

# Waste Management by Solar Powered Mechanical Shredder Machine

Prof. Divya.N.Dubey<sup>1</sup>, Namrata.Arun.Dable<sup>2</sup>, Swati.Sanghpal.Kumare<sup>3</sup>, Alpesh.Sanjay.Gadpayle<sup>4</sup>,  
Hitesh.Rajesh.Padole<sup>5</sup>, Milind.Gopal.Patankar<sup>6</sup>, Rohit.Shekhar.Gajbhiye<sup>7</sup>

<sup>1</sup>Assistant Professor, Department of Mechanical Engineering, D.B.A.C.E.R., Nagpur, Maharashtra  
<sup>2,3,4,5,6,7</sup> UG students, Department of Mechanical Engineering, D.B.A.C.E.R., Nagpur, Maharashtra

**Abstract-** The available machines used to recycle this waste are very costly. They pack this waste and give them to the local processing plants. So the process of packaging and transporting is much costly. So our intension behind this project is to process the plastic waste as cheap as possible by cutting where it is made for reducing of labour work which results in cost reduction. A cutting machine is designed to reduce large solid material objects into a smaller volume or small pieces.

In this project they describes about the experimentation of plastic bottle cutting machine and analysis of mechanism used in machine. Plastic bottle cutter is a machine used for cutting the plastic in small pieces to make waste management easier. We are making this project model for recycling of plastic and paper wastage in domestic area; industries as well as it can be useful to the scrap collectors. This machine is solution on the problem of space.

**Index terms-** Packaging and Transporting, Labour Work, Cost Reduction, Waste Management

## I. INTRODUCTION

1. Solar powered shredder is a machine used for cutting the paper, hard boxes, plastic in small pieces to make waste management easier. This project focuses on recycling of plastic wastage in domestic area, industries etc.

2. In these areas the plastic waste is present in large quantity, but the available machines used to recycle this waste are very costly. They packs this waste and give them to the local processing plants. So the process of packaging and transporting is much costly. So the main intension behind this project is to developed the solar operated shredder machine, that process the plastic waste as cheap as possible by shredding where it is made for reducing cost of processing and transportation.

3. 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.

4. 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.

## II. OBJECTIVES

1. The objective of a project is to recycle plastic to reduce the burning solid plastic waste and control the environmental pollution.
2. To develop cost effective Solar powered shredder machine, with less labour work.
3. Study of Shredder machine with Different elements like, Blades, V-belt Drive, Single-Shaft, Frame.
4. Fabrication of Solar powered Shredder in Proper Size
5. Use of Machine at local recycles stations.

## III. LITERATURE REVIEW

1. ND Jadhav, Akshay Patil Proposes the available machines used to recycle plastic waste are very costly. A cutting machine is designed to reduce large plastic material objects into a smaller volume or small pieces so aim is to process the plastic waste as

cheap as possible by cutting where it is made for reducing of labour work which results in cost reduction.

2. Dr.M. Muthukumaran: Proposed to design and development of Shredder machine focus on plastic wastes to prepare the new product. Concept was developed considering the safety factor users operating environment and maintenance. Considering the user’s needs and buying capacity, a prototype was fabricated. The shred particle can be converted into the new product. The main drawback of this machine is the efficiency and the outcome of the shredder machine was less than what was expected. The reason for less efficiency and the outcome are Blades of the shredder machine are not perfect .The blades are not machined in a CNC machine. It was wound with hands on gas cutting process. So blades are not tight. The blades generated less torque over the plastic waste and it will not be as strong as expected. There were some misalignments and it caused a drop in output.

IV. PROBLEM DEFINITION

1. Plastic waste is not homogenous. Different types of plastics demand special attention from a waste management point of view. Most commonly found plastics in rural areas (polythene bags, bottles, etc.) are thermoplastics. Unsafe disposal of plastics in rural areas is becoming prevalent and will come at massive costs to the rural ecology and economy. As population in India is forecasted to experience an unprecedented growth from currently 1.31 billion to 1.65 billion by 2030, the management of plastic waste in rural areas needs innovative solutions to address the challenge. There needs to be a development of plastic waste management in order to stop unsafe and hazardous methods to dispose plastic waste.

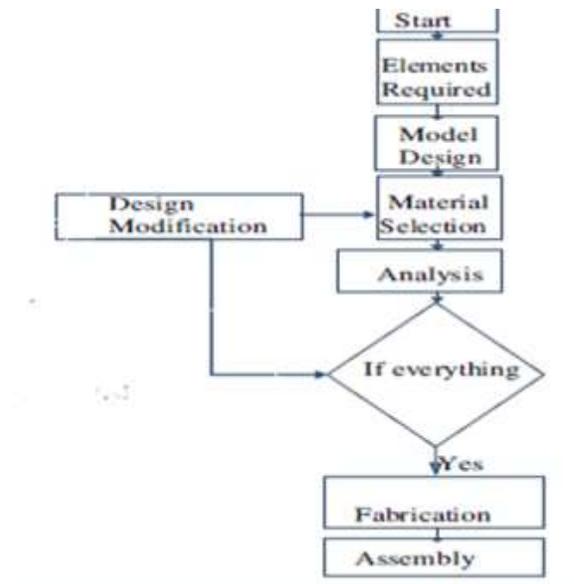
2. There is more than 15,000 tons of plastic waste generated in India daily; more than 40% of this quantity is disposed unsafely. Only 9,205 tonnes of plastics, which correspond to approximately 60% of the total quantity generated, are recycled daily.

V. METHODOLOGY

1. 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 Operation. The 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].

2. This project comprises few Components: Solar Panel , Shredder blade setup, High torque DC 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].



VI. ELEMENTS REQUIRED

Sr.No.	Parameters	Specification
1.	Name	Solar power shredder machine.
2.	Mechanism	V-belt Drive with Motor.
3.	Shredder	Operated.
4.	Material	Plain carbon steel for Shaft, Tungsten carbide for Cutting tips, Mild steel for Structural frame.
5.	Manufacturing	Machining, Laser cutting and Fabrication.
6.	Safety	Avoid sharp corners, Safety guards.
7.	Motor specification.	DC motor 300 rpm.
8.	Bearing.	No.6204

VII. DESIGN SPECIFICATION AND CALCULATION

DESIGN SPECIFICATION

Working principle gives us the functionality of the developed model. The developed model, acts as an electro mechanical which reduces the human effort as well as human intervention by utilizing the electrical dc motor for the shredder. The process is very much simplified as compared to the earlier processes. The machine is first connected to the solar power supply. Shredder are mounted on dual shaft each shaft has 4 cutters. After that dry agro waste are fed through the hopper into the Shredder assembly. As the waste moves towards the Shredder, rotating at the speed of 550 rpm, the waste get chopped and chopped is collected on the other side of the machine

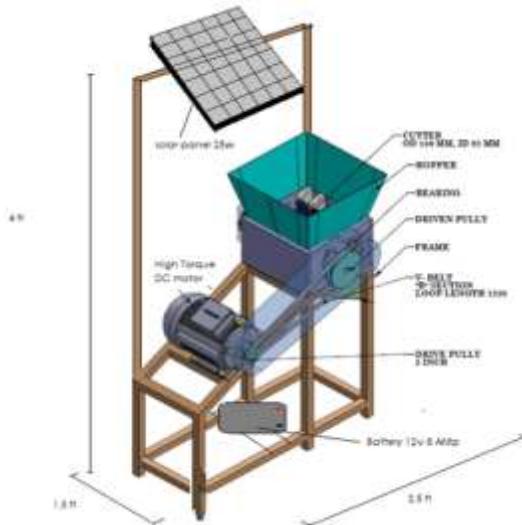


Fig. (a) Isometric view of shredder machine

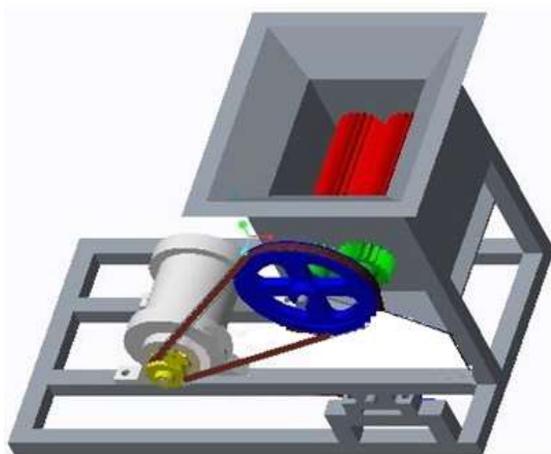


Fig. (b) CAD design



Fig.(c) Actual Project Model

Components details:

7.1 Solar Panel



Solar energy can be stored to utilize at night and when there is a cloudy conditions. Storage is an important issue in the development of solar energy because continuous availability is a vital requirement of modern energy use. Solar energy is only available in the hours of daylight. Solar energy is stored in form of heat or electrical energy. Solar energy is also stored as mechanical energy in the form of flywheel.

7.2 Battery



An electric battery is a device consisting of one or

more electrochemical cells with external connections provided to power electrical devices such as flashlights, smartphones and electric cars. When a battery is supplying The terminal marked negative is the source of electrons that when connected to an external circuit will flow and deliver energy to an external device.

### 7.3 High Torque D.C. Motor



To drive the whole mechanism of shredder machine, High torque DC motor (300 RPM) is with 100 kg of torque is used. Also for shredder mechanism DC motor is used with belt and pulley arrangement. A variety of electric motors provide power to machine, making them move with various motions. The efficiency rating of a motor describes how much of the electricity consumed is converted to mechanical energy. The direct current (DC) high torque motor is one of the first machines devised to convert electrical power into mechanical power.

### 7.4 Bearing



A bearing is a machine element that constraint that constraint relatively motion to only the desired motion to only the desired motion and reduced friction a machine element that a bearing being a machine element that allows one part to bear another.

Material is used for bearing is steel. From the chart bearing no.6204 is selected by obtaining  $C=13.50(Cr<C)$ . So, bearing no.6204 is suitable and it is selected.

### 7.5 Belt and Pulley Mechanism



A pulley is a wheel on an axle or shaft that is designed to support movement and change of direction of a taut cable or belt, or transfer of power between the shaft and cable or belt. In the case of a pulley supported by a frame or shell that does not transfer power to a shaft, but is used to guide the cable or exert a force, the supporting shell is called a block, and the pulley may be called a sheave. A pulley may have a groove or grooves between flanges around its circumference to locate the cable or belt. The drive element of a pulley system can be a rope, cable, belt, or chain.

### 7.6 Shaft



A shaft is rotating machine element, usually circular in cross section and which is used to transmit power from one part to another part or from a machine which is power producer to power machine, which absorbs power. The various members such as cutting blades, bearing and pulley are mounted on it. Material is used for shaft is EN31 steel. Shaft is manufactured and diameter of shaft is 25 mm. 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.

### 7.7 Shredder blades



Cutting system consists of the shafts, cutting blades, washers and bearings. The cutting blade of 6 inch is round-shaped blade with 2 cutting edges, given circle-shaped hole in the middle with keyway, mounted on the main shaft and main shaft move together, The blades are made Mild Steel and of length 146 mm and thickness 5mm. The blades are divided into two parts, the fixed blade and the movable blades. 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.

### 7.8 Frame



Construction machine consists of stand, bearing support plates, nuts and bolts. Frame is the supporting member which provides support for components like bearing, shaft, blades, belt, pulley etc. In order to get the required strength, two plates (Bearing support blades) are fixed with the help of nut and bolts. The machine frame with a size of 275

X 220 X 178 mm which will connect through fastening process. The material used for the machine frame is MS (Mild Steel). The analysis of frame was done to check whether it can support the load of the cutting and transmission system assembly.

### DESIGN CALCULATION:

Formula for tension in belt ( $T_b$ ) & Power required (P) to drive the belt:

Diameter of smaller pulley (D) = 0.071 m.

Speed of motor (N) = 300 rpm.

Type of belt material = Rubber.

Length of belt (L) = 1000 mm = 1 m.

Load due to waste paper (mm) = 0.5 Kg/m.

Load due to belt (mb) = 0.1248 Kg/m.

Inclination of belt and pulley mechanism ( $\theta$ ) =  $20^\circ$ .

Vertical height of belt and pulley mechanism (H) = 0.15 m.

Coefficient of friction between pulley and belt (f) = 0.12.

Now,

$$T_b = 1.37 * f * L * g * (2 * mb + mm) * \cos(\theta) + (H * g * mm)$$

$$T_b = 1.37 * 0.12 * 1 * 9.81 * (2 * 0.1248 + 0.5) * \cos(20) + (0.15 * 9.81 * 0.5).$$

$$T_b = 1.872 \text{ N.}$$

Velocity (v) =  $\pi D * N / 60$ .

$$v = \pi * 0.071 * 300 / 60.$$

$$v = 1.12 \text{ m/s.}$$

Power required to drive the pulley mechanism (P) = Belt Tension \* Velocity.

$$P = T_b * v.$$

$$P = 1.872 * 1.12.$$

$$P = 2.10 \text{ Watt.}$$

### VIII. CONCLUSION

A small unit of waste paper mechanical shredder machine by using solar power was developed. The machine is tested to evaluate the performance of waste paper shredding operation by means of solar operated mechanical shredder machine by using different types of techniques. The effect of shredding the waste paper and making the useful application without any harm to environment is studied. On the basis of observations and results the following conclusions are drawn:-

1. With the help of solar panel, solar power is generated by using sun rays which is converted into electrical energy which charges the 12V 8AH battery. The electrical energy stored in the

battery is supplied to the high torque D.C. motor which runs the motor and converted into mechanical power.

2. The movement of the belt and pulley mechanism is totally depending upon the speed of the high torque D.C. motor. The motor transfers the mechanical power to the driving pulley which runs the driven pulley in contact.
3. The size of waste paper mound is depended upon the surface area of the hopper which is mounted on the top of the shredding blade mechanism.
4. The waste paper mound is the raw material which is the input to the hopper and it should be in a specific amount which is important otherwise the shredder blades will not able to shred the waste paper properly. The shredder blade mechanism shreds the waste paper mound in the minute particles as per the expected assumption.

[6] All formulae are taken from “Dunlop conveyor belt technique design and calculation”.

#### REFERENCES

- [1] ND Jadhav, Akshay Patilel, “Development of Plastic Bottle Shredding Machine” International Journal of Waste Resources ISSN: 2252-5211 Volume 8, Issue 2, DOI: 10.4172/2252-5211.1000336.
- [2] Dr .M.MUTHUKUMARAN, P.MURASOLI MARAN etl., “DESIGN AND FARICATION OF PLASTIC WASTE SHREDDER MACHINE” INTERNATIONAL JOURNAL FOR RESEARCH & DEVELOPMENT IN TECHNOLOGY Volume-7, Issue-4, (April-17) ISSN (O) :- 2349-3585.
- [3] Akinfiresoye Waleola Ayo\*, OJ Olukunle etc, “Development of a Waste Plastic Shredding Machine” International Journal of Waste Resources Volume 7, Issue 2 ISSN: 2252-5211 DOI: 10.4172/2252- 5211.1000281.
- [4] Adepo, S. O, Obanoyen, N. O etc, “Design and Construction of a Plastic Shredding Machine” Journal of Multidisciplinary Engineering Science and Technology (JMEST) ISSN: 2458-9403 Vol. 4 Issue 9, September - 2017.
- [5] Sekar L.R.1, Vinoth Kumar S “Utilization of Upgraded Shredder Blade and Recycling the Waste Plastic and Rubber Tyre” International Journal of Science and Research (IJSR) Volume 7 Issue 9, September 2018 ISSN: 2319-7064 DOI: 10.21275/ART2019736 160.