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Case Study and Development of Plastic Shredding Machine

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Abstract - *In last few decades there is a very large increase in the use of plastic. The Plastic is a substance which is harmful to the environment. So this plastic can be recycled by the plastic shredder machine. Plastic shredder machine and analysis of mechanism used in machine. Plastic shredder may be a machine used for cutting the plastic in small pieces to form waste management easier. We are making this project model for plastic shredder machine. In these areas the plastic waste is present in great quantity, but the available machines wont to recycle this waste are very costly. They packs this waste and provides 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 shredding where it's made for reducing cost of processing and transportation. Benefit of this machine is the reduction of labor work which results in cost reduction.*

Key Words: Plastic, Decompose, Shredding Machine, Waste Management

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. 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.

2. LITERATURE SURVEY

This paper focuses on the available machines used to recycle waste are very costly They pack this waste and give them to the local processing unitSustainable waste management of post-recycling municipal solid wastes (MSW) is an important component in the 'green' movement toward a cleaner, environmentally-conscious society. Waste-to-Energy (WTE) power plants have potential to significantly reduce the amount of land filled refuse while producing a carbon neutral form of heat and power. Chemical rate and heat transfer theories indicate that the productivity of a moving grate WTE boiler should be enhanced by means of pre-shredding the MSW, thus reducing the average particle size, homogenizing the feed, and increasing its bulk density by an estimated 30%. Smaller particle sizes enhance reaction kinetics and flame propagation speed, due to the higher surface to volume ratio, and thus lower the amount of combustion air needed to meet the required combustion rates.

Table-1: Stress– Strain properties of some MSW components

Material	Type of container	Ultimate strength (psi)	Ultimate strain (in. /in.)	Rupture energy (ft.-lb./ in^3)
Steel	12 oz. Can, beverage	82000	0.005	9.4
Aluminum	12 oz. Can, beverage	31000	0.012	26.5
Cardboard	Box, laundry detergent	6400	0.025	8.3
Paper	Bag, brown paper	4000	0.025	5.1
Plastic, PVC	Bottle, liquid soap	4000-5000	0.36-0.06	111-19
Plastic, PE	Bottle, shampoo	1000	0.8-0.9	56-66

Above table demonstrates well the variance in strength and ductility of common materials comprising municipal solid wastes (MSW). Due to this composition variance the brute force method of size reduction can lead to undesired imbalances in the size reduction of different materials.

Table-2: Part list and material of machine

Sr. No.	Part Name	Material Quantity
1	Hopper Mild steel	1
2	Electric motor	1
3	Pulley Cast Iron	4
4	Belt Leather	2
5	Gear N8 steel	2
6	Bearing Stainless steel	6
7	Shaft Mild steel	3
8	Strips N8 Steel	10
9	Casing Mild steel	1
10	Blades N8 Steel	10
11	Frames Mild Steel	1

3. DESIGN CONSIDERATION

While designing this plastic shredding machine, some assumptions are considered which is standard for their parts. We made safe design for this machine by calculating the dimensions of each parts and considering formulations. Material selection based on availability, durability, cost and ease of fabrication were also considered.

Shredding process is to reduce size of the plastic wastes into the small size. The plastic wastes are collected from the different kind of places. These are particularly sorted based on the thickness and the types of plastics. This separation is achieved by the use some grades of plastics. Once these processes are completed the plastic wastes are cutter into small scraps (i.e shred) by manually.

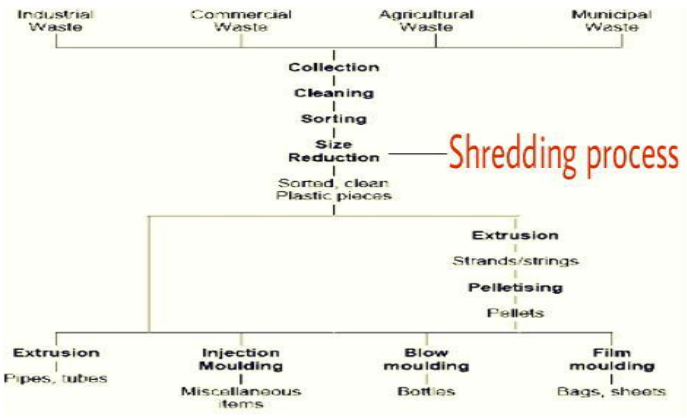

Fig -1: Working flow chart

DESIGN CALCULATION

DESIGN OF SHAFT

The material choosen for shaft is C40 STEEL having Shear stress Design Based on Strength against static load Shear strength , ()=65N/mm2 Shaft length between of two edge=30mm Torsional Moment,

(Mt) = (π/16)×l3×()=344593.4Nm

DESIN OF MOTOR

The rpm of the motor is 2800 rpm. But the machine was designed based on the load conditions 70rpm is in ought to withstand the load from the above details we find the rpm of the motor 344593.4=P×60/(2πN) N=55.4~70rpm

DESIGN OF SIEVE

Length of the sieve=180mm
Breadth of the sieve=149mm
Radius of the curve, r=70mm
Diameter of the shape holes=4mm
Area of the sieve, A=(l×b)+(πr2/2)-[(πd2/4)×30]
A=180×149+(π×702/2)-[(π×42/4)×30]
=3414.9 mm .

Table-3: Design of plastic shredder machine

Machine type		Single shaft shredder
Cutting zone	approx. mm	150*150
Knife-length	Mm	127
Dimensions	LxWxH mm	180*180
Weight	Kg	450
Shaft [length]	Mm	508
Bearing	Model serial No.	6207ZZ

4. STRENGTH OF PLASTIC MATERIAL

Specimen: - Bisleri bottle

EPET in its natural state is a colour less, semi crystalline resin. Based on how it is processed, PET can be semi rigid to rigid, and it is very lightweight.

Specification:

IUPAC name: - Poly(ethyl benzene1,4dicarboxylate)
Abbreviations: - PET, PETE
Chemical formula: - (C10H8O4)n
Density: - 1.38 g/cm3 (20 °C)
Amorphous: - 1.370 g/cm3, Single
crystal: - 1.455 g/cm3
Young's modulus (E):- 2800–3100MPa
Tensile strength (σt):-55–75 MPa

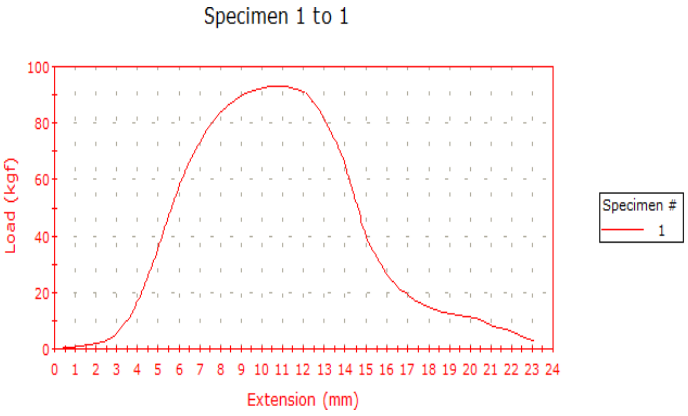

Fig -2: Graph extension Vs. load 1 to 1

Table-4: specification of specimen I

	Maximum Load (kgf)	Extension at Maximum Load (mm)	Tensile strain at Maximum Load (%)
1	93.08	11.15	22.30
Mean	93.08	11.15	22.30
Standard Deviation	-----	-----	-----
Coefficient of Variation	-----	-----	-----

Specimen: - saline bottle

Polyvinyl chloride, more correctly but unusually poly(vinyl chloride), commonly abbreviated PVC, is the third most widely produced synthetic plastic polymer, after polyethylene and polypropylene.

Specification:

IUPAC name: - poly(1chloroethylene)
Abbreviations: - PVC
Chemical formula: - (C2H3Cl)n
Elongation at break:- 20–40%
Density [g/cm3]:- 1.1–1.35
Thermal conductivity [W/(m·K)]:- 28 0.14–0.17
Yield strength [psi]:- 1450–3600
Young's modulus [psi]:- 490,000
Flexural strength (yield) [psi]:- 10,500
Compression strength [psi]:- 9500

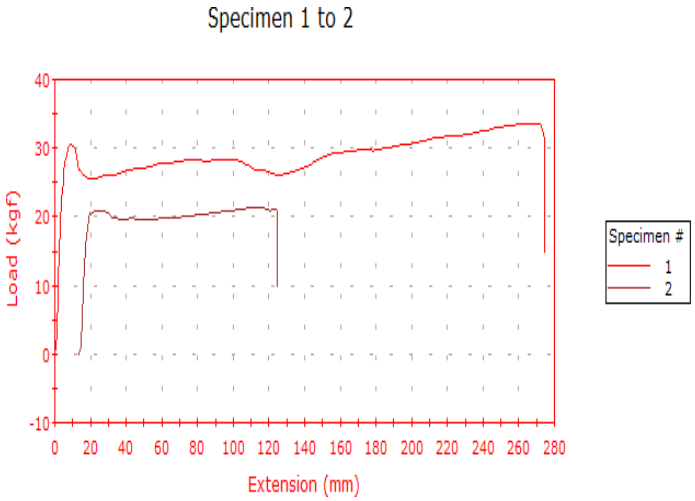

Fig -3: Graph extension Vs. load 1 to 2

Table-5: specification of specimen II

	Maximum Load (kgf)	Extension at Maximum Load (mm)	Tensile strain at Maximum Load (%)
1	33.60	270.38	540.77
2	21.36	100.02	200.03
Mean	27.48	185.20	370.40
Standard Deviation	8.66	120.47	240.93
Coefficient of Variation	31.51	65.05	65.05

5. CONCLUSIONS

The plastic shredding machine is widely utilized in industries for the plastic waste management. By using this plastic shredding machine the general costing of recycling process get reduced.it require less labor work and there's no requirement skilled labor in industry.

In recycling process of plastic waste required low energy thanks to compact sort of plastic waste it reduces the process time in industry. Since the start of a project can realize the importance of plastic shredder for what they serve, realize that the work can get done faster and more efficient when plastics are crushed. The use of machinery is critical for business that's why this machine was elaborated so as to possess more efficient performance for the corporate which plastic garbage cheaper and more effective at the time of operation.

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