Design and Fabrication of Low Cost Recycled Plastic (Wire) Cutting Machine

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Abstract – This paper discusses the research and analysis conducted on a cutting machine for recycling plastic strips. In the plastic industry, plastic pallets are used to create plastic strips for packing materials and box strapping . These strips are produced using an extruder machine, but if impurities are present in the plastic material, the strip-making process is halted, resulting in plastic waste in strip form. While melting is a common method for recycling this waste, it can be time-consuming and costly. The objective of this machine is to convert plastic waste into pallets in a short period and at a low cost. This machine uses pressure rollers and blades to convert the plastic strips into pallets efficiently. The motivation behind creating this machine is to minimize plastic waste, which is not environmentally friendly and is being wasted excessively. With this machine's help, the amount of plastic waste can be reduced to a certain and specific limit.

Keywords – Nut bolt, coupler, pressure roller, blades, Shaft, Gear, electric Motor.

I. INTRODUCTION

Designing and fabricating a recycled plastic strip cutting machine to form plastic strip pallets cost-efficiently is an important consideration for ensuring its widespread adoption in the plastic waste management system. While there are existing machines available in the market, they may not be cost-effective, particularly for small and medium-sized enterprises that require a lower investment cost. To address this issue, the design and fabrication of a recycled plastic strip cutting machine can be optimized for cost-effectiveness without compromising its functionality and performance. This can be achieved through the use of appropriate materials, reducing the number of components and simplifying the design, and adopting efficient manufacturing processes. The optimization of the machine's design and fabrication for cost-effectiveness requires a multidisciplinary approach involving expertise in mechanical engineering, material science, manufacturing technology, and cost analysis. The machine needs to be designed to handle various types of recycled plastic waste while minimizing the energy consumption and reducing the waste generated during the cutting process. Moreover, the fabrication process should be streamlined to reduce the overall cost of production. This can be achieved by utilizing low-cost materials, reducing assembly time, and minimizing the use of specialized tools and equipment.

In summary, designing and fabricating a recycled plastic strip cutting machine to form plastic strip pallets cost-efficiently is crucial for its widespread adoption in the plastic waste management system. A multidisciplinary approach that considers the functionality, performance, and cost aspects can result in a machine that not only benefits the environment but also offers a viable solution for businesses looking to reduce their production costs.

II. LITERATURE SURVEY

A. A.E. Oladejo et. Al., developed a Shredded Machine for processing of Agro-chemical. According to them, the shredding of twigs will provide an alternative for the use of Agro-chemicals. The machine consists of three-phase electric motor, bearings, structural frame, cutters, hopper, shredding unit, discharge chute, belt drive and shaft. The performance of the machine was evaluated and test results showed that there was a correlation between the weight of the shredded twigs and the shredding time and the weight of small bits of twigs collected increases with time

B. Vaibhav Edke1 et. Al., have made Plastic shredder machine and made analysis of mechanism used in machine. So, they developed a machine which processes the plastic waste as cheap as possible by shredding where it's made for reducing cost of processing and transportation.

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D. aypal Singh Rana et. Al., have designed and developed Plastic Shredder Machine which is light in weight and less costly. In this, they described the experimentation of plastic bottle cutting machines and analysis of mechanism used in the machine. They made a model for recycling of plastic wastage in the domestic area; industries as well as it can be useful to the scrap collectors. According to them, this machine will be a solution to the problem of space.

E. Abhay Katiyar et. Al, have designed and constructed a Shredding machine. Their machine will initially convert larger particle size of Collected organic waste into desired size such that it can be treated other chemical and biological processes in order to convert it into compost in least amount of time possible.

III. GENERAL DESIGN PRINCIPLES

Cutter can be rolled to give a PVC Strip a certain form after a simple shearing procedure. Parts' ability to cut depends on the material's characteristics .The work material must be subjected to principal forces in order to cut: a shearing force operating against the forward speed and the torque supplied to move the material through roller feeder.

IV. SELECTION OF VARIOUS PARTS FOR PLASTIC STRIP CUTTING MACHINE

Shaft choice

The motion from the electric motor is transferred to the cutting blades in this instance through the shaft. In most cases, the combined twisting moment and bending moment theory is used to calculate the shaft diameter.
However, this machine uses blades to cut plastic, and as we all know, plastic is a relatively easy material to cut.
As a result, the stress value won't be much greater, and one can choose the standard shaft that is widely accessible in the market.

Fig. Shaft

Selection of electric motors

Using a coupling, the motor is joined to the shaft. The choice of electric motor is determined by the demand for an output in the form of pallets made from strip. Depending on the needs, a single phase flange mounted motor with a 0.5 hp rating and 2800 input RPM is used.

Specifications

Motor Type :-AC Motor

Size :-1/12

Power :-0.5 HP

Fig Electric motor

Selection of blade

Blade is defined as a sharpen edge plate which is used to cut some kind of material. In this cutting machine The use of the blade is to cut the waste plastic strip by means of shear. It is fitted on the shaft.

Fig Blade

Pulley selection

Pulleys are often used in machines to transmit power between different parts. For example, in a car engine, pulleys are used to transfer power from the engine to the alternator, water pump, and other accessories.

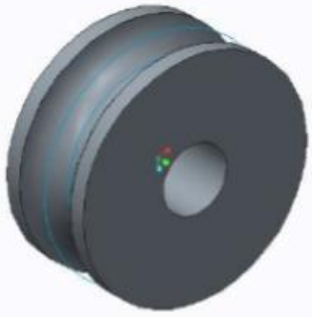

Fig pulley

Wire feed mechanism

A plastic strip feeding mechanism is a device that is used to supply a continuous feed of plastic strip material to a manufacturing process. The mechanism typically consists of a motorized drive system, a feed roller, and a tensioning system to ensure a consistent and reliable feed rate.

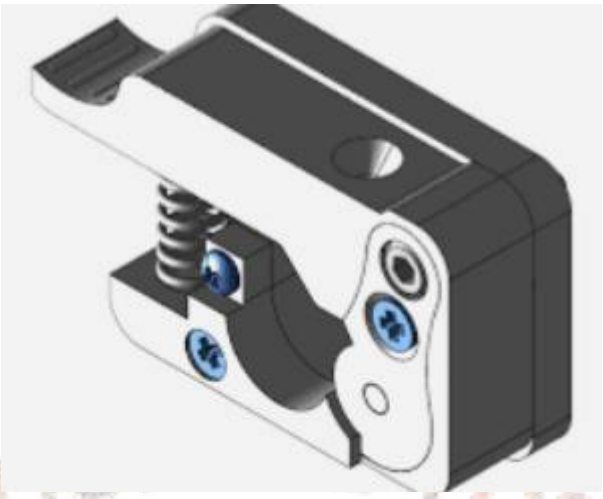

Fig Wire feeder mechanism

Bearing selection

Bearing Selected – SKF 6006-2Z

[1] Open Deep Groove Ball Bearing

D = 30 mm

D = 55 mm

B = 13 mm

Dynamic load rating, C = 13.8 kN

Reference speed = 28000 RPM

Weight = 0.12 kg

Material of bearing: white metal

Here the white metal is selected for the bearing because it has high bending strength.

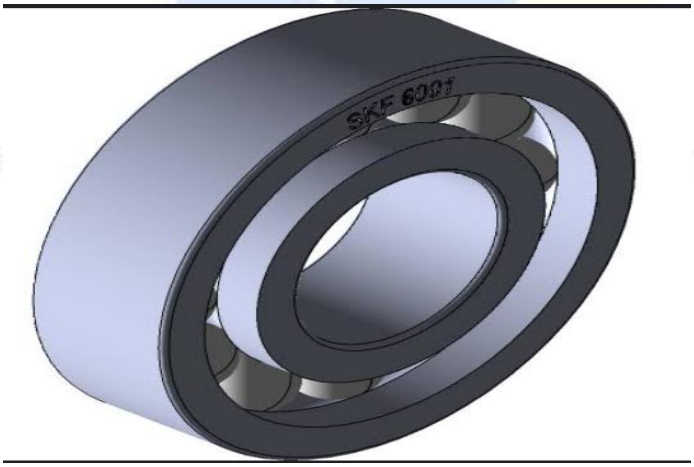

Fig . Bearing

V. **Methodology**:

The methodology for the design and fabrication of the low-cost recycling plastic strip cutting machine involved the following stages:

1.Requirements gathering: We gathered information on the requirements for the plastic strip cutting machine, including the types of plastic materials to be cut, the required cutting speed and accuracy, and the energy consumption of the machine.

2.Design: Based on the requirements gathered, we developed a design for the plastic strip cutting machine. We selected appropriate materials and components, determined the machine's dimensions, and created a detailed design plan.

3.Fabrication: Once the design was finalized, we fabricated the plastic strip cutting machine using the selected materials and components. The fabrication process involved cutting, welding, and assembling various parts of the machine.

4.Testing: After fabrication, we tested the plastic strip cutting machine to evaluate its performance. We measured the cutting speed and accuracy of the machine, as well as its energy consumption. We also evaluated the quality of the plastic strips produced by the machine.

5.Comparison with existing machines: We compared the performance of the low-cost plastic strip cutting machine with existing commercial machines in terms of cost-effectiveness and efficiency.

6.Optimization: Based on the results of the testing and comparison with existing machines, we optimized the design of the plastic strip cutting machine to improve its performance.

7.Demonstration: We demonstrated the feasibility of the low-cost plastic strip cutting machine as a potential solution for promoting plastic recycling in resource-limited settings.

VI. Actual working model

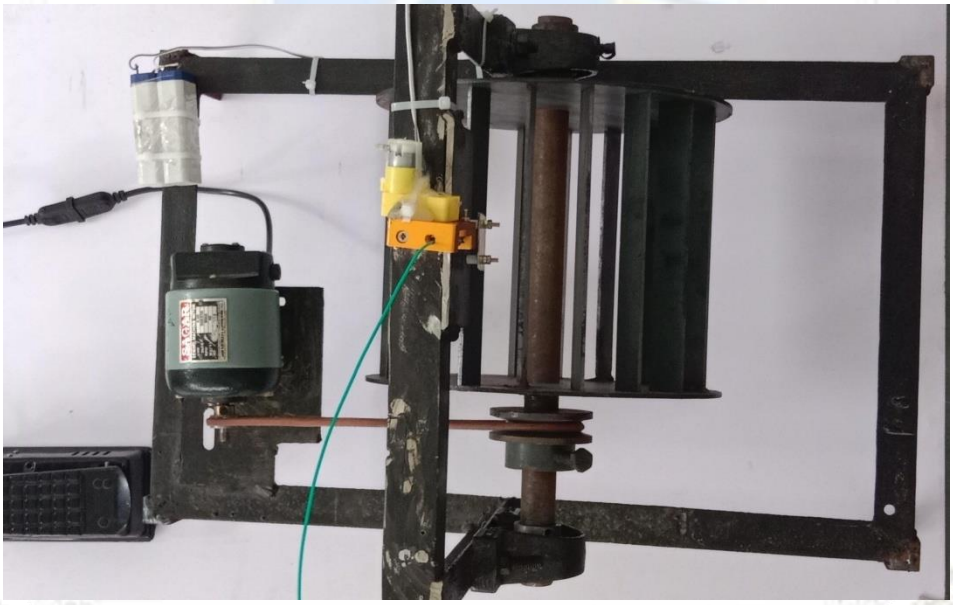

Fig . Actual working model

VII. Litrature review:

Plastic waste has become a major concern worldwide due to its impact on the environment and public health. Recycling is one of the ways to address this issue, and several studies have been conducted to explore different methods and technologies for plastic recycling.

1. Achilias et al. (2007) studied the chemical recycling of plastic waste made from polyethylene (LDPE and HDPE) and polypropylene (PP). The study demonstrated that chemical recycling is an effective method to convert plastic waste into useful products. However, it also highlighted the importance of selecting the right catalyst and reaction conditions to optimize the yield and quality of the products.

2. Bovea et al. (2019) discussed the challenges and opportunities in plastic recycling. The study highlighted the need for a holistic approach to plastic waste management, which includes waste reduction, reuse, and recycling. It also emphasized the importance of developing sustainable business models and policies to support the growth of the recycling industry.

3. Han et al. (2017) reviewed the current status of plastic waste recycling and the flotation of plastics. The study discussed the different methods of plastic recycling, including mechanical, chemical, and biological recycling, and highlighted the potential of flotation as an effective method for separating plastics.

4. Lim and Pang (2020) provided an overview of current technologies and challenges in plastic waste recycling. The study discussed the advantages and disadvantages of different recycling methods and highlighted the need for more research and development to improve the efficiency and cost-effectiveness of plastic recycling.

5. Madhoushi et al. (2017) designed, fabricated, and tested a low-cost plastic shredder for small-scale recycling enterprises. The study demonstrated that a low-cost shredder can be an effective tool for reducing the size of plastic waste and preparing it for recycling.

6. Muniyasamy et al. (2020) reviewed the trends and challenges in plastic waste management. The study discussed the current state of plastic waste management globally and highlighted the need for a more sustainable and integrated approach to address this issue.

7. Nikolic et al. (2015) reviewed the processing and application of recycled polyethylene terephthalate (PET). The study discussed the different processing techniques for recycled PET and highlighted its potential for use in various applications, including packaging, textiles, and construction.

8. Nigam et al. (2019) discussed the challenges and opportunities in sustainable management of plastic waste in India. The study highlighted the need for better waste management policies, infrastructure, and public awareness to address the growing problem of plastic waste in India.

9. Ong and Awang (2017) designed and fabricated a low-cost recycling plastic extruder machine for small-scale enterprises. The study demonstrated that a low-cost extruder can be an effective tool for recycling plastic waste and creating new products.

10. Villanueva et al. (2018) constructed a low-cost shredder for used plastics. The study demonstrated that a low-cost shredder can be an effective tool for reducing the size of plastic waste and preparing it for recycling.

VIII. Design Considerations:

The machine should be capable of cutting wires of various thicknesses.
The machine should be easy to operate and maintain.
The machine should be made of recycled plastic to reduce its environmental impact.
The machine should be cost-effective and affordable.
The machine should have safety features to prevent accidents.

IX. **Design Calculations**:

The cutting blade should be made of high-speed steel to ensure durability and efficiency.
The motor should be powerful enough to drive the cutting blade.
The gear system should be designed to provide the required torque for cutting wires of different thicknesses.
The frame should be designed to be sturdy and stable, to prevent vibrations during operation.

X. Design Conclusion:

Based on the design considerations, the machine has been designed to meet the requirements of cutting wires of different thicknesses. The machine is made of recycled plastic, which reduces its environmental impact. The cutting blade is made of high-speed steel for durability and efficiency. The motor is powerful enough to drive the cutting blade, and the gear system is designed to provide the required torque for cutting wires of different thicknesses. The frame is designed to be sturdy and stable, to prevent vibrations during operation.

XI. Design Results:

The recycled plastic wire cutting machine has been successfully fabricated based on the design considerations and calculations. The machine can cut wires of various thicknesses with ease, and it is easy to operate and maintain. The machine is also cost-effective and affordable, making it accessible to a wide range of users. The safety features of the machine ensure that accidents are prevented, making it a reliable and safe tool for cutting wires. Overall, the recycled plastic wire cutting machine is a sustainable solution that meets the needs of cutting wires while reducing its environmental impact.

XII. Advantage

Efficient cutting of plastic strips: The recycling plastic strip cutting machine can effectively cut plastic strips into smaller pallets with consistent sizes and shapes, making it easier to reuse and recycle plastic materials.

Improved productivity: The machine's automated cutting process can help increase productivity and reduce manual labor, making it more efficient and cost-effective for businesses that deal with plastic recycling.

Customizable cutting options: Depending on the design of the machine, it may be possible to customize the cutting options to produce pallets in various sizes and shapes to meet different manufacturing needs.

Reduced waste: The machine can help reduce waste and promote sustainability by converting plastic waste into smaller pallets that can be reused in various applications.

Cost savings: By reusing plastic waste, the recycling plastic strip cutting machine can help businesses save money on raw materials, which can ultimately lower production costs.

Overall, the design and fabrication of a recycling plastic strip cutting machine can have significant positive impacts on plastic recycling, sustainability, and cost-effectiveness.

XIII. Conclusion

Designing and fabricating a cost-effective plastic strip cutting machine for creating plastic strip pallets is essential for efficient plastic waste management. The existing recycling machines in the market may not be affordable for small and medium-sized enterprises, so a multidisciplinary approach is required to optimize the design and fabrication of the machine. The literature review highlights various methods of plastic waste management, including chemical, mechanical, and biological recycling, and emphasizes the need for sustainable business models and policies. The design and fabrication methodology for the machine involves gathering requirements, selecting appropriate materials, simplifying the design, and streamlining the fabrication process. Overall, the machine can minimize plastic waste and production costs while benefiting the environment.

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