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FABRICATION OF PLASTIC BOTTLE SHREDDING MACHINE

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Abstract - *This project, titled "Fabrication of Plastic Bottle Shredding Machine," aims to reduce plastic waste by shredding plastic bottles into small pieces for easy recycling. The machine uses an AC motor, hopper, gears, and rotating cutting blades to cut the bottles using the principle of shearing. When bottles are fed through the hopper, they pass through the cutter blades and are shredded into smaller pieces, which are collected for further processing. This low-cost and efficient machine helps improve waste management and supports environmental protection.*

1. INTRODUCTION

Plastic waste has emerged as one of the most significant environmental challenges globally. Each day, countless plastic bottles are discarded after their use. These bottles require hundreds of years to decompose, resulting in land and water pollution, as well as posing threats to wildlife. Consequently, recycling and waste management have become critically important.

Recycling firms favor plastic in small chip form due to its ease of melting, transportation, and reuse. Nevertheless, the manual cutting of bottles is both time-consuming and hazardous. This situation creates a demand for a straightforward, cost-effective, and efficient plastic bottle shredding machine suitable for small industries, educational institutions, and rural communities.

This project aims to design and construct a compact machine that can safely and efficiently shred plastic bottles into small fragments.

2. Problem Identification

Plastic bottles take up considerable space because of their design and rigidity. Gathering and moving them in their entirety necessitates additional room, thereby raising the recycling operational expenses. Further-more.

- Industrial shredders come with a high price tag
- They demand significant power
- Their weight is excessive for small-scale applications
- Maintenance costs are high

Consequently, there is a demand for an economical shredding solution that caters to smaller users.

3. Aim of the Project

The objective is to create an affordable, space-efficient, and easy-to-use plastic bottle shredding machine utilizing basic mechanical components like shafts, cutters, a belt, and a motor.

4. Objectives

1. To examine various shredding mechanisms employed in industrial applications.

2. To engineer a shredder blade system that is both lightweight and robust.

3. To construct the machine utilizing materials those are readily available locally.

4. To evaluate the strength and efficiency of the cutter and shaft.

5. To minimize the dimensions of plastic bottles to facilitate recycling.

6. To ensure a design that prioritizes user safety.

7. To develop a machine that demands minimal maintenance and is user-friendly.

5. Literature Review

A number of researchers and engineers have created shredding mechanisms to address the issue of plastic waste. Their research emphasizes:

- The necessity for reducing costs in waste recycling equipment
- The significance of blade design, which has a direct impact on the quality of the output
- Issues associated with belt-driven systems, including slippage
- The benefits of gear-driven mechanisms
- The critical nature of slow-speed shredding, which minimizes noise and enhances cutting torque
- This project is inspired by these findings and aims to create a simplified and cost-effective shredding solution.

6. Machine Components

6.1 Frame

- Made of Mild Steel
- Provides structural support
- Carries motor, hopper, and cutters

Fig. 1: **7mm thickness Frame**

6.2 Cutter Blades

- High-carbon steel or carbide-tipped steel
- 12–14 blades arranged uniformly
- Designed to cut PET and HDPE bottles easily

Fig. 2: **8mm thickness Blades**

6.3 Shafts

- Mild Steel
- Designed to handle high torque
- Connected with bearings for smooth rotation

6.4 Motor

- 1HP to 1.5HP
- Provides enough torque for slow-speed shredding

Fig. 3: **Motor 1 HP**

6.5 Hopper

- Guides bottles safely into the cutter
- Protects the user from coming in contact with blades

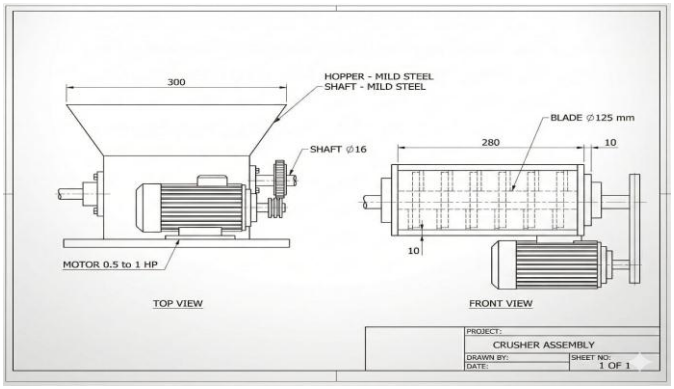
7. Working Principle

The machine operates on the principles of cutting and shearing.

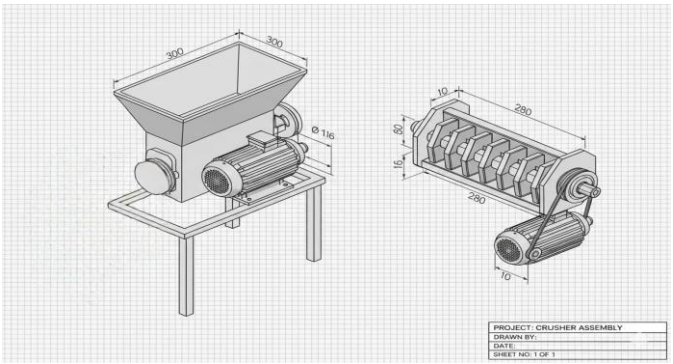
1. Plastic bottles are fed into the hopper.2. Two shafts equipped with several cutters rotate towards one another.
2. As the bottle enters the cutting area, it becomes ensnared between the rotating cutters.
3. The combined forces of shearing and tearing fracture the bottle into small pieces.
4. The fragments then drop through the collection tray at the bottom.
5. The motor and gear mechanism guarantees smooth and uninterrupted rotation.

This technique effectively minimizes the size of plastic bottles without causing overheating or melting of the plastic.

8. 2D Diagram



9. 3D Diagram



10. Fabrication Process

1. Cutting and welding of the MS frame structure.
2. Machining of shafts to the required diameter.
3. Manufacturing of cutter blades with accurate angles.
4. Drilling and fitting blades onto the shafts.
5. Mounting bearings on the frame.
6. Connecting the motor to the belt system.
7. Installing a hopper for safe feeding.
8. Testing machine with different bottle sizes.

11. Advantages

- Reduces plastic bottle volume up to 70%
- Transportation and storage become easier.
- Safe and simple to operate.
- Low power consumption.
- Affordable for small businesses.
- Helps in environmental protection.
- Low maintenance due to simple design.

12. Applications

- Small recycling units.
- Municipal waste centers.
- Schools for eco-projects.
- Colleges for engineering projects.
- Hostels, canteens, and cafeterias.
- Rural waste management systems.
- Scrap dealers.

14. Future Scope

- Adding an automated feeding mechanism
- Integrating sensors for safety shutdown
- Adding a heating chamber to convert chips into filaments
- Connecting the shredder to a conveyor system
- Solar-powered system for rural areas

Conclusion

The designed and fabricated plastic bottle shredding machine successfully converts waste plastic bottles into small chips. The machine is simple, cost-effective, and more efficient.

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