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Design and Development of Agricultural Waste Shredder Machine

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Abstract: *Agricultural waste poses significant environmental and economic challenges due to improper disposal methods like burning and natural decay. To address this, an Agricultural Waste Shredder Machine was designed and fabricated to convert crop residues into smaller, usable forms for composting, animal feed, and biofuel production. The machine uses a rotary cutting mechanism powered by a motor, with durable steel blades for efficient shredding. It demonstrates good performance, low maintenance, and ease of operation. This project supports eco-friendly waste management, promotes sustainable agriculture, and provides an affordable solution for farmers.*

Keywords: Agricultural waste, Shredder machine, Crop residues, Waste management, Biomass conversion

I. INTRODUCTION

Design and Development of agricultural waste shredder machine was design for agriculture its was really benefit for all the farmers of india as we know india is also known as the agricultural country it is also very useful for reuse of agriculture waste like coconut waste and trees cutted unnecessary woods. One of the major problems associated with agricultural waste is its improper disposal. Farmers often resort to burning crop residues in open fields due to lack of proper waste management techniques. This practice, commonly known as stubble burning, releases harmful gases like carbon dioxide, methane, and particulate matter into the atmosphere, leading to severe air pollution and health hazards. It also contributes to climate change and degrades soil quality by destroying essential nutrients and microorganisms.

II. LITERATURE REVIEW

Sahay and Singh (2017) developed a multi-crop shredder to efficiently manage post-harvest agricultural waste from crops like maize, cotton, soybean, and sugarcane. Their study focused on improving blade design, material, and feeding mechanisms to enhance shredding performance. They found that blade angle and speed greatly affect efficiency and power use, while high-carbon steel blades improve durability and output quality. The machine's compact and portable design makes it suitable for small and medium farmers. Overall, the shredder helps reduce residue burning, supports composting, and promotes sustainable farming practices.[1]

Sreenivas and Reddy (2018) developed a portable agricultural waste shredder designed for small and medium-scale farmers. Their study focused on creating a lightweight, cost-effective machine powered by a single-phase motor, with optimized blade design and feed mechanisms for efficient shredding of various crop residues. The shredder demonstrated good performance in terms of throughput, energy efficiency, and uniform particle size. Its portability allowed easy field operation, reducing labor and time. Overall, the machine supports better waste management, lowers environmental impact, and promotes sustainable farming practices.[2]

Patil, Kulkarni, and Jadhav (2019) developed an organic waste shredder aimed at improving composting efficiency by reducing biodegradable waste into uniform particles. Their design featured dual rotating blades powered by an electric motor with a belt and pulley system, along with adjustable screens to control particle size. The shredder showed

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effective performance with good throughput, low power consumption, and minimal clogging. Its easy maintenance and suitability for both farm and household use make it a practical solution for sustainable waste management and enhanced composting.[3]

Kamble, Deshmukh, and Mane (2020) designed a multi-purpose agricultural shredder capable of processing both wet and dry crop residues efficiently. Their study focused on optimizing blade material, geometry, and rotational speed, finding that high-speed steel (HSS) blades provided superior durability and cutting performance. The shredder, powered by an electric motor with a belt and pulley system, achieved effective shredding at around 1000–1200 rpm with low energy consumption. It successfully processed various agricultural wastes into uniform particles suitable for composting, mulching, and animal feed, supporting sustainable waste management.[4]

Kiran and Manjunath (2021) evaluated a tractor-operated shredding machine designed for large-scale agricultural waste management. The system utilized the tractor's PTO shaft for power, eliminating the need for a separate motor and enabling efficient handling of bulky residues like sugarcane trash and maize stalks. Their study showed high shredding capacity, improved efficiency, and consistent performance compared to smaller electric models. Although effective for field operations, the machine requires proper alignment and regular maintenance for reliable long-term use.[5]

Sharma and Verma (2022) improved agricultural shredder performance by redesigning the cutting blades and hopper system to handle fibrous waste more efficiently. They introduced serrated, curved-edge blades made of hardened alloy steel, which reduced clogging, prevented material wrapping, and enabled smoother cutting. The improved design enhanced shredding uniformity, lowered power consumption, and minimized maintenance needs. Overall, their work increased operational efficiency, safety, and durability in shredding fibrous agricultural residues.[6]

In their 2023 study, Gupta, Patel, and Nair proposed an automated agricultural waste shredding system with smart monitoring to improve efficiency and reliability. By integrating sensors for current, temperature, and vibration with a microcontroller, the system could detect overloads and adjust operation accordingly, preventing motor damage and reducing energy waste. This adaptive approach enhanced safety, extended machine lifespan, and enabled predictive maintenance through data analysis.[7]

Mathews et al. (2004) focused on developing a manually operated shredder for food and agricultural use in low-resource settings. Their design emphasized affordability, simplicity, portability, and ease of maintenance, while also considering user ergonomics. The study showed that such manually operated machines can improve processing efficiency and productivity compared to traditional methods without increasing costs, making them suitable for rural applications.[8]

III. WORKING PRINCIPLE

An agricultural shredding machine works by using mechanical cutting and crushing action. Agricultural waste is fed through the hopper into a shredding chamber, where high-speed rotating blades cut and break the material into smaller pieces. A screen or mesh controls the size of the output, allowing only finely shredded material to pass through. The processed material is then discharged through an outlet or conveyor. The machine converts mechanical energy into

The above machine is shredder machine as mentioned above in introduction this machine is very useful for the farmers specially the agriculture waste many of farmer have acutally confused that the agricultural waste is happen in large amount of quantity so for that this machine is the best solution for the farmer for not excalty but this is we can say waste from best we add many type of agricultural waste in it and make some new from it I would hope this type of machine can make more for our indian farmers

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cutting force to efficiently reduce waste size.

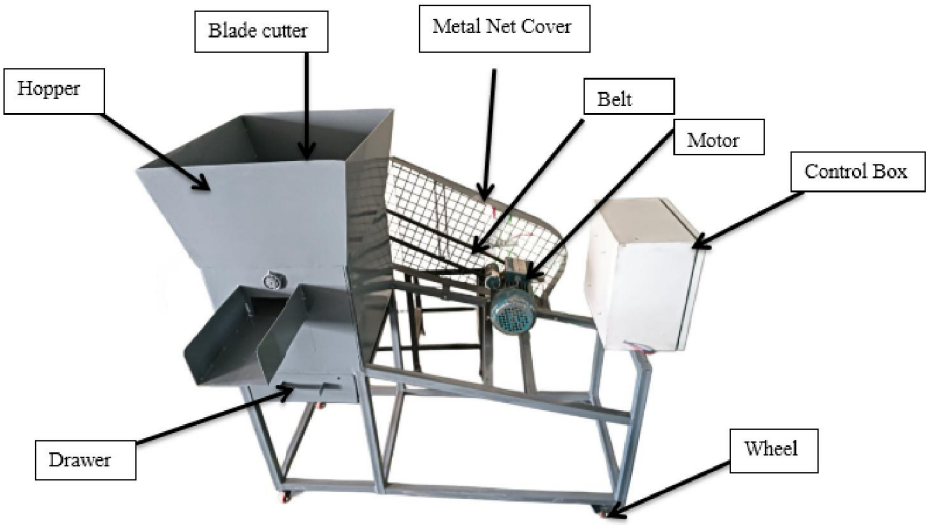

Fig :- Shredder Machine

V. RESULT

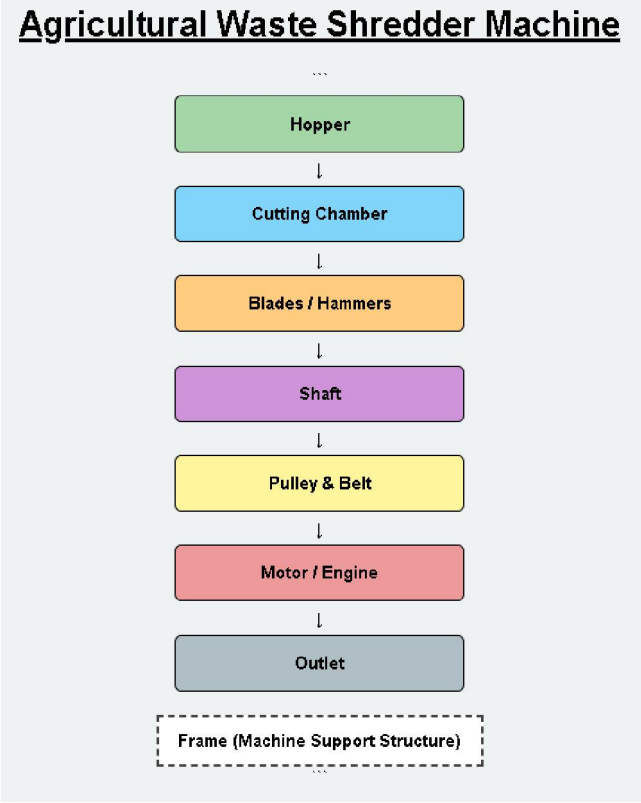

Fig: Flow Chart of shredder machine

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The project "Design and Development of Agricultural Waste Shredder Machine" has been successfully completed, resulting in the development of a functional, efficient, and costeffective machine for managing agricultural waste. The fabricated shredder machine is capable of effectively reducing the size of various types of agricultural residues such as dry leaves, crop stalks, and small branches into smaller, uniform pieces. The machine operates smoothly with the help of an electric motor and provides consistent performance with minimal vibration and noise. The inclusion of a well-designed hopper, efficient cutting mechanism, and proper discharge system ensures continuous operation and ease of handling.

Table- Standard Material cutting chart

Sr. No.	Material	Nature of Material	Cutting Speed (m/s)	Power Consumption (kW)
1	Cotton Stalk	Hard, fibrous	10 – 12	0.45 – 0.50
2	Maize Stalk	Medium fibrous	9 – 11	0.40 – 0.45
3	Sugarcane Leaves	Soft, light	8 – 10	0.35 – 0.40
4	Banana Stem	Soft, moist	7 – 9	0.30 – 0.38
5	Dry Leaves & Grass	Very light, dry	6 – 8	0.25 – 0.35

Table-Actual Material Cutting Chart

Sr. No.	Material	Nature of Material	Cutting Speed (m/s)	Power Consumption (kW)
1	Cotton Stalk	Hard, fibrous	11	0.47
2	Maize Stalk	Medium fibrous	10	0.43
3	Sugarcane Leaves	Soft, light	9	0.38
4	Banana Stem	Soft, moist	8	0.35
5	Dry Leaves & Grass	Very light, dry	7	0.30

Table-Actual Material Cutting Chart

IV. CONCLUSION

As the result machine has been successfully launched and working successfully testing of machine has done successfully in the presence of respective guide and my group memebers finally it is ready for use. The design included major components such as a feeding hopper, cutting chamber, frame structure, and power transmission system. Appropriate materials like mild steel for the frame and hardened steel for blades were selected to ensure durability and

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strength. The fabrication work was then carried out using standard manufacturing processes such as cutting, welding, drilling, and assembly, resulting in a strong and stable structure.

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