Design and Fabrication of Plastic Shredder Machine for Clean Environment

S. VijayAnanth[1], TN. Sureshkumar[2], Dhanasekaran C[3],Aravinth Kumar A[4]

[1,3,4]*Department of Mechanical Engineering, VELS Institute of Science, Technology and Advanced Studies, Chennai, 600117, India*

[2]*Department of Mechanical Engineering, Agni College of Technology, Chennai 603103, India*

*Corresponding Author Mail id: ssvijayananth@gmail.com

ABSTRACT

Plastic shredder is a machine used for cutting the plastic in small pieces to make waste management easier. This project focuses on recycling of plastic wastage in domestic area, industries etc. 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 process the plastic waste as cheap as possible by shredding where it is made for reducing cost of processing and transportation.

Keywords: Plastic Recycling, Shredder Machine, Polymer

1 Introduction

Plastics are synthetic organic materials produced by polymerization. They are typically of high molecular mass, and may contain other substances besides polymers to improve performance and or reduce costs. These polymers can be moulded or extruded into desired shapes. There are two main types of plastics first is “thermoplastics” and other one is “thermosetting” polymers.Thermoplastics can repeatedly soften and melt if enough heat is applied and hardened on cooling, so that they can be made into new plastics products. Examples are polyethylene, polystyrene and polyvinyl chloride, among others.Thermosets or thermosetting can melt and take shape only once. They are not suitable for repeated heat treatments; therefore after they have solidified, they stay solid. Examples are phenol formaldehyde and urea formaldehyde. Prior to their conversion into fuel resources, waste plastics are subject to various methods of pre-treatment to facilitate the smooth and efficient treatment during the subsequent conversion process (1-3). Depending on their structures (e.g. rigid, films, sheets or expanded (foamed) material) the pre-treatment equipment used for each type of plastic (crushing or shredding) is often different. Some of the modification were made in newly developed shredding machine are First generation of shredders: - Most of the first generation of the transmission mechanism is driven by a belt with low noise.Second generation of shredders: - Plastic gear rolls, because it is difficult to master injection and shrinking process accurately of the shredder

machine, resulting in the low accuracy of the gear itself.Third generation shredders: - Metal sprocket: quiet operation, low energy loss, efficient cutting, and the perfect coordination of the various components of the system achieve the compelling features.Fourth generation of shredder machine. The drive mechanism of shredder machine is the metal gear, although the metal gear so overcome the above drawbacks, it is difficult to avoid the impact of the metal gear and friction sound.Fifth generation of shredder:- Diamond snug movement, it takes use of alloy steel materials, quenching process of metal tool, completely CNC machining technology, and the workmanship guarantee transmission installation accuracy.Sixth generation of shredders (modern):- Currently, the high-tech multimedia high series grinder has the high technology content which can be used to broken CD-ROM, floppy disk, tape, video, etc. and the embedded button panel with a protective film ensure the function of the way forward, rewind, stop, and full stop. In the modern world, we pay attention to care for the quality of life (4-7).

2 Design of the Machine

The shredder machine were designed as per the procedure. The power requirements and gear requirement were calculated thorugh the design procedures. (10-11)

T = force (F) x perpendicular distance (r), Nm

$F = (2\pi mNr)/60$, N

$P = (2\pi NT)/60$, W

Where,

T=Torque in Nm

P=Power in Watts

N=Speed of motor in rpm

m=Mass of shaft in Kg

r=Distance of blade end from centre of shaft

Actual readings

The standard specifications of motor are

Voltage = 415 V

Speed of motor = 1415 rpm

Power of motor = 2 hp

Theoretical readings

Assume N_1= 1415 rpm

We know that, N_4= $(N_1 d_1 d_3)/(d_2 d_4)$

= (1415 x 102 x 76)/(254 x 305)

N_4= 142 rpm

From Newton's second law of motion:

F = (m x v) /t

Linear velocity, v = ωx r

Angular velocity, ω = (2πN) /60

From the above formulas, we can find torque,T

T = F x r

We know that, F = (2πmNr)/60

So it becomes, T = (2πmNr^2)/60

= (2πx2x142x0.1x0.1) /60

= 0.297 Nm

Power , P = (2πNT)/60

= (2π x 142 x 0.297) /60

= 4.42 watts

Number of teeth on driving gear = 50

Number of teeth on driven gear = 70

Length of the belt (L1) = [2C + 1.57($d_1 + d_2$)] + $(d_2 - d_1)^2$ /4C

= [2(34.3) + 1.57(10.2+25.4)] + $(25.4 - 10.2)^2$ /4(34.3)

= 127 cm

Length of the belt (L2) = [2C + 1.57($d_3 + d_4$)] + $(d_4 - d_3)^2$ /4C

= [2(47) + 1.57(7.6+30.5)] + $(30.5 - 7.6)^2$ /4(47)

= 158 cm

3 Shredder blade

The shredder blade plays the major role in the plastic shredder machine. There are many types of shredder blades and the one which is used is a three edged blade. The tip of the blades are strengthened by coating it with the help of carbide tool.The blades are arranged in two

shafts, each shaft consisting of a total of nine blades. A space is also provided between each of the blades for the shredded pieces to come down (8,9).

Fig3.1Shredder blade

4 CAD Drawing

Initially the rough drawing and dimensions were drawn. After the drawing the three dimensional model of the shredder machine were drawn in CATIA V5. Each part has been drawn separately and assembled. The figure shown the details of the diagram.

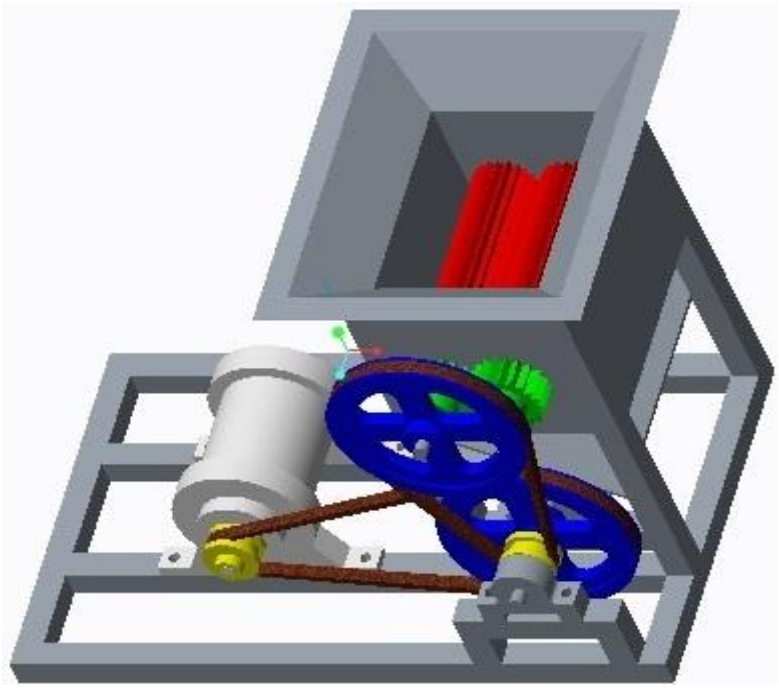

Fig 4.1Isometric view of the Shredder Machine

5 Working

Initially the power supply is supplied to the electric motor by means of an external power source. The motor is controlled by a switch for the forward and reverse rotation of blades.It is done by the controlling of the Double Pole Double Throw switches. The switches are made in such a way to operate in forward as well as in reverse directions of the motor.Now the motor is switched on to the forward rotation and the power is transferred to the smaller pulley by means of the shaft coupled to it. Then the smaller pulley drives the larger pulley which is connected with the belt. Again the larger pulley is coupled with another smaller pulley by means of a pillow block. The smaller pulley is then connected with the larger pulley with the help of the belt.The larger pulley is finally coupled with the main shaft in which the shredder blades are arranged. Gear arrangement is provided in between the larger pulley and the shaft for the opposite rotation of another shaft. Due to the smaller to larger pulley power transformation, the torque produced will be more from the larger pulley shaft than the smaller pulley and also the speed will be reduced for smoother operation.The larger pulley is directly connected to the blade shaft. Due to that it starts to rotate in preferred direction. Now the plastic objects are feeded manually through the hopper at the top. When the plastic objects came into contact with the blades, it started to get crushed and shredded due to the crushing and shear stress acted upon them by the shredder blades.Finally, the shredded pieces of plastics will come down below the blades

and it is collected in the collecting basket. The plastic which is larger in volume before the shredding process is now reduced to very small pieces.The main objective behind the plastic shredder is to reduce the volume acquired by the plastic waste during loading it to the recycling process.

Fig 5.1 Fabricated Shredder Machine

6 Conclusion

The plastic shredding machine is widely used in industries for the plastic waste management. By using this plastic shredding machine the overall costing of recycling process get reduced. It require less labour work and there is no requirement of skilled labour in industry. In recycling process of plastic waste required low energy due to compact form of plastic waste. It reduces the process time in industry. The use of machinery is critical for business that is why this machine was elaborated in order to have more efficient performance for the company and that plastic garbage cheaper and more effective at the time of operation. If the machine is well maintained, its durability is guaranteed and its maintenance cost is also lower when compared with existing machineries.

7 References

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