

Manufacturing of Shredder for used Plastic Bottle

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Abstract— This project deals with a detailed study & manufacturing procedure of a Plastic bottle recycling machine. A detailed study of various parts of recycling machine like stand (frame), transmission system and cutting system are made and manufactured separately. The first part deals with the study of cutting system of a recycling machine i.e. types of blades, different profiles, its dimensions, its alignment, advantages and disadvantages of different types of blades.

Key words: Plastic Bottle, Shredder, Volume

I. INTRODUCTION

Plastic recycling is the process of recovering scrap or waste plastic and reprocessing the material into useful products. Since plastic is non-biodegradable, recycling is a part of global efforts to reduce plastic in the waste stream, especially the approximately eight million metric tons of waste plastic that enter the Earth's ocean every year. This helps to reduce the high rates of plastic pollution. A crusher is a machine designed to reduce large solid material objects into a smaller volume, or smaller pieces. Crushers may be used to reduce the size, or change the form, of materials so they can be more easily and efficiently used in the purpose intended to. Crushing is the process of transferring a force amplified by mechanical advantage through a material made of molecules that bond together more strongly, and resist deformation more, than those in the material being crushed do.

Crushing devices hold material between two parallel or tangent solid surfaces, and apply sufficient force to bring the surfaces together to generate enough energy within the material being crushed so that its molecules separate or change alignment in relation to each other. The equipment mainly includes the cutting machine and the crushing machine, whose basic principle is to destroy the material's integrity depend on the shear strength and the impact strength.

II. PROBLEM STATEMENT

From the reference papers and Social Media, we find out the problem that used plastic bottle is very harmful for nature. And for recycling purpose from the various rural places used plastic bottles are to be collected.

Today most of the world's plastic waste still goes to landfill. Plastic waste disposal is one of the cumbersome process which is very less efficient. In most of the functions, parties, events etc. water has been served in bottles of different sizes. These used bottles occupy very large disposal space which usually overflows the dustbins provided at these places and are mostly goes to landfill. Used Plastic bags, pieces of plastic sheets and bottles of diverse sizes, colors and textures are found flying around freely, scattered in the

streets, swimming in the gutters, posing a serious environmental threat.

These keep the environment dirty and cause blockages to our sewer system. Several attempts were made to discourage plastic bags and other plastic products but yield no result due to its versatility in daily use. Nowadays the trucks are overloaded with plastic wastes especially bottles which leads to accidents causing severe casualties.

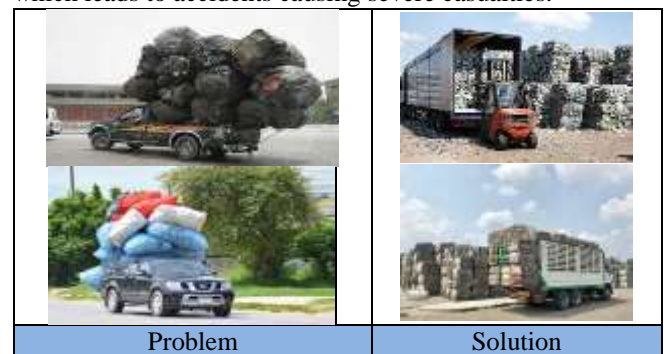


Fig. 2.1: Problem Identification

- 1) For transporting the plastic bottles space is required more in trucks as compared to its weight. i.e. If Vehicle is having capacity to transport 1 tonn of material but bottles required more space. So, it can't be stored in vehicle.
- 2) To reduce the bottles volume the Paper Shredder machine that is to be used, but due to the load and extreme vibrations are generated.
- 3) The normal cutters used, which are able to shred/cut papers into strips can't cut the used plastic bottles.

III. METHODOLOGY

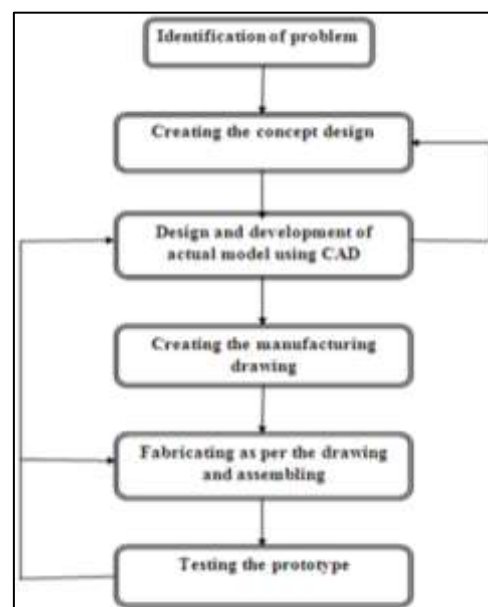


Fig. 3.1: Methodology

- 1) The very basic and important step was to study the basics of the shredder machine. It included the machine element. The main component of a bottle shredder machine is the blade. Thus our more focus is on the study of an appropriate blade design which will serve our purpose.
- 2) Once the blade type is fixed, the second important thing is the machine design. The design was being done in CAD SOLIDWORKS 14. The different components designed along the blade are frame/stand, shaft, washers, gears, pulley etc. Thus the designing phase is briefly classified as the machine construction, cutting system and the transmission system. The main aspect while design is the space occupation. Our main aim is to create a horizontal machine (like a Xerox ones) such that the space occupied will be horizontal in nature.
- 3) Once the CAD Modeling is done the next step is the material selection. The material for the blade and the frame is mild steel. Gears and pulleys are made of cast iron.
- 4) Before starting the actual fabrication, it is necessary to test the blade design, whether it works or not.
- 5) Depending upon the prototype results, the actual manufacturing will start. If there is any error, then the modifications will be done in the existing design.

IV. CONSTRUCTION

As per the material selection and methodology, we have creating the model of crusher machine in CATIA.

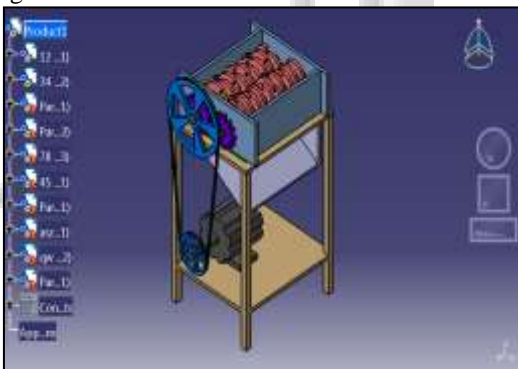


Fig. 4.1: Model of Crusher Machine in CATIA

As per the design and model we have fabricated the actual model.



Fig. 4.2: Fabricated Shredder Machine



Fig. 4.3: Shredder

V. EXPERIMENTATION

In the experimentation we are taking empty used plastic bottles to crush. After crushing the bottles it get into chip formed. Then all chips we are taking into one circular cylinder to measure the final volume of the crushed bottles. The following are the some reading we have taken:

- 1) Firstly we have taken 3 used plastic bottles to crush, and each bottle is having volume 1lit. After crushing the bottle, it filled in to the circular cylinder and measures the final volume of crushed bottles.

Initial Volume = 1 lit. = 1000cm³

Initial Volume = 1000 cm³ × 3 = 3000 cm³

Initial Volume = 3000 cm³

Area of Circular Cylinder = $\pi \times r^2$

Area of Circular Cylinder = $\pi \times 5^2$

Area of Circular Cylinder = 78.54 cm²

Final Volume = Area of Circular Cylinder

× Height of crushed plastic

Final Volume = 78.54 × 6.5

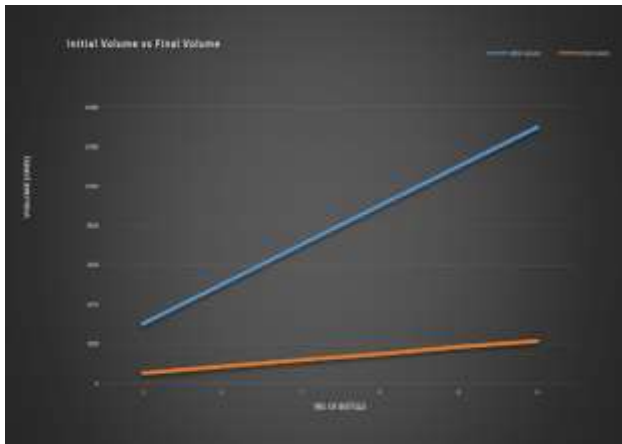
Final Volume = 510.51 cm³

Sr. No.	No. of Bottles	Height of Crushed (cm)	Initial Volume (cm ³)	Final Volume (cm ³)
1	3	6.5	3000	510.51
2	5	10.8	5000	848.23
3	7	15	7000	1178.09
4	9	19	9000	1492.26
5	11	23.5	11000	1845.69
6	13	27.5	13000	2159.85

Table 1:

VI. RESULT

On the basis of experimental data, i.e. Initial Volume and final volume we drawn the graph. From the graph it is seen that by using the Crusher volume of the bottles drastically reduced.



VII. CONCLUSION

If we consider 4th no reading

In this the Initial Volume of Used Plastic Bottle is 9000cm³

And after the crushing final Volume of Used Plastic Bottle is 1492.26cm³

Reduction in Volume = Initial Volume – Final Volume

Reduction in Volume = 9000-1492.26

Reduction in Volume = 7507.74cm³

% of Volume Reduction = $\frac{\text{Reduced Volume}}{\text{Initial Volume}} \times 100$

% of Volume Reduction = $\frac{7507.74}{9000} \times 100$

% of Volume Reduction = 83.42 %

From the above calculation we can conclude that nearly 80% of Volume is reduced by the Plastic Bottle Crusher Machine.

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