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Design and Fabrication of Plastic Shredder Machine

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Abstract: *Plastic have been mostly used in food packaging and water bottling due to low bulk density and inertness property. This paper discuss plastic waste management scheme anddesign and fabrication of plastic shredder machine. In this project we give the working mechanism of plastic bottle cutting machine and mechanism used in machine. Plastic are chipper and lightweight flexible material which can be easily moulded variety of product with wide range. Crushing is a process in which waste is converted into 1 -1.5 CM size. So, our intension behind this project is to reduce the cost of transportation of plastic. This machine is more beneficial in reducing labour work or labour cost.*

Keywords: *Plastic waste, shredder machine.*

I. Introduction

One of the most difficult problem found in developing countries is solid waste management. Recycling is an complicate method of environment protection, which purpose is the limitation of the raw materials consumption and decrement of waste quantity. Plastics are inexpensive, lightweight and durable materials, which can easily moulded into a variety of products that find use in wide range of applications. As outcome the production of plastic has increased over the last 30 years, usage and disposal generator several environmental problems.

This plastic shredder machine is used for cutting and shredding plastic in small pieces to make waste management easier. We are making this project model for recycling of plastic wastage is domestic area, industries etc.

II. Parts Description

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, gears and pulley are mounted on it. Circular shaft is used with one has a circular cross section for cutting system. Material is used for shaft is mild steel.

Cutting system

Cutting system is consists of the shafts, cutting blades, washers and gears. Material used for cutting blade is mild steel.

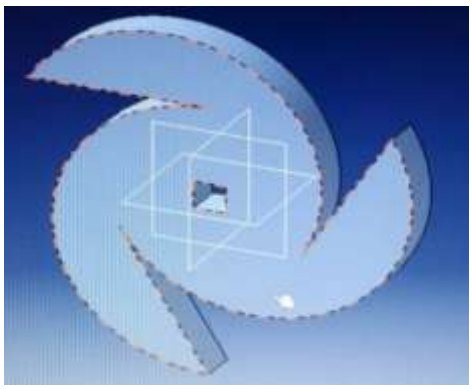

Fig. cutting blade

Spur gear

A gear is a rotating machine part having cut teeth which mesh with another toothed part to transmit torque. A geared device gives different desired speed, torque, and direction of a power source. The teeth on two meshing gears all have the same shape. Material is used for spur gear is mild steel. spur gear designed and manufactured which have equal number of teeth and diameter of gear. One set of gears are used which has two spur gears.

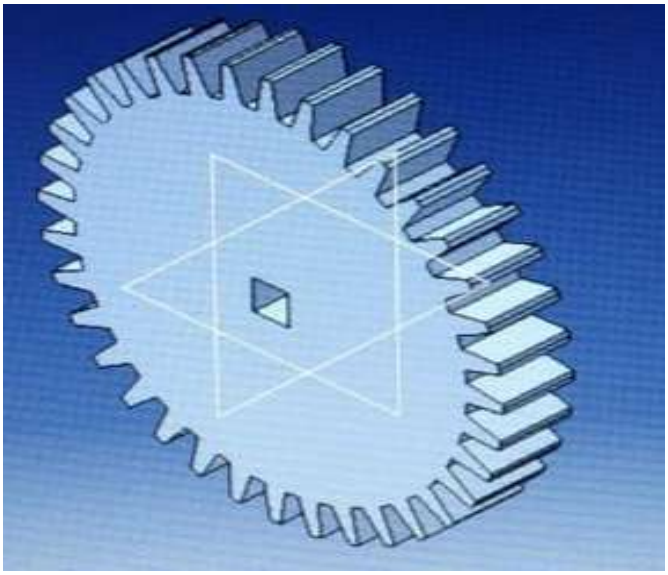

Fig. spur gear

Pulley and Belt

V-belt pulleys are devices that transmit power between axles by the use of a v-belt, a mechanical linkage with a trapezoidal cross-section. V-belt pulleys are solely used for transmitting power between two parallel axels. The v-belt and its complementing pulley create the most efficient belt drive known transmission. Material is used for pulley and belt respectively mild steel and rubber. Large pulley diameter (D) =20.32 cm, Small pulley diameter (d) =7.62cm and distance between two pulleys=47.5cm sufficient to get power requirement by gearbox from motor.

Fig. pulley

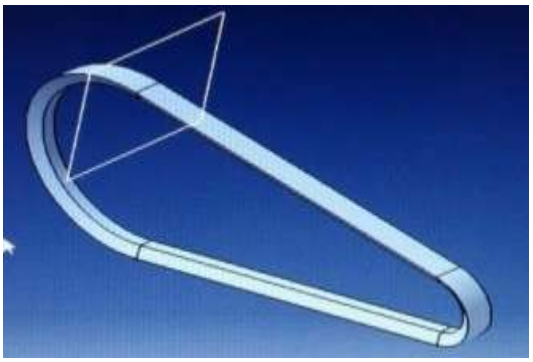

Fig. V- belt

III. Working Principle

Now the motor is switched on 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. 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 blade. 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.

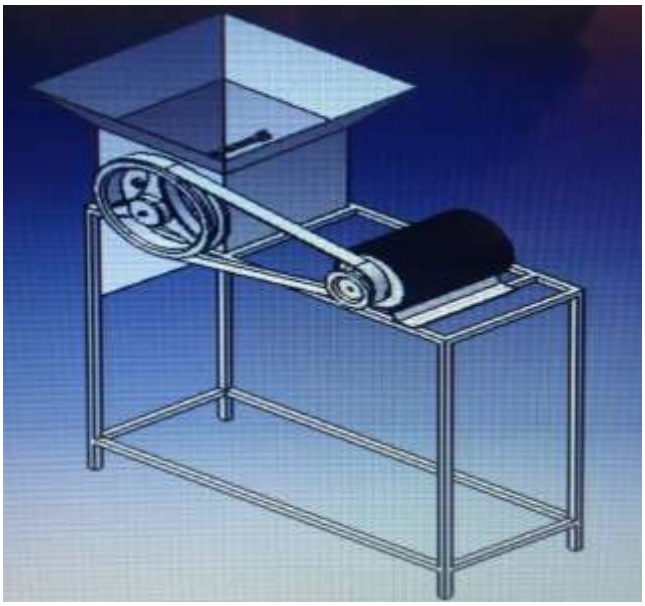

Fig. fabrication of machine

IV. Detail Of Design

1. Total Power Requirement

Weight of plastic material need to filling up in the machine hopper is given by;

$W_p = V_h \rho_p g$

Where, W_p= Weight of plastic materials in Newton.
V_h= Volume of the hopper chamber.
ρ_p= Density of plastic material. (970/kgm^3)

2. Volume Of The Hopper

Total volume required is the difference of the volume of larger pyramid and the volume of smaller pyramid.

$V_h = \frac{LHW}{3} - \frac{lhw}{3}$

Where,

L and l= Base length of larger and smaller pyramid resp.

W and w = Base width of larger and smaller pyramid resp.

H and h= Height of larger and smaller pyramid resp.

According to the principle of similar triangle

Hence, the required volume of the hopper is;

$$\mathbf{V_h = \frac{0.47 \times 0.42 \times 0.2}{3} - \frac{0.265 \times 0.28 \times 0.127}{3}}$$

$$\mathbf{= 0.01\ m^3}$$

But, Weight of plastic material need to filling up in the machine hopper is

$W_p = V_h \rho_p g$

$$\mathbf{W_P = V_h \times 970 \times 9.81 = 95.157N}$$

3. Length Of V- Belt Drive

$L = \pi (r_2 + r_1) + 2x + \frac{(r_2 - r_1)^2}{x}$

Where,

$r_1$and r_2 = Radius of bigger and smaller pulley.

x= The distance between the center of two pulleys.

d_1= Diameter of the larger pulley (0.2032m)

d_2 = Diameter of the smaller pulley (0.0762m) r_1= 0.1016m

r_2=0.0381m

x=0.47m

$$\mathbf{L = \pi (r_2 + r_1) + 2x + \frac{(r_2 - r_1)^2}{x}}$$

L=1.28m

4. Velocity Ratio of V-Belt Drive

$$\frac{N2}{N1} = \frac{d1}{d2}$$

Where,

d_1= Diameter of the larger pulley (0.2032m)

N_1 = Speed of the driver (motor) in rpm (1440rpm)

N_2 = Speed of the driven in rpm

$$\frac{N2}{1440} = \frac{0.2032}{0.0762}$$

N_2=540 rpm

5. Velocity of the Belt (V)

$$\mathbf{V = \frac{\pi d1 \times N1}{60}}$$

$$= \frac{\pi \times 0.2032 \times 1440}{60}$$

= 15 m/s

where, d_1 = Diameter of the larger pulley

N_1 = Speed of the larger pulley in rpm

V. Conclusion

This machine is designed and fabricated, to developed a new window towards the scientific management of the scientific management of the domestic plastic waste. The innovative machine is cost

effective to produce high output of plastic granules. The price of the machine can be low, when produced commercially. This will make the machine viable for a common man and thus enabling the process of zero waste generation.

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