GRANULATOR RECYCLING OF PLASTICS AND GLASS FIBER

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Abstract - *Disposing plastic wastes into environment is a big problem. This is because of its low biodegradability. The utility of plastics has been on increase from year to year, at the same time, the Ministry of the Environment continues to restrict plastic disposal sites and to direct them to incineration plants and similar sites that causes emission of toxins such as dioxins. These days their disposals are recognized to be safe, the basic policy stated for the Waste Disposal Law was amended in May 2005 it says that "first, emission of waste plastic should be reduced, after which recycling should be promoted; any remaining waste plastic should not go to landfill as it is suitable for use in mechanical recovery". The world consumed that 70 to 80 percent of bottles end up in land fill that will cause pollution of natural resource such as water and harmful to the environment and living organism. In order to overcome this problem a granulator recycling of plastic and glass fibre has been designed and fabricated which cheaper in cost and comparatively smaller in size.*

1 INTRODUCTION:

Plastic usage superseded all other product for its properties and characteristics, including aluminium and glass.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 aluminium and plastic can for having easier storage option in the recycle bins they gives you extra space by flattening single or multi cans. These 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. All these 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.

1.1 Literature survey:

Pual.t Mativenga, Norshah et al 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, fluidised bed, HVF, mechanical, microwave pyrolysis, pyrolysis. The two equipment was discussed such as SELFRAG high voltage fragmentation laboratory and Whitman MASI granulator. In SELFRAG high voltage fragmentation equipment operated by supplying voltage. Wittmann granulator It is a mechanically size reduction machine operated with help of motor. In these literature survey has characterised HVF for a new application in recycling GFRP and compared it to its competitor the mechanical method [1].

jack howarth, et al 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. 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. In this paper specific energy modelling and extrapolating the mathematical models to predict energy demand for mechanical recycling of the different composite material [2].

Norshah aizat shuaib, et al worked on the Increased demand of fibre reinforced plastic composite has led to high volume of manufacturing scrap. In these paper says model and experimentally validate the energy demand in mechanical recycling of the GFRP.FRP are used in various critical sector such as aerospace, automotive and wind energy industry. These composite material can be recycled through mechanical milling based granulator recycling machine. These paper provide valuable information on the impact of processing rate and granulator capacity in relation to reducing in recycling of GFRPT [3].

Norshah Aizat et al concentrate on studying the Current recycling technologies for glass fibre composite are divided into mechanical, thermal, chemical land electrochemical and electrical method. The two machines are used to recycle the glass fibre such as Eco-wolf grinder and wittmann granulator these both machines are operated by using motor. Both machines are used to size reduction plastic and glass fibre. In this study, material thickness was found to be have a significant role in determining the power requirement and how efficiently the material being cut [4].

Ninoslav Pesic et al investigate the recent development in the technology of concrete and demand for eco-friendly and sustainable construction gave raise to idea of disposing waste polymer into structural concrete. Strength of concrete reinforced with recycled HDPE fibres. The serviceability behaviour of HDPE was investigated. HDPE fibre reduce plastic shrinkage cracks drying shrinkage and permeability. SEM imaging showed no signs of chemical deterioration of HDPD fibres in concrete. In this study attempt to promote sustainability in construction. It also focused on mechanical properties of concrete reinforced with recycled HDPE fibres [5].

M.A.Dalhat et al focused on the recycled plastic bounded concretes (RPBCs) which containing zero Asphalt binder and zero Portland cement. Mechanical properties of the RPBCs was analysed with reference to Portland cement and Asphalt Concrete. All of the RPBCs exhibited excellent moisture for better than the Asphalt concrete in some cases. RPP-bounded concrete exhibits excellent stiffness and a flexural strength, approximately 3 times that of the Acs. The efficiency of the RPBCs for healing cracks is in the order of 92 percent as opposed to 9 percentage for ACs. In this paper the RPBCs is made to have much lower thermal sensitivity than that of ACs. The energy required in casting a RPBCs is not far from the energy consume in heating and mixing the aggregate with asphalt binder in the case of asphalt in the case of asphalt pavement construction [6].

Ahmad K.Jassim et al proposed the disposal of plastic waste in an environment is considered to be a big problem due to its very low biodegradability and presence in large quantities. Polyethylene waste and Portland cement can be effectively utilised in plastic cement production by using 60 percent and 40 percent of them respectively .In addition, their decreased density, increased ductility, and well improved workability leaded to production of lightweight materials. The best compressive strength for product has been found for 25 percent, 30 percent and 35 percent of polyethylene utility. The yield points for them are 971,915 and 945 N, for immersed 7 days, respectively, and 2352 for mixed of 25% and 1271 N 30% after immersed 28 days. The product with 25% to 30% waste polyethylene have good workability to make holes without any problem [7].

1.2 PROPERTIES OF PLASTICS:

Plastics can also be classified by: their various physical properties, such as hardness, density, tensile strength, resistance to heat and glass transition temperature, and by their chemical properties, such as the organic chemistry of polymer and its resistance and reaction to various chemical product and process, such as: organic solvents, oxidation, and ionizing radiation. In particular, a most plastics will melt upon heating to a few hundred degrees Celsius.

2. RESEARCH METHODOLOGY:

Mechanical recycling of composite on an industrial scale can usually be run at fixed set of speeds. To ensure an assessments of the normalised and specific energy requirements in mechanical cutting composite for recycling, controlled tests were performed to evaluate the specific machining energy.

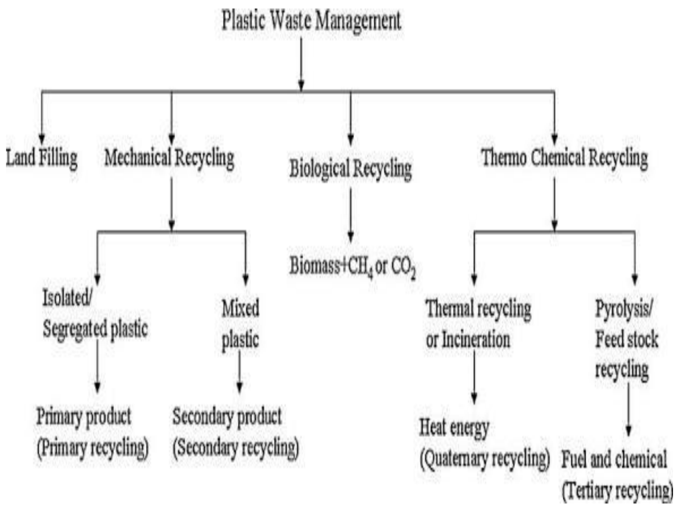

Fig-1 : Plastic waste management

2.1 MATERIALS AND METHODS

MACHINE DESCRIPTION AND OPERATION

The waste plastic shredder has four main components; the feeding unit, the shredding unit, the power unit and the machine frame. The feeding unit is made of 16 – gauge galvanized mild steel sheet of 2 mm thick plate and a dimension of 200 mm × 550 mm through which the waste plastic are fed into the shredding unit. The shredding unit is where the waste plastic are been cut into smaller sizes. The unit consists of a shaft, 50 mm length made up of 30 mm mild steel rod and a cylinder of 55 mm length and 200 mm diameter. Attached to the shaft are cutters made of 12 mm mild steel having nine serrated teeth welded 2 mm apart. The cylinders are possessed with same cutters having sharp edges for shredding the waste plastic. Under the shredding unit/area is the outlet made of galvanised mild steel. Through the outlet the discharge is made from shredding unit. The machine is powered by an electric motor with the help of a belt and a pulley arrangement.

2.2 Design considerations:

Various factors considered while designing the plastic waste shredding machine. They are safety, compactness, ease of operations, power requirement and overall cost for production. While the material selection is made based on its availability, cost and ease of fabrication.

2.3 Experimental Procedure:

Specific energy for mechanical recycling of CFRP is evaluated with the help of a Mikron HSM Milling machine. The cutting conditions used are listed in A single tool insert was used in order to be able to track the specific energy per cutting action. The tool insert was changed after every 'cut', to negate the variability that would be brought by tool wear. The feed per tooth (f_z, given by dividing spindle speed by the product of table feed and the number of 'teeth' in the tool) was varied by varying the table feed (v_f). For each feed per tooth, the material removal rate was varied by varying the width of cut. Thus at each feed per tooth widths of cut of 1, 2, 3, 4 and 5 mm were used. Three tests at each width of cut were performed. The spindle speed was set to 1000 rpm for all tests. For each test the power demand was measured using a Fluke 345 clamp meter, and this formed the basis for evaluation of power and energy demand. The specific energy parameter at each feed per tooth is calculated from the gradient of the plot of material removal rate vs power demand.

A lot of new tests is then performed with the help of a industrial scale composite recycling machine to assess the validity of the available model. The machine is made to have a large milling cutter constrained within a milling drum. The hammer heads used here are the HSS cutting inserts available in market. Thin composite panels are fed into the machine through the chute and mechanically reduced by milling until short fibres and resin powder can be sieved through the classifier screen. The short fibres can then be used as fillers in re-manufacturing. The machine recycles composites on an industrial scale and is run at a fixed set of speeds. The internal structure. The processing of thin composite plates is the current capability of most mechanical recycling processes. If thicker panels have to be processed then for industrial machines down-sizing of composites or cleavage may be required. Thus CFRP plates of 3 mm thickness were used, and a total of 1 kg was processed over a period of 6 min, which equates to a processing rate (Q) of 10 kg/hr.

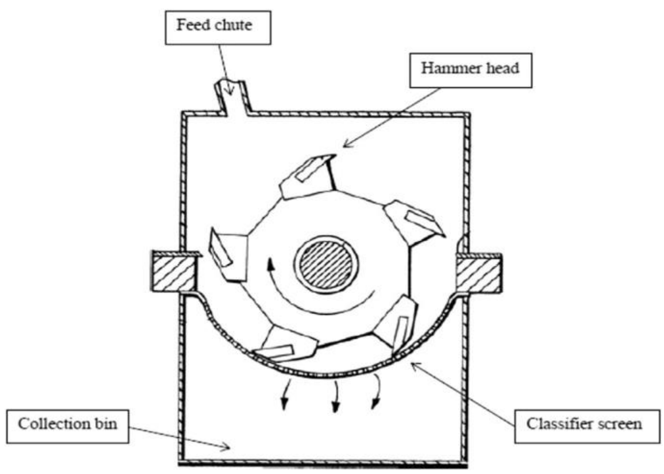

Fig-2 : Mechanical recycling of CFRP cutting conditions.

Solid tool diameter (mm) 12
Number of inserts 1
Edge radius of insert (mm) 70
Feed per tooth, f_z (mm/tooth) 0.028, 0.07, 0.15, 0.3
Width of cut, a_e (mm) 1, 2, 3, 4, 5
Depth of cut, a_p (mm) 7
Spindle speed (RPM) 1000

2.4 PERFORMANCE OF EVALUTION PROCEDURE

One kilogram (1 kg) each of the four different plastic types (Polyethylene Terephthalate (PET), the High density polyethylene (HDPE), the Polyvinylchloride (PVC) and the Polypropylene (PP) were shredded at varied motor speed of 1,806.7 rpm, 1,290.5 rpm and 1003.7 rpm using 10 Hp three-phase electric motor as the prime mover. The shredded waste plastic, is weighed to determine the quantity of the actual shredded waste plastic before operation in order to determine the average size and area. The various performance characteristics are evaluated as:
Specific Mechanical Energy is given as the product of Power, Time and Output mass.

Throughput is the product of Output mass of recycled waste plastic with Time taken for recycling.

Recycling Efficiency can be taken as the product of Output mass of recycled waste plastic with 100 Input mass of waste plastic.

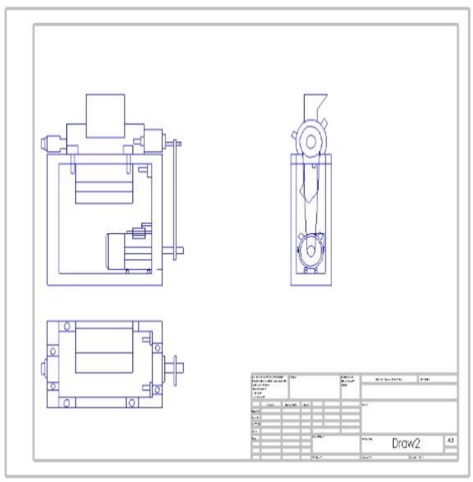

Fig-3 : DESIGN AND FABRICATION OF PLASTIC SHREDDING MACHINE

2.5 Results and Discussion:

The results obtained from the machine were presented and represent the summary of the average size and percentage number of plastic shredded at three variable speed of the motor.

At the machine speed of 1806.7 rpm, the shredder performed optimally when shredding PVC with a result of 53.6% shredding achievement while the average shredded size particle is 5.07 mm^2. It takes a machine for a minimum of 3 minutes to shred a bottle with a recovery efficiency of about 95 percent and with a specific mechanical energy of 392 KJ/kg having a throughput of 19 kg/hr.

Even at the machine speed of 1290.5 rpm, the shredder showed its performance optimally while shredding PVC with 52.8 percentage of shredding output within 2 minutes and an average shredded particle size of 6.29 mm^2. The SME for PET was even reduced for 61 percent even when compared to a speed of 1806.7 rpm the recovery efficiency was evaluated to be 94 percent and the throughput increases by 100 percent to 238.1 KJ/kg which is This is followed by HDPE and PP which has a minimal variance for all the parameters measured.

At the machine speed of 1003.7 rpm, 53.3percent of PVC plastic was shredded to an average particle size of 7.51 mm^2 within 2 minutes. The specific mechanical energy at a maximum speed 1806.7 rpm possess a recovery efficiency of 95 percent having throughput of 31.67 kg/hr. The machine shredded 52.3 percentage of HDPE with an average size of 4.58 mm^2 in this speed within four minutes having a recovery efficiency of 83 percent.

3.CONCLUSION:

The capacities of the machine at different shaft speed of 1806.7 rpm, 1290.5 rpm, and 1003.7 rpm were respectively. The recovery efficiencies were up to 95%, 94% and 95% respectively. The specific mechanical energy at different speed of motor was 1077.6 KJ/kg, 1065.7 KJ/kg and 973.0 KJ/kg respectively. The average particle size are 18.05 mm^2, 14.25 mm^2 and 7.51 mm^2 respectively and percentage shredded were 53.6%, 52.8% and 53.3% respectively. The machine therefore has an average Throughput of 27.3 kg/hr, Recovery Efficiency of 95%, Specific Mechanical Energy of 1,039 KJ/kg, Percentage shredded of 53.2% and 95% specifically for PVC type of plastic. The average particle size shred of 13.3 mm^2 and the production cost of the shredding machine is One Hundred and Forty Thousand, Seven Hundred and Fifty Naira (N 140,750:00 k) only.

The results obtained from the waste plastic shredding machine performance further shows that the machine can be very useful in a situation where considerable plastics to be shredded and also efficient in shredding large sizes. Therefore the machine is recommended for use by small and medium scale entrepreneurs working on recycled plastic.

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