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Comprehensive Design and Development of a Manual Briquette Machine

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Abstract

This comprehensive research delves into the intricacies of designing and developing a manual briquette machine, aimed at facilitating the conversion of biomass waste into a sustainable and environmentally friendly source of energy. By exploring various design considerations, material selections, and mechanical configurations, this study aims to present a comprehensive analysis that underscores the potential of manual briquette machines to positively impact global energy sustainability.

1. Introduction

In the face of depleting natural resources and growing environmental concerns, the quest for sustainable and clean energy sources has become increasingly critical. Biomass briquettes stand out as a viable solution, offering a renewable and carbon-neutral alternative to fossil fuels. The design and development of a manual briquette machine are pivotal, targeting affordability, ease of use, and adaptability to different biomass types. Through a thorough examination of existing technologies, design innovations, and the integration of sustainable practices, this study endeavors to lay down a blueprint for the efficient production of biomass briquettes.

2. Literature Review

Extensive research has highlighted the critical role of biomass as a renewable energy source, with a particular focus on the conversion of agricultural and forestry waste into briquettes. Studies underscore the environmental benefits of biomass briquettes, including reduced greenhouse gas emissions and decreased dependency on fossil fuels. However, there remains a significant gap in the availability of low-cost, efficient, and user-friendly solutions, particularly for small-scale applications. The exploration of various briquetting technologies reveals the potential of manual systems in contexts where electricity is scarce or cost-prohibitive.

3. Materials and Methods

3.1 Design Requirements

The establishment of rigorous design requirements guides the development process, ensuring sustainability, cost-effectiveness, user-friendliness, and adaptability. These criteria aim to create a versatile and effective tool for briquette production that addresses the energy needs of rural and economically disadvantaged populations while mitigating environmental hazards associated with agricultural waste.

3.2 Material Selection

The selection of materials for the manual briquette machine prioritizes sustainability and durability. High-strength steel is chosen for its robustness and longevity, while recycled plastics and sustainable wood sources are incorporated wherever possible to reduce the environmental footprint of the machine.

3.3 Mechanical Design

The mechanical design of the briquette machine centers around a lever and piston mechanism, optimized for high-pressure application with minimal human effort. This system leverages basic principles of physics to maximize force amplification, allowing users to produce dense briquettes efficiently.

4. Component:

1. Bell Crank Lever : One of the legs of this lever is in contact with the hinge, serving as a crank.

2. Hinge Plates: These plates are welded onto an oscillating cover plate.

3. Hinge: The carriage is hinged, acting as a coupler or connecting rod.

4. Cylinder: Firmly mounted within the structure. This cylinder is where the briquette-making process takes place.

5. Piston: Reciprocates within the cylinder. It has four tapered pins at the top, evenly spaced around its circumference.

6. Pin

7. Carriage: The piston is mounted on this carriage, which slides within guideways.

8. Carriage Rod

9. Swing

10. Structure : The overall framework or frame that holds the various components together.

5.Working:

1. **Briquette Mixture:** Initially, the cover plate is opened, and a mixture of briquette material (such as wood sawdust and cow dung as binder) is poured into the cylinder with the piston at its bottommost position.
2. **Compression Process:** The bell crank lever engages into the circular slot of the hinge plates, allowing effort to be applied by oscillating the lever. As the leg engages with the hinge and rotates, the hinge oscillates, causing the piston to move upward. This compresses the briquette mixture.
3. **Optimized Quantity:** Trials revealed that using an optimized quantity of mixture material is essential to avoid cracks in the briquettes.
4. **Completion and Disengagement:** Once compression is complete, the lever returns to its original position, and with a slight jerk, it is disengaged from the circular slot of the hinge
5. **Surface Contact:** Initially, there is surface contact (lower pair) between the carriage and guide ways. However, this design increases friction. Ideally, there should be either line contact or point contact (higher pair) to reduce friction.

6. Testing

During testing, various parameters such as briquette density, production rate, and machine reliability are measured and analyzed. These tests provide valuable data for evaluating the performance of the machine and identifying areas for improvement.

7. Results and Analysis

7.1 Machine Performance

Testing results demonstrate the machine's ability to produce high-quality briquettes with minimal operator effort, confirming the effectiveness of the design. Analysis of briquette density, production rate, and energy efficiency provides valuable insights into the machine's performance metrics.

7.2 User Feedback

User feedback highlights the machine's ease of use, reliability, and overall satisfaction with the briquette production process. Suggestions for improvement are considered for future iterations of the machine design.

8.Application of Briquette

Biomass Briquettes are widely used for any type of Thermal Application like steam generation in boilers, heating purpose, drying process & gasification plant to replace existing conventional fuel like coal, wood & costly liquid fuel like FO, Diesel, LDO, Kerosene etc. Use of Eco-Friendly Briquettes as a fuel to save non-conventional fuels has shown very promising results.
Bio coal briquette made by briquetting press is a forth coming fuel of the world. It's a high excellence asset towards inexpensive, ecological & progressive environmental company policy.

9. Briquette Production/Cost:
The production of biomass briquettes involves several cost factors that need to be analyzed to determine its economic feasibility compared to traditional fuel sources. In this section, we delve into a detailed analysis of the costs associated with briquette manufacturing and explore strategies for cost optimization.
Raw Material Procurement: One of the primary cost components in briquette production is the procurement of raw materials. Biomass waste materials such as agricultural residues, forestry waste, and organic by-products are commonly used as feedstock for briquette manufacturing. The cost of sourcing these materials

varies depending on factors such as availability, transportation distance, and seasonality. Additionally, fluctuations in market prices and competition for biomass feedstock can impact procurement costs.

Machine Operation:
The operational costs of the briquette manufacturing process include expenses related to machine operation and maintenance. This encompasses the energy consumption of the briquette machine, lubricants, and spare parts. Regular maintenance and repair costs also contribute to the overall operational expenses. The efficiency and reliability of the briquette machine play a crucial role in minimizing operational costs and maximizing production output.

Labor:
Labor costs are another significant component of briquette production expenses. Skilled and unskilled labor may be required for tasks such as material handling, machine operation, quality control, and packaging. The number of labor hours and wage rates impact labor costs, making it essential to optimize production processes to minimize manual intervention and maximize productivity.

Transportation:
Transportation costs encompass the expenses associated with transporting raw materials to the briquette manufacturing facility and distributing finished briquettes to end-users or markets. Factors such as distance, mode of transportation, fuel prices, and logistics infrastructure influence transportation costs. Efficient logistics planning and coordination are essential to minimize transportation expenses and ensure timely delivery of briquettes to customers.

Overhead Expenses: Overhead expenses include various indirect costs associated with briquette production, such as facility rent, utilities, administrative salaries, insurance, and taxes. These overhead costs contribute to the overall cost structure of briquette manufacturing and need to be carefully managed to maintain profitability. Implementing cost-saving measures and optimizing resource utilization can help mitigate overhead expenses and improve cost efficiency.

Strategies for Cost Optimization:
To enhance the economic viability of briquette manufacturing, several strategies for cost optimization can be implemented. These include:

Efficiency Improvements: Investing in advanced briquette machine technology and process optimization to improve production efficiency and reduce energy consumption.

Bulk Procurement: Negotiating favorable contracts with suppliers for bulk procurement of raw materials to secure competitive prices and minimize procurement costs.

Labor Optimization: Streamlining production processes, providing training to workers, and implementing labor-saving technologies to optimize labor utilization and reduce labor costs.

Logistics Optimization: Optimizing transportation routes, consolidating shipments, and leveraging economies of scale to minimize transportation costs and enhance logistics efficiency.

Waste Minimization: Implementing waste reduction strategies and recycling initiatives to minimize material wastage and maximize resource utilization, thereby reducing production costs.
By carefully analyzing and optimizing these cost factors, briquette manufacturers can improve cost efficiency, enhance competitiveness, and promote the widespread adoption of biomass briquettes as a sustainable energy solution.

10. Conclusion and Future Directions

The design and development of a manual briquette machine offer a promising solution to the challenges of biomass waste management and energy access. By combining innovative engineering solutions with sustainable practices, this study lays the groundwork for future advancements in manual briquette technology. Future research will focus on refining the machine design, optimizing production processes, and expanding outreach to underserved communities.

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