EFFECT & ENERGY OF RECYCLING MECHANICAL PARAMETERS
WASTE PLASTIC AND GLASS TO PRODUCE USABLE COMPOSITES

Deepak Dabhade
M.E (Mechanical Engineering), APCOER College, Parvti. Pune, India
deepakvdabhade@gmail.com

K.E.Kondhalkar
Department of Mechanical Engineering, APCOER College. Pune, India
----@gmail.com

ABSTRACT:
this research work is aimed at solving the problems of plastic wastes management in developing countries. In this study, we designed and constructed a plastic shredding machine. The machine consists of the following main components; hopper assembly, shredding chamber, drive shaft, frame, V-belts, and an electric motor. Although the form of the plastics was vastly different to their equivalent when it comes to mass recycling over large sizes, the energy difference highlights the potential environmental benefit of utilizing re-cyclates plastics where it can be pointed out that shredding machine is a feasible operation for recycling purposes. The results obtained show that the machine has a hopper capacity of 0.0725m3, centrifugal tension of 36.17 N, maximum tension of 733.83.5N, shredding force of 500N, shaft diameter of 40mm, shearing stress of 42MPa, and torque of 477.21Nm. This information is vital in selecting conditions for running recycling processes and in assessing the potential market for the generated re-cyclate where it is never thrown away causing irreparable damages to the environment.

Keywords— recycling; plastic; polyethylene; waste; cement; disposal, composites; recycling; mechanical recycling, Resource Modeling, Energy Demand , Granulator Mechanical Recycling.

1. INTRODUCTION
Humans have always produced trash and disposed of it in some way so solid waste management is not a new issue. What have changed are the types and amounts of waste produced, the methods of disposal, and the human values and perceptions of what should be done with it. The applications of plastic materials and their composites are still growing rapidly due to their low cost and ease of manufacture. Therefore, high amount of waste plastic being accumulated which create big challenges for their disposal.

Municipal solid waste (MSW) generation in developing countries is a major concern to government, institution and the society at large; this solid waste is worrisome especially with an increasing population pressure and socio-economic factors i. Solid wastes are the unusable and undesirable products in solid state, discarded by members of the society. Generally, solid wastes can be classified on the basis of their source as: Municipal Solid Waste, Industrial Solid Waste and Agricultural Solid Waste. Most cities in India spend 20-50% of their
environmental budget on solid waste management and only 20-80% of the waste is collected. Furthermore, the standard of solid waste management in India is at its lowest with poor documentation of waste generation rates, inefficient storage and collection system, and the under-utilization of disposal sites. India’s urban cities are today struggling to clear heaps of solid waste from its environment. Strategic centers of desirability in India are now taken over by the shambolic nature of unattended tons of solid waste emanating from the society. City officials appear unable to combat unlawful dumping of solid household and industrial waste, which is a clear defilement of the clean Air and Health Edicts in our environmental sanitation laws and regulations in India.

Plastic waste is a constituent of the solid waste stream of which polyethylene terephthalate (PET) is a part. PET is used to produce plastic & Glass bottles and several other plastic products. Most bottles produced from PETs are transparent in nature and used for packaging water, soda etc. They are non-biodegradable and can stay unchanged for as long as 4500 years on earth causing menace to our lands, streams and drainage systems. Plastic waste accounts for more than 20% of the municipal solid waste stream in India. 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 have 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. The continuous increase in hot weather as a result of global warming coupled with the lack of accessible safe drinking water in both rural and urban areas of India’s growing population drives constant demand for bottled water. Although some areas do have public water systems available but distribution channels are not trusted to provide safe drinking water. Many Indians own private boreholes but the purification system is often poor.

In terms of recycling there is an economic incentive to recover high value carbon fibres. However the bigger waste problem in terms of volume is with plastic wastes. These conflicting incentives pose a difficult challenge for research and industry alike in the development of recycling technology. Legislation on disposal to landfill such as the Waste Landfill Directive (1999), combined with industry specific legislation which affects composites such as the End of Life Vehicle Directive (2000) and the Directive on Waste Electrical and Electronic Equipment (2002) have highlighted the need to develop resource efficient recycling technologies for composite materials. The lack of industrial scale composite recycling needs to be addressed by the industry, both to comply with legislation and become an acceptable waste management solution for the increasing accumulation of waste (both production and end of life). This is a global issue. Recycling technologies, as well as being technologically capable and environmentally beneficial, must be capable of high-throughput. A shredding machine is designed to reduce large solid material objects into a smaller volume, or smaller pieces. Shredding machines are usually used to reduce the size and shape of materials so they can be efficiently used for the purpose intended to. Shredding just like crushing can be defined as 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. The shredding materials must possess a better strength and toughness than the plastic materials.

Plastic recycling is the process of recovering scrap or waste plastic and reprocessing the material into useful products. Since the majority of plastic is non-biodegradable, recycling is a part of global efforts to reduce plastic in the waste stream, especially the approximately 8 million metric tonnes of waste plastic that enters the Earth's ocean every year.

Compared with lucrative recycling of metal, similar to the low value of glass recycling, plastic polymers recycling is often more challenging because of low density and low value. There are also numerous technical hurdles to overcome when recycling plastic. Materials recovery facilities are responsible for sorting and processing plastics. As of 2019, due to limitations in their economic viability, these facilities have struggled to make a meaningful contribution to the plastic supply chain.

When different types of plastics are melted together, they tend to phase-separate, like oil and water, and set in these layers. The phase boundaries cause structural weakness in the resulting material, meaning that polymer blends are useful in only limited applications. There are two most widely manufactured plastics, polypropylene and polyethylene, behave this way, which limits their utility for recycling. Each time plastic is recycled, additional virgin materials must be added to help improve the integrity of the material. So, even recycled plastic has new plastic material added in. The same piece of plastic can only be recycled about 2 – 3 times before its quality decreases to the point where it can no longer be used.

The use of biodegradable plastics or plastics which can be organically recycled or can be composted in industrial composting is increasing for certain short-lived packaging applications.

The percentage of plastic that can be fully recycled, rather than down-cycled or go to waste can be increased when manufacturers of packaged goods minimize mixing of packaging materials and eliminate contaminants. The Association of Plastics Recyclers has issued a "Design Guide for Recyclability".
The aim of this work was to develop and validate on an industrial scale a model for calculating the specific energy demand for milling as a recycling option for waste. Most Life Cycle Assessment (LCA) software does not have relevant data for recycling of composites. LCAs are important for assessing the environmental impact (and potential benefits) of utilising re-cyclates, and demonstration of these potential benefits is essential if re-cyclates are to be incorporated into new products as opposed to going to landfill. This stated that the quality of any environmental assessment is strongly dependent on data quality and availability. This highlights the need for accurate resource models. A mechanical process (milling) was chosen as there is machinery on the market capable of processing waste on an industrial scale. As other recycling technologies (pyrolysis, fluidised bed, chemical processes etc.) are developed from pilot plant to industrial scale, resource models for them should also be developed so that the appropriate environmental analyses (typically LCA) can be carried out. Raising the integrity of environmental data is important and critical for supporting sound sustainability decisions.

### 1.1 BACKGROUND

Waste is now a global problem, and one that must be addressed in order to solve the world's resource and energy challenges. Everything we consume becomes waste including plastic bottles. Plastic is most commonly used material in the world today. They come in five major categories, the Polyethylene terephthalate (PET), High density polyethylene, Polyethylene (HDPE), the polyvinylchloride (PVC), the polypropylene (PP), Low density polyethylene. The disposal of waste plastics (PET, PP, etc.) is a biggest challenge, as repeated recycling of PET bottles poses a potential danger of being transformed to a carcinogenic material and only a small proportion of PET bottles are being recycled.

Plastic 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 cost. These polymers can be molded or extruded into desired shapes.

Plastic & Glass bottles are made from a petroleum product known as polyethylene terephthalate (PET), and they require huge amounts of fossil fuels to both make and transport them. It's harder to recycle plastic & Glass bottles than you think. Some plastic bottles consumed throughout the world, most of them are not recycled because only certain types of plastic bottles can be recycled by certain municipalities. They either end up lying stagnant in landfills, leaching dangerous chemicals into the ground, or they infiltrate our streets as litter. There is a big disadvantage of plastic that is difficult to decompose.

So we have to recycle the plastic and there are various methods for plastic recycling. As well as the scrap collectors also avoid to taking the plastic bottles because of its high volume and less weight. Machinery available is costly, so overcome this problem it is need to develop a low cost cutting machine. The project is about development of plastic bottle cutting machine which would help to the scrap collectors to crush the used plastic bottles and would thereby help in waste management and disposal the transportation cost also reduces. A cutting machine is designed to reduce large volume into smaller pieces.

Cutting is a 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. The equipment mainly consist a cutter, whose basic principle is to destroy the plastic bottle depend on the shear and impact strength.

Plastic usage superseded all other product for its properties and characteristics, including aluminum and glass, for that a 5% increase in the global production of plastics has been observed in that last 20years reaching over 300 million tons annually , and are over whelming used in all commodities from wrapping food to making must have consumer product . A can crusher can be used to crush aluminum and plastic can for having easier storage option in the recycle bins they gives you extra space by flattening single or multi cans. This machine can decrease the volume of the empty cans for ease of storage and disposal. Cold drinks and other beverages are also packed in plastic cans.

Commercial establishment like cafeterias and bars, have to deal with these empty or leftover cans. Storage is often a problem as these can consume too much space, thereby increasing the total volume of the trash. This entire storage problem can be conveniently avoided by using can crusher. As crushed can occupy less space, you can easily keep more cans in a bag once they are properly crushed.

The shredding process which is the type of cutting down the scrap by running the blade at a fixed speed which is being run by the motor which is coupled with the reduction motor. But it is hard to cut down the plastic directly by the shredder blades with small serrated edges. Time of invention of the shredding process of scrap such as plastics being processed by some treatment to bring down the strength of the plastic to the level of being cut-down is easily.

There following are the processes carried out before shredding process: Incineration, Autoclaving, and Shredding. But the process of incineration and autoclaving reduces the quality of the product that is to be shredded. In order to reduce the variation in quality during the shredding process, the serrated edges made with increased surface area and hard tool steel. The thickness of the blade
is not more than 5mm. Thus, the shredded pieces that are obtained after shredding are less than or equal to 5mm thickness. Since these pieces are equal to or less than 5mm in size, there is no need to treat the products with heat, which do not reduce the quality of the material. Thus, these pieces can be directly fed into the injection moulding machine. This doesn’t use high temperature on the products, which result in a good quality product after the moulding process. This process enables to use the recycled product many times than before since the grade doesn’t very much.

1.2 RELATED WORK

Raghatate Atul has done research on “Use of plastic in a concrete to improve its properties”. Plastic bags which are commonly used for packing, carrying vegetables, meat etc. It creates a serious environmental problem. Plastic bag last in environment up to 1000 years because of plastic bag last so long the number of plastic bag accumulated increases each year. Disposal of large quantity of plastic bag may cause pollution of land, water bodies and air. The proposed concrete which is made up by adding plastic in concrete may help to reuse the plastic bag as one of the constituent’s material of concrete, to improve the certain properties of concrete. The properties of concrete containing varying percentages of plastic were tested for compressive strength and Split tensile strength and shows that an appreciable improvement in tensile strength of concrete can be achieved by introducing cut pieces of plastic bags. He concluded based on the Experimental result following points are summarized with regard to effect of plastic on the properties of concrete

- Compressive strength of concrete is affected by addition of plastic pieces and it goes on decreasing as the percentage of plastic increases addition of 1 % of plastic in concrete causes about 20% reduction in strength after 28 days curing.

- The splitting tensile strength observation shows the improvement of tensile strength of concrete. Up to 0.8 % of plastic improvement of strength recorded after that addition of strength of concrete decreases with addition of plastic.

- Thus it is conclude that the use plastic can be possible to increase the tensile strength of concrete.

- From the above discussion it is identified that the use of plastic can be possible to improve the properties of concrete which can act as a one of the plastic disposal method.

Ibrahim Asii has done research on “Use of selected waste materials in concrete mixes”. A modern lifestyle, alongside the advancement of technology has led to an increase in the amount and type of waste being generated, leading to a waste disposal crisis. This study tackles the problem of the waste that is generated from construction fields, such as demolished concrete, glass, and plastic. In order to dispose of or at least reduce the accumulation of certain kinds of waste, it has been suggested to reuse some of these waste materials to substitute a percentage of the primary materials used in the ordinary Portland cement concrete.

The waste materials considered to be recycled in this study consist of glass, plastics, and demolished concrete. Such recycling not only helps conserve natural resources, but also helps solve a growing waste disposal crisis.

Ground plastics and glass were used to replace up to 20% of fine aggregates in concrete mixes, while crushed concrete was used to replace up to 20% of coarse aggregates. To evaluate these replacements on the properties of the OPC mixes, a number of laboratory tests were carried out. These tests included workability, unit weight, compressive strength, flexural strength, and indirect tensile strength (splitting). The main findings of this investigation revealed that the three types of waste materials could be reused successfully as partial substitutes for sand or coarse aggregates in concrete mixes. The researchers concluded that the tests carried out in this study were primarily designed to provide an indication of relative advantages and disadvantages of the use of a number of construction wastes, such as crushed concrete waste, plastics, and glass. This would provide an overview of the reuse of construction waste materials in the construction industry. Based on the test results and on the physical observations, the following conclusions can be drawn:

1. Waste and recycling management plans should be developed for any construction project prior to the start of work in order to sustain environmental, economic, and social development principles.

2. The increase of the surface area of the recycled crushed concrete, due to its irregular shape, necessitates an increase of cement and water; hence the irregular shape negatively affects the workability of the said mix.

3. A comparison between the cost of crushing glass, plastic, and concrete with that of supplying prime aggregates (gravel) should be considered in the project management plans, taking into consideration the availability of prime materials, and location.

4. The strength of concrete mixes was improved by the partial replacement of fine aggregates with crushed glass aggregates, but the high alkali content of such aggregates would affect the long-term durability and strength, both of which need long-term investigation.

5. Using glass of different percentages showed no significant effect on the slump, unlike the use of plastic and crushed aggregates, which showed that higher the percentage used, the lesser was the slump.

6. In addition to recycling glass by its use in concrete mixes, glass aggregates can be used aesthetically in
masonry, which can give a shiny clean finishing effect on the surface of the concrete product.

7. When up to 20% of plastic and crushed concrete was used in concrete, the strength of the concrete exhibited lower compressive and splitting-tensile strength than that of normal concrete using natural aggregates. Therefore, it is recommended that concrete with recycled materials of lower strength be used in certain civil engineering applications, especially in non-structural application, where lower strength up to 25 MPa is required. This will contribute to cutting down the cost of using non-structural concrete.

Research was also done on Performance of concrete by using Non-recyclable plastic wastes as concrete Constituent. The safe disposal of non-recyclable thin plastics bags is the most challenging issue for the solid waste management across the globe. Even today, at least 15% of total plastic waste remains untreated. Concrete is the first choice for construction in many countries today. This has increased the fast vanishing of natural resources. It could be worth experimenting to use non-recyclable plastic bags in concrete to overcome the dual issue of shortage of raw material and safe disposal of leftover plastic to environment. This paper presents a comparative study of compressive strength of concrete made by mixing of plastic bags as concrete constituent. This study focuses on the use of polyethylene plastic bags of 20 micron thick in M25 concrete. Plastic was added 0% to 1.2% by volume. The compressive - strength was compared for manually cut and shredded plastic form. Based on the experimental data received after a wide range of samples with different proportions of polyethylene fibers, following conclusions are made,

1. The plastic bags could be used preferably in shredded form to avoid difficulty in workability.
2. Macro fibers made from bags by hand cut, are not suitable due to their low aspect ratio.
3. Beyond 0.6% of concrete volume of the fibers made from the plastic bags having thickness less than 20 microns reduced the strength and compaction factor nearly up to 30% and at 1.2% the strength reduced up to 50% compared to the controlled concrete.
4. The concrete prepared by addition of polyethylene fibers less than 20 micron thickness, could be suitably used for non- structural works, where the strength of concrete is not a prime concern.
5. Various durability aspects must be checked with wider range of sampling and testing.
6. The authors are experimenting different types of post-consumer plastic wastes in different form and proportions to check the feasibility of usage of such wastes in concrete to have an alternate solution towards the solid wastes.

1.3 AIMS AND PURPOSE

A shredding machine is designed to reduce large solid material objects into a smaller volume, or smaller pieces. Shredding machines are usually used to reduce the size and shape of materials so they can be efficiently used for the purpose intended to. Shredding just like crushing can be defined as 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. The shredding materials must possess a better strength and toughness than the plastic materials.

This study’s aim was to investigate the effect of operational parameters on process energy demand and quality of re-cyclates in mechanical recycling of glass fibre composites. Three control factors investigated were hammer mill screen size, material thickness and material size. Performance of two different granulator technologies was also compared. The vision is to develop the knowledge base for selecting optimum parameters to minimise energy footprint and to predict re-cyclates quality.

To summarize, the main objectives of the project were to:

- Build a functioning shredding machine for plastics waste.
- Make an easily detachable modular PSU that can be used for other future applications.
- Redevelop the shredder to improve performance, output quality, assembly and/or user-friendliness, after testing of the machine.
- If possible, rebuild the machine with the new improvements.
- Minimize building cost

II. LITERATURE REVIEW

High voltage fragmentation and mechanical recycling of glass fibre thermoset composite. (Pual Lt Mativenga, Norshah) 2016.

Introduced a glass fibre reinforced plastic material which accounts for 98 percent of the production volume. There are different process of recycling they are Biotechnology, Electrochemical, fluidized bed, HVF, mechanical, microwave pyrolysis, pyrolysis. There are two equipment was discussed such as SELFIRAG high voltage fragmentation laboratory and Whitman MASI granulator, high voltage fragmentation equipment operated by supplying the voltage. Wittmann granulator It is a mechanically size reduction machine operated with help of motor. In this literature survey has characterized HVF for a new application in recycling GFRP and compared it to its competitor the mechanical method.

Deepak Dabhade and K.E.Kondhalkar
Global increase of composite waste urgently requires innovative recycling technology. The three dimensional cross-linked structure makes melting and remolding of thermoset composite impossible. In this study, high voltage fragmentation, originally conceived for fracturing rocks was investigated as a potential process for composite recycling. It was then benchmarked against its competitor, mechanical recycling. The investigation covered effectiveness in separating composite phases, energy demand and re-cyclates quality. The work is a new contribution to the performance evaluation of key technologies for rapid recycling glass fibre thermoset composites, a major challenge for manufacturing and end-of-life product waste.

Energy intensity and environmental analysis of mechanical recycling of carbon fibre composite  
Jack howarth2014  
This explained that the lack of industrial scales of composite recycling needed to be addressed by the industry to comply with the legislation to become an acceptable waste management solution for increasing accumulation of wastes. This is turning to be a global issue and recycling technology for possessing technological capability and environmental benefits. The main techniques for recycling of composite materials are classified into categories of Thermal, Chemical, Mechanical and Radiation. The specific energy modeling and extrapolating the mathematical models to predict energy demand for mechanical recycling of the different composite materials.

Fly ash is typically used as reinforcing filler in acrylonitrile butadiene styrene (ABS) to develop lightweight composites. However, study on the effect of particle size on mechanical properties of thermoplastic-based fly ash products is very limited. The information is vital in developing the products for high performance application. This study compares mechanical properties of fly ash reinforced thermoplastic products made using different particle size. The products were mixed and cured using a hot press machine, before underwent several mechanical tests and environmental assessment. The results show that as the size of the fly ash particle increases, the tensile and flexural properties of the sample decrease. This is due to formation of agglomerations as a result of difficulties of achieving homogeneous dispersion of bigger particle size. In contrast, the environmental assessment result shows that the ABS reinforced by larger particle size of fly ash shows less global warming impact because of less electrical energy used during sieving process. Findings of this study have provided an important insight on the simultaneous consideration of mechanical properties and global warming impact of fly ash based thermoplastic products.

Energy efficient fibre reinforced composite recycling.  
Norshah aizat shaib(2016)

The composite materials have a heterogeneous nature. Thermoset matrixes, which are used in most high grade applications, have three dimensional cross-linked structures which make melting and re-moulding impossible. Such complex nature requires appropriate composite recycling technologies, a number of which are currently under research and development. At this early stage it is important to select and develop sustainable solutions in terms of economic performance and reduced environmental impact. Unfortunately at present, there is limited high integrity environmental related data in literature to help assess the life cycle benefits of composite recycling. This information is vital in exploring environmental credentials of composite recycling processes, and to ensure resource efficient use of manufacturing and end of life composite waste.

The effects of key process variables in mechanical recycling on process energy demand and re-cyclates quality were also investigated. This study highlights the importance of selecting the right conditions for running recycling processes and generating re-cyclates with a high market value. Potential of new recycling techniques, namely high voltage fragmentation, was also assessed. Performance of the method, which was originally developed for fracturing rocks, was compared to the mature mechanical recycling process. The final part of this study used a life cycle assessment method to evaluate end of life options for an automotive composite product with the highlights on positive environmental impacts of recycling scenarios.

Recycling of polyethylene waste to produce plastic cement  
Ahmad K.Jassim (2017)  
Disposal of plastic waste in environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. Therefore, finding alternative methods of disposing waste by using friendly methods are becoming a major research issue. In this research, high density polyethylene waste is mixed with Portland cement to investigate the possibility to produce plastic cement, and study the effect of replacing sand by fine polyethylene waste with different percentage on the properties of product. The experiments were done by using the waste of polyethylene packages include bottle and food crates in the range of 10% to 80% by volume as a short reinforcement structure. The results show that there is a possibility to produce plastic cement from polyethylene waste and Portland cement by using 60% and 40%, respectively. In addition, their density was decreased, ductility increased, and the workability improved, which lead to produce lightweight materials.

**DESIGN AND FABRICATION OF PAPER SHREDDER MACHINE**

**DR. FAUZIA SIDDQUI**  
This paper deals with a detailed study & design procedure of a paper shredder machine. A detailed study of various parts of shredder machine like stand (frame), transmission system and cutting system are made and designed separately. The first part of deals with the study of cutting system of a shredder machine i.e. types of blades, different profiles, its dimensions, its alignment, advantages and
disadvantages of different types of blades. The second part includes problem definition, objectives, procedure of design with the detailed design of each component of the cutting and transmission system i.e. designing a blade and making certain modifications in it and the frame. The third and last part deals with the design of 3D model of various parts on Dassault Systems “SOLIDWORKS 2014” and its motion study and the analysis of the stand in ANSYS 15. Keywords: SolidWorks 2014, ANSYS 15, Shredder Machine. INTRODUCTION A paper shredder is a mechanical device used to cut paper into chad, typically either strips or fine particles. Government organizations, businesses, and private individuals use shredders to destroy private, confidential, or otherwise sensitive documents. Privacy experts often recommend that individuals shred bills, tax documents, credit card and bank account statements, and other items which could be used by thieves to commit fraud or identity theft. Types of paper cut:i. Strip-cut shredders: These rotating knives to cut narrow strips as long as the original sheet of paper. Such strips can be reassembled by a determined and patient investigator or adversary, as the product (the destroyed information) of this type of shredder is the least randomized. ii. Cross-cut or confetti-cut shredders: They use two contra-rotating drums to cut rectangular, parallelogram, or lozenge (diamond-shaped) shreds. iii. Particle-cut shredders: They create tiny square or circular pieces. iv. Cardboard shredders: They are designed specifically to shred corrugated material into either strips or a mesh pallet. v. Pierce-and-tear shredders: They have rotating blades that pierce the paper and then tear it apart. vi. Grinders: They have a rotating shaft with cutting blades that grind the paper until it is small enough to fall through a screen.

Re-Use of Polyethylene Plastic Waste in Concrete
Venkat Narsimha Rao

The increase in population and the changed lifestyle has resulted in a significant rise in the quantity of plastic waste. This project in particular deals with the possibility of using the waste polyethylene as partial replacement of fine or coarse aggregate in concrete. Concrete with 2%, 4%, 6% pulverized/non-pulverized polyethylene material is prepared after doing the mix design. Various tests on cement like specific gravity, fineness, setting time, etc., tests on coarse and fine aggregates like sieve analysis, fineness modulus, specific gravity, etc. are performed. Mix design using IS Code method is done and cubes and cylinders are cast for M25 grade concrete with and without plastics and tests on concrete like slump, cube tests and cylinder tests are performed to understand their behavior and usefulness as replacement. The standard mechanical properties of concrete like compressive strength, split tensile strength are tested and compared with the results of standard specimen.

Effect of process parameters on mechanical recycling of glass fibre thermoset composites.
Paul Tarisai Mativenga

High demand of glass fibre reinforced thermoset composites has led to manufacturing and end of life waste. Mechanical recycling is currently a mature, rapid process in recycling such waste at an industrial scale. Unlike manufacturing processes, the effect of key process variables on re-cyclates quality is not well understood. In this study analysis of variance was used to establish the key mechanical granulator process variables that influence energy demand and re-cyclates quality. Two different granulator technologies were also compared. This information is vital in selecting conditions for running recycling processes and in assessing the potential market for the generated re-cyclates.

Recycling of Polyethylene Waste to Produce Plastic Cement
Ahmad K. Jassim

Disposal of plastic waste in environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. Therefore, finding alternative methods of disposing waste by using friendly methods are becoming a major research issue. In this research, high density polyethylene waste is mixed with Portland cement to investigate the possibility to produce plastic cement, and study the effect of replacing sand by fine polyethylene waste with different percentage on the properties of product. The experiments were done by using the waste of polyethylene packages include bottle and food crates in the range of 10% to 80% by volume as a short reinforcement structure. The results show that there is a possibility to produce plastic cement from polyethylene waste and Portland cement by using 60% and 40%, respectively. In addition, their density was decreased, ductility increased, and the workability improved, which lead to produce lightweight materials.

III. OBJECTIVES

Build a functioning shredding machine for plastics waste. Make an easily detachable modular PSU that can be used for other future applications.

Redevelop the shredder to improve performance, output quality, assembly and/or user-friendliness, after testing of the machine.

If possible, rebuild the machine with the new improvements.

Minimize building cost.
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IV. METHODOLOGY

Figure 4.1: Waterfall Model

We have decided to complete the project in simple waterfall model.

Communication Phase
Communication phase includes:

- Discussion of topic with guide
- Actual farm visit and understanding various farming method
- Literature survey
- Problem identification
- Analysis of problem
- Concept development
- Discussing various certainties and uncertainties

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 paper shredder machine is the blade. Thus our more focus is on the research and the study of an appropriate blade design which will serve our purpose.

Planning Phase
Planning phase includes:

- Process planning
- Raw material planning
- Force analysis
- Process scheduling

Modeling Phase
Modeling phase includes:

- Design of various components
- CAD modeling of components
- Assembly model of component
- Prototype model making

Once the blade type is fixed, the second important thing is the machine design. The design was being done in Creo Parmetric 4.0. 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.

Construction and Testing
Construction phase includes:

- Selection of proper manufacturing methods
- Working as per process scheduling and plan
- Testing of equipment on field
- Error analysis
- Repair if any
- Construction of Prototype using wooden shaft and metal blades

Deployment

- Rework of design based on failure of results in prototype stage
- Construction of the model in stages: Welding the square pipes for the frame, Bending of sheet metal for hopper, fitting of motor and Pulleys, Assembly of shredder shaft with the spur gears and fitting through nuts and bolts, and usage of dampers.

V. PROBLEM DEFINATION

- From the reference papers, we find out the problem in the Shredder machine that, due to the load factor noise and extreme vibrations are generated.

- The normal cutters used, which are able to shred/cut papers into strips can’t be considered as a reliable method of disposing the stuff. The strips are easy to be arranged or assembled again by some wiser brains.

- Because of the mechanical components like the blades, gears, etc. a periodic maintenance and through lubrication is required.
VI. WORKING PRINCIPLE

The plastic & Glass bottles have more volume compared with its weight, so due to this plastic & Glass bottles take more space than other scrape so the scrap collector avoids taking plastic bottles. If we crush or cut this plastic then it is convenient and economical to scrap collector to transportation and this cut plastic can be directly used for further processing.

So we decided to make plastic cutting machine which is motor operated so it is affordable to the customer. The bottle crusher is cutting the parts from the bottles with rotary cutting tool within a specified depth and the speed limit, then the two parts separately or it will be truncated. The machine is powered by motor. The principle of operation is a follows:

- Align the plastic bottle into the hopper.
- Cutter will rotate when the shaft is rotated after starting of motor.
- Bottle will cut when contact with the cutting tool.
- The scroll will fall in the collector provided.

COMPONENTS AND THEIR SPECIFICATIONS

Before we started modeling the CAD, we listed all the dimensions and specifications based on the design calculations done before. Further below is the table of all components and their specifications.

**Frame**

Construction machine consists of stand, bearing support plates, nuts and bolts. Frame is the supporting member which provides support for components like gear, shaft, blades etc. In order to get the required strength, two plates (Bearing support blades) are fixed with the help of nut and bolts. The material used for the machine frame is MS (Mild Steel). The analysis of frame was done to check whether it can support the load of the cutting and transmission system assembly. A36 has a density of 7,850 kg/m3. Design and manufacturing of frame to follows dimensions:

- Length (l) = 311 mm, Width (w) = 224 mm, Height (h) = 192 mm.

**Cutting Blades**

Cutting system consists of the shafts, cutting blades, washers and gears. The cutting blade is round-shaped blade with 3 (three) cutting edges, given circle-shaped hole in the middle with keyway, mounted on the main shaft and main shaft move together.

In drawing of cutting blades in Creo 4.0 software, cutting blades are equally divided into certain degree of angle and each cutting edge of cutting blade is joined by arc to second cutting edge up to particular length of cutting edge.

We design the cutting system in such a way that angle between keyway of each cutter blade is 40 degree. And cutting blades are placed in such a manner that after first blade apart from 40 degree from second blade. This concept used in paper shredder machine. Because of that, power which was requiring rotating the shaft was large. Now that power to rotate the shaft is lesser than previous. Material used for cutting blade is EN31 steel.

**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 keyway (square) has a circular cross section for cutting system. Material is used for shaft is EN31 steel. Shaft is manufactured and diameter of shaft is 40 mm.

**Spur gear**

A gear or cogwheel is a rotating machine part having cut teeth or cogs, 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 the two meshing gears all have the same shape, Material is used for spur gear is EN31 steel. Required gear ratio to cutting system is 1. So, 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.

**Pulley and belt**

V-belt pulleys (also called vee belt sheaves) 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 axles.

The v-belt and its complementing pulley create the most efficient belt drive known (sometimes achieving 98%) transmission. Material is used for pulley and belt respectively mild steel and rubber. Large pulley diameter (D) = 667 mm, Small pulley diameter (d) = 400 mm and distance between two pulleys=1000 mm sufficient to get power requirement motor. Speed ratio between two pulleys
EFFECT & ENERGY OF RECYCLING MECHANICAL PARAMETERS WASTE PLASTIC AND GLASS TO PRODUCE USABLE COMPOSITES

Deepak Dabhade and K.E. Kondhalkar

Bearing

A bearing is a machine element that constraint relatively motion to only the desired motion and reduced friction a machine element that a bearing being a machine element that allows one part to bear another. Material is use for bearing is steel. From the chart bearing no.6208 SKF is selected.

List of all components

<table>
<thead>
<tr>
<th>S. NO</th>
<th>COMPONENT NAME</th>
<th>SPECIFICATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>AC MOTOR</td>
<td>3 PHASE, 500 RPM</td>
</tr>
<tr>
<td>2</td>
<td>PULLEY</td>
<td>CAST IRON, 2 NOS. (666 MM AND 400MM DIA)</td>
</tr>
<tr>
<td>3</td>
<td>SHAFT, HOT ROLLED PCS</td>
<td>40 MM DIA</td>
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<tr>
<td>4</td>
<td>BEARINGS</td>
<td>2 NOS, 60 MM ID, 110MM OD, NO. 6208 SKF</td>
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<tr>
<td>5</td>
<td>SPUR GEARS</td>
<td>2 NOS, 40 MM ID</td>
</tr>
<tr>
<td>6</td>
<td>STEEL FRAME</td>
<td>2 SQUARE PIPE</td>
</tr>
<tr>
<td>7</td>
<td>HOPPER</td>
<td>MS, 0.22 MM THICK</td>
</tr>
<tr>
<td>8</td>
<td>BELTS</td>
<td>V-BELT.3.6 M LONG, 22X14 MM CROSS SECTION</td>
</tr>
<tr>
<td>9</td>
<td>KEY</td>
<td>12<em>08</em>85 MM</td>
</tr>
</tbody>
</table>

ACKNOWLEDGMENT

We express our sincere thanks to PG coordinator, Dr. K.H. Munde, for his continuous support. We also thankful to our Head of Department of Mechanical Dr. G.E. Kondhalkar, for support.

RESULTS & DISCUSSION

<table>
<thead>
<tr>
<th>S. NO</th>
<th>COMPONENT</th>
<th>OUTPUT TYPE</th>
<th>RESULT S</th>
<th>Exp. Result</th>
<th>% Error</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Cutter</td>
<td>Equivalent Von Mises Stress</td>
<td>2.414 MPa</td>
<td>2.3MPa</td>
<td>4.1</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Equivalent Elastic strain</td>
<td>1.2 x 10^-5 mm/mm</td>
<td>1.1x 10^-5 mm/m m</td>
<td>8.3</td>
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<tr>
<td></td>
<td></td>
<td>Strain energy</td>
<td>9.01 x 10^-5 mJ</td>
<td>5 x 10^-5 mJ</td>
<td>5.55</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Factor of Safety (FOS)</td>
<td>15</td>
<td>14</td>
<td>6.67</td>
</tr>
</tbody>
</table>

| 2     | Frame     | Equivalent Von Mises Stress | 3.26 MPa | 3.0 MPa | 7.96 |
|       |           | Equivalent Elastic strain | 1.83 x 10^-5 mm/mm | 1.65 x 10^-5 mm/m m | 9.8 |
|       |           | Strain energy | .005 mJ | .005 mJ | 0 |
|       |           | FOS | 13 | 12 | 7.6 |
| 3     | Hopper    | Equivalent Von Mises Stress | 3.31 MPa | .3 MPa | 9.3 |
|       |           | Equivalent Elastic strain | 2.1 x 10^-6 mm/mm | 1.9x 10^-6 mm/m m | 9.52 |
|       |           | Strain energy | 2.1 x 10^-6mJ | 2.0 x 10^-6mJ | 4 |
|       |           | FOS | 15 | 14 | 6.66 |
| 4     | Shaft     | Equivalent Von Mises Stress | 32.42 MPa | 30 Mpa | 7.4 |
|       |           | Equivalent Elastic strain | 0.00016 mm/mm | 0.00015 mm/m m | 6.25 |
|       |           | Strain energy | 0.079 mJ | .075 mJ | 5 |
|       |           | FOS | 7.7 | 8 | 4.05 |

REFERENCES


[6] Glogowska.k and Rozpedowski, J., “Examination of shredding process parameters and the properties of recyclate” Advances in Science and
technology research Journal volume 10, issue 29, 2016


