



Design and Fabrication of Plastic Bottle Crushing Machine

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Abstract- High urbanization rates and changes in the life styles and steady rise in living standards have resulted in the increase of solid waste both in type and volume. The rapid growth of spring water industry, trade and services has accelerated the generation of plastic bottles. Now a days the plastic is one of the most used material in world wide. The advantage of using plastics produced from polyethylene terephthalate (PETs) include bottles in packaging water, soft drinks, soda etc. However, they are non-biodegradable and can stay unchanged for as long as 4500years on earth causing menace to our lands, streams and drainage systems. Plastic waste accounts for more than serious of the municipal solid waste stream in our country. The problem of plastic waste is not only limited to India rather it is a worldwide phenomenon. The world's annual consumption of plastic materials has increased from around 5 million tons in the 1950's to more than 100 million tons; thus, twenty (20) times more plastic is produced today than in the past fifty (50) years ago. This simply means that more resources are being used to meet the increased demand for plastic, thus, more plastic waste is being generated.

Keywords— Plastic bottle, Plastic bottle recycling, Crusher machine, slider crank mechanism, crusher design.

I. INTRODUCTION

Waste (or wastes) are unwanted or unusable materials. Waste is any substance that is discarded after primary use or is worthless, defective, and of no use. A by-product, by contrast, is a joint product of relatively minor economic value. A waste product may become a by-product, joint product, or resource through an invention that raises a waste product's value above zero. Examples include plastics, municipal solid waste (household trash/refuse), hazardous waste, wastewater (such as sewage, which contains bodily wastes (feces and urine) and surface runoff), radioactive waste, and others. But in this survey, we consider details about plastic. The development of plastics has evolved from the use of natural plastic materials (e.g., chewing gum, shellac) to the use of chemically modified, natural materials (e.g., natural rubber, nitrocellulose, collagen) and finally to completely synthetic molecules (e.g., Bakelite, epoxy, polyvinyl chloride). Early plastics were bio-derived materials such as egg and blood proteins, which are organic polymers. In around 1600 BC, Mesoamericans used natural rubber for balls, bands, and figurines. Treated cattle horns were used as windows for lanterns in the middle Ages. Materials that mimicked the properties of horns were developed by treating milk-proteins (casein) with lye.

In the nineteenth century, as industrial chemistry developed during the Industrial Revolution, many materials were reported. The development of plastics also accelerated with Charles Goodyear's discovery of vulcanization to thermoset materials derive.

II. MOTIVATION

The motivation of the project is very high in small scale businesses, industries and everywhere where plastic waste is generated at large scale due to its low cost, low maintenance, low space requirement and easy access. It can also be applied in housekeeping techniques. The crushing of used water bottles will also ensure that the bottles are no used beyond the shelf life of its plastic. The crusher will help in managing the plastic waste as well as it will reduce the overall volume of plastic waste generated so that landfills and dump yards will not overflow. This will result in lower impacts on environment and public health indirectly.

III. METHODOLOGY

Step 1: - We started the work of this project with literature survey. We gathered many research papers which are relevant to this topic. After going through these papers, we learnt about Water Bottle Crusher Machine.

Step 2: - After that the components which are required for our project are decided and creating the manufacturing drawing.

Step 3: - After deciding the components, design and development of actual model using solid works software.

Step 4: - The components will be manufactured and then assembled together.

Step 5: - The testing will be carried out and then the result and conclusion will be drawn.

IV. CALCULATIONS

Motor Calculations for Power (P_m):

$$P_m = V \cdot I$$

$$P_m = 48 \text{ watt}$$

Power Transmitted By Crank (P_c):

$$P_c = [2\pi NT] / 60$$

$$P_c = 5.65 \text{ watt}$$

Final angle velocity = $(2\pi \cdot 30) / 60$

$$= 30 \text{ rad/s}$$

Output power = 41.76 watt

$$T = 41.76 / 3$$

$$= 13.92 \text{ Nm}$$

$$T = F \cdot R$$

$$= 15.46$$

So, Average force required will be 16N. Safety load to crush will be 20N.

Ball Bearing:

$$P = X V F_r + Y F_a \quad \dots \dots (f_a = 0)$$

$$P = 1.2 \cdot 1 \cdot F_r$$

Where, $X=1.2$ i.e. for rotation of shaft

$V = 1$ i.e. roller bearing

Therefore, $F_r = 1.2 \cdot 20$

$$= 24 \text{ N}$$

Shaft:

$$F_{\text{shaft}} = F_r + F_t + F_a$$

$$= 20\text{N} + 20 \text{ N}$$

Resultant load will be maximum when loads are equal and the sum is 20N.

Therefore, $F_r = 10$, $F_t = 10$

$$\text{Resultant load} = \sqrt{10^2 + 10^2}$$

$$= 14.14 \text{ N}$$

V. EXPERIMENTAL SETUP



Figure 1. Experimental Setup

VI. MAIN COMPONENTS

1. Horizontal Linear Bearing Slider

A linear motion bearing or linear slide is a bearing designed to provide free motion in one direction. Linear bearings are used in machine tool applications such as sliding doors, sliders, 3d printers, automation settings where reducing friction and guiding linear motion is needed.



Figure 2: Horizontal Linear Bearing Slider

2. Infrared Sensor

An infrared sensor is an electronic instrument that is used to sense certain characteristics of its surroundings. It does this by either emitting or detecting infrared radiation. Infrared sensors are also capable of measuring the heat being emitted by an object and detecting motion.



Figure 3: Sensor

3. Motor:

1. Name: Planetary Geared Motor

2. Speed: 30 rpm

3. Power: 48 W

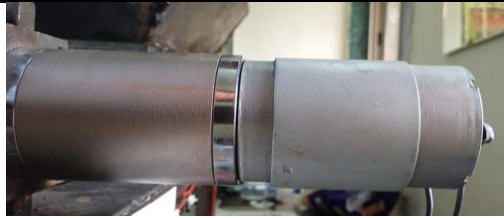


Figure 4: Motor

3. Hopper:

- 1 .Orientation: Horizontal
- 2 .Manufacturing Process: Laser Cutting
- 3 .Material: Mild Steel
- 4 .Weld Type: Electric Arc Welding

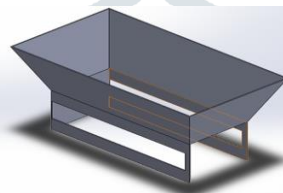


Figure 5: Hopper

4. Frame:

1. Frame is the base of system on which overall assembly is done and system is placed for working.
2. It is made up of mild steel.

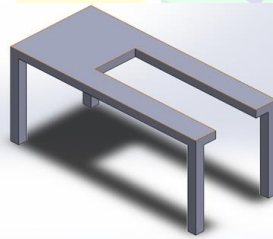


Figure 6: Frame

5. Electronic Circuit:

1. AC to DC Converter: Converts Alternating current into direct current using transformer.
2. PCB: Printed Circuit Board for mounting electronic components.
3. Arduino Nano: Programmed Microcontroller of sensor and motor.



Figure 7: Circuit

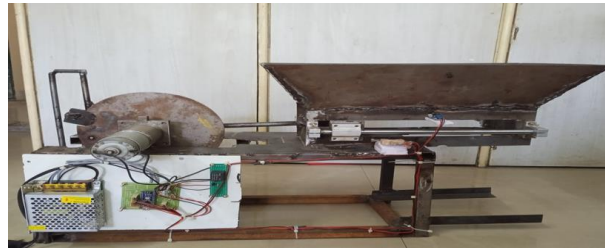


Figure 8. Experimentale Setup

VIII. CONCLUSION

We can conclude that plastic is crushed with the help of a plastic crushing machine hence we also design and manufacture plastic crushing machines. Plastic is an essential part of our day-to-day life. But there is a big disadvantage of plastic, it is difficult to decompose. So, we have to recycle plastic and there are various methods for plastic recycling. We selected one method for plastic recycling and we will make a machine which is used for plastic recycling. We studied how to design the machine from the literature review and we got many technical details about this machine this is very helpful to us. The crusher machine crushed the plastics as per our requirement. This project also helps in protecting the environment as it crushes the plastic wastes. The crushed plastics which come out can also be used for recycling.

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