Design and Development of mini plastic shredder machine

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Abstract: The Use of plastic is increasing day to day life in present scenario which cause a serious environmental issue, for this purpose we need to make eco-friendly environment by recycling possible waste plastic. To solve this issue already exist highly operated machines but they are too costly, so, the main purpose of our study is to design and fabrication of cost effective plastic shredder machine, the use of power supply and single shaft mechanism which can be useful for Micro, Small & Medium Enterprises. To implement this concept plastic shredder machine implemented which consists some mechanical & electrical components like Frame, hopper, electric motor, V-belt drive System, shredder setup. This machine is used for cutting the plastic in to small pieces, which are in irregular shaped flakes which can be processed further Recycle recovers the raw material, which helps to make new plastic product. Recycled plastic pieces are fed in to extrusion machine where it can form wire like plastic called filament and further used in 3D printing machine.

Keywords: shredding machine, Cutter-belt drive system, Single-Φ motor.

1. Introduction

A Shredder is a mechanical device used to cut plastic into Undefined Flakes, we design this project for recycling of plastic, Recycling Reduces the waste Management Solution. Shredder Machine Includes Crusher Setup with Single Axle Shaft basic purpose is to Cutting of material Depends of Shear Strength and Impact Strength. Machines Available for Recycling are costlier and setup is also high, to overcome this Problems we developed Plastic shredder machines, with this machines individual start the recycle setup without skill [1, 2]. This Paper Deals with design and Fabrication Mini Shredder Machine depends on various Parameters, Study of Manufacturing is very important aspect in order to carry out this project. The Project mainly important on manufacturing of shredder machine which is low cost and easily operate. In Heavy Shredder Machines twin shaft shredder blades are used where as in this model the Single Shaft Shredder is used for OperationThe selection of tool also contributes the efficiency of the machine and the results can be seen on crushing results. more, the selection of the right motor should be considered because it will affect the machine operation[3, 4, 5]. This project compromises few Components: Shredder blade setup, Single Phase 1.5hpAC Motor, Frame, blades and Spacers are mounted on hexagon Shaft Power Transmitted through V Belt Drive System from motor shaft to Hexagonal shaft then the blades rotates along with the shaft in mechanism box due to this cutting of material happen[6].
1.1. Objectives of the Project:

1. Study of Shredder machine with Different elements like Blades, V-belt Drive, Single-Shaft, Frame.
2. Fabrication of Shredder in Compact Size
3. Less manufacturing cost with best output
4. Use of Machine at local recycle stations.
5. Development with Single Shaft
6. Usage of knives opposite to shaft

1.2 Project Scope:
This project is limited to the scope as follows;
(i) Research, Design and Fabrication of Mini Plastic Shredder Machine
(ii) Test-run and verify the Machine.
(iii) Research and suggest the safe protection during process.
(iv) Reduce the plastic
(v) As a solution, a medium-sized machine has been developed.

2. Literature Review

Yeshwant M. Sonkhaskar, Amit Choubey, Amritpal Bhamra, Raghav Singhal, Anurag Sahu Has been explained about design of a Plastic Bottle Crusher which would help to crush the used Plastic bottles and would thereby help in waste management and disposal. This project aims to design a portable Plastic Bottle crusher that could be installed anywhere and would aid crush of used bottles[7].

Dr Muhammad Maqbool Sadiq, Muhammad Rafique Khattak, Plastic waste is silent threat to the environment and their disposal is a serious issue for waste managers. Now a day society does not have any alternative to plastic products like plastic bags, plastic bottles, and plastic sheets etc. In spite of all efforts made to limit its use but unfortunately its utility is increasing day by day. To circumvent this issue many efforts were made in the past to reuse the plastic waste but no significant results were achieved[8].

Vishal N. Kshirsagar describes about the experimentation of can or plastic bottle crusher machine and analysis of mechanism used in machine. Hence in this the knowledge of analysis is necessary, and by analysis of various parts the quality and life of machine can be increased and improved. Overall, for experimentation this machine involves processes like design, fabrication, analysis and assembling of different components etc. From this the knowledge of all the parameters like design, fabrication and analysis etc. will get increase but most important the knowledge of analysis, the use of Ansys-Workbench Software is increasing day by day to determine the parameters like stress, strain, deflection etc. for safe design and long durability [9].
3. Methodology

![Flow chart diagram]

4. Elements Required

| S.no | Specification |
|------|---------------|
| 1. Name | Plastic waste shredder machine |
| 2. Mechanism | V-belt Drive |
| 3. Shredder | Motor operated |
| 4. Process | Plain carbon steel for Shaft, Tungsten carbide for Cutting tips, Mild steel for Structural frame |
| 5. Material | Machining, Laser cutting and Fabrication |
| 6. Manufacturing | Avoid sharp corners, Safety guards |
| 7. Safety | 1.5 HP Single phase AC motor, 1440 RPM |
| 8. Motor specification | UCFL205 D1 |
5. Design Specification and Calculations

Some of the factors considered in the design of the recycled plastic waste shredding machine are safety, power requirement, and compactness, ease of operations and overall cost of production. Material selection based on availability, durability, cost and ease of fabrication were also considered [10].

5.1 Shaft

The cylindrical shaft is made of mild steel of diameter 35 mm and 600 mm long. The shaft was stepped down at both sides to a diameter of 25 mm so as to accommodate the bearings of diameter 25mm on the shaft. The shaft is machined on the lathe machine [11].

5.1.1 Cutting blades

The blades are made Mild Steel and of length146mm and thickness5mm as shown in Fig 2.2. The blades are divided into two parts, the fixed blade and the movable blades [12]. The movable blades are bolt on the blade carrying bars welded on the shaft while the fixed blades are bolt on the edge of the lower hemisphere of the cutting chamber [13].
5.1.2 Electric Motor
A 1-phase electric motor with 1.1 kW (1.5 hp), 1400 rpm (rotational speed) and 50 Hz was used.

5.1.3 Transmission Drive
The power transmission drive used for the machine is belt and pulley drive

Figure 4: Pulley diagram

5.1.4 Design for driven pulley

**Velocity ratio** This is calculated using the formula:

\[
\text{Velocity ratio} = \frac{\text{diameter of the driven pulley}}{\text{diameter of the driver pulley}}
\]  

Diameter of driven pulley = 152.4 mm
Diameter of driver pulley = 88.9 mm
velocity ratio = \(\frac{152.4}{88.9} = 1.71\)

\(8.9\) mm

**Output speed**

\[
\text{Output speed} = \frac{\text{input speed}}{\text{velocity ratio}}
\]

Therefore, input speed, input speed means speed of ac motor 1440 rpm.
velocity ratio = 1.71
1440
Output speed = 847 rpm
N2 = 847 rpm

*Note: N2 is the speed of the shaft arrangement at no load [10].*

Required Torque to produce Power[11].

\[P = \frac{2\pi NT}{60}\]

\[1.5 \times 746 = \frac{2 \times 3.14 \times 1440 \times T}{60} = 7.4\text{N-M}\]
6. Conclusion
The developed model is simple, efficient, requires less time and cost effective when compared to the existing available model. Importance is given towards user friendly in operation and mainly towards safety. The rotating elements like belt and pulley and gears are covered, so it is fully safety to operator. The overall performance of shredder machine was satisfactory by considering the quantity of powder produced with respect to time.

7. Future Work
Design of the single Shaft Shredder machine & Blades has successfully completed with required design calculation. The Required level RPM of Motor also analyzed and find out as per the project of single Shaft Shredding Machine. In this project Design of single Shaft Shredding Machine and Blades is completed with CatiaV5 software and the blades and shredding machine is analyzed in future with the use of ANSYS software. And calculate the stack up calculation of the blades assembly.

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