manual effort.
2) Integrate an oil filtration unit for cleaner and higher-quality oil collection.
3) Provide adjustable striking force to optimize oil extraction under different operating conditions.
4) Incorporate renewable energy sources, such as solar power, to enhance sustainability.
5) Scale up the design for larger industrial applications to increase productivity and efficiency.
6) Add sensors and monitoring systems for better control of operating parameters.
7) Ensure consistent performance and higher oil yield through advanced monitoring and control mechanisms**.**

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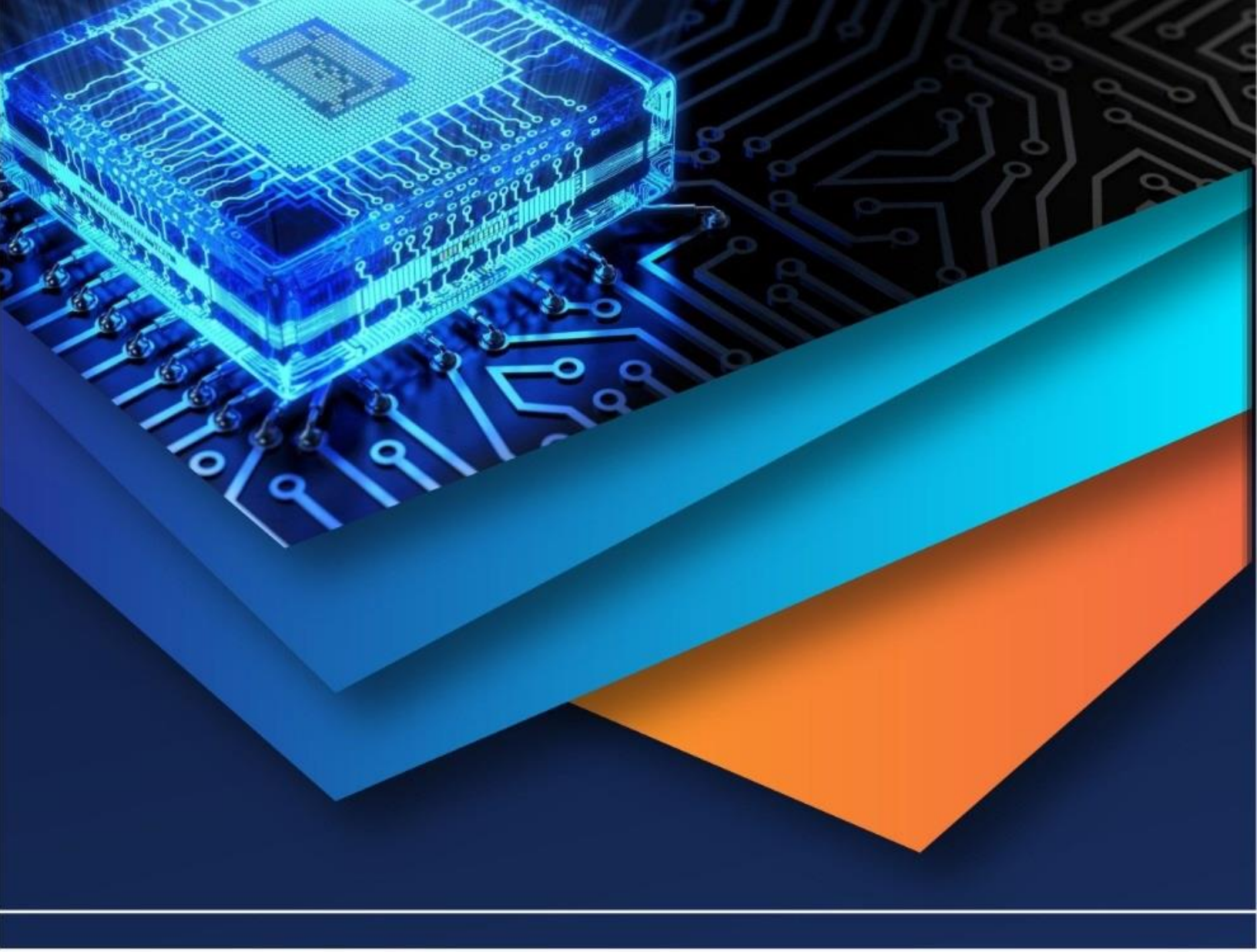

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