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Solid Waste Crushing and Separation of Plastic Waste Machine

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ABSTRACT: This project deals with the design and the fabrication of the waste separating machine using belt conveyor drum. There is a direct connection between the country population and the waste produced. As the population of a country increases, the waste produced by them also increases tremendously. A suitable method must be suggested for recycling or disposing the wastes in order to lead a healthy and a social life. There a lot of methods of disposing the wastes such as landfills, incineration, etc. Machines which assist these methods are readily available in the market nowadays. The major problem with these types of machines is that they need a lot of space and also the cost of the machine is high. In our project, we fabricate a simple waste separating machine which is of low cost and occupies a very less space. Simple components and mechanisms are used in this fabrication and an efficient waste separating machine is built. The parts of this project are designed and assembled in the Creo software and finally the fabrication part has been carried out.

KEYWORDS: Municipal Solid Waste, Plastic Solid Waste, Plastic Waste Separation.

I. INTRODUCTION

Waste separation is the method of treating solid wastes and offers wide range of solutions for recycling items that don't go to trash. It is about how waste can be used as a helpful resource. Waste separation is something that each and every domestic and business owner in the world needs. Waste separation disposes of the products and substances that you have use in a safe and efficient manner. The fast urbanization, steady change in utilization model and social behaviour have enlarged the production of municipal solid waste (MSW) past the allowable capacity of our environment and management capacity of the current waste management systems. Therefore, there is a sudden necessity of enhanced planning and implementation of complete MSW management systems for improving the environmental circumstances of the State. It requires complete information on the amount and character of MSW generated and their physical and chemical properties. This is to evolve proper waste management strategy based on the principles of reduce, reuse and recycle and design appropriate collection, transportation, processing and disposal system. We introduce a new innovative concept of waste separation which is highly useful for separation of wastes.

II. LITERATURE REVIEW

Waste categorization is the process by which waste is divided into different elements. Waste categorization can occur by hand at the domestic and collected by different collection schemes, or automatically sorted in materials recovery services or mechanical biological treatment systems. The categorization of waste by hand was the first method used in the olden times of waste categorization. A variety of separation methods for municipal solid waste materials are available.

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1. **Screeners** are shifting units that are rotated as powder is fed into their interior.
2. **Air classifiers**, cones or cyclones use the spiral air flow action or acceleration within a chamber to separate or classify solid particles.
3. **Concentrating tables or density separators** screen mass materials or minerals base on the density (specific gravity), size and shape of the particles.
4. **Electrostatic separators** are used for separating wastes by restricted ionization
5. **Floatation systems** separate hydrophobic particulates from hydrophilic particulates by passing well air bubbles up from beginning to end of a solid- liquid mixture. The fine bubbles connect to and lift or float the hydrophobic particles up where they are collected.
6. **Magnetic separators** employ existing magnetic fields to detach iron, steel, ferrosilicon or other ferromagnetic materials from non-magnetic large materials. The magnetic field may produced by permanent magnets or electromagnets.
7. **Rake, spiral and bowl classifiers** use mechanical accomplishment to dewater, deslime or separate coarse bulk materials as of finer materials or liquids.
8. **Trommels** are big rotating drum shaped with a grate-like surface with large openings to detach very high materials from bulk materials.
9. **Water classifiers** such as elutriators and classifying hydro cyclones use settling or flow in water or a liquid to separate or classify powdered materials based on particle size or shape.
10. **Hydro cyclones** are a type of Static Separator based on centrifugal disjuncting in which a vortex generated with a cone-cylindrical arrangement.

Plastic Solid Wastes

Plastic items are used in our everyday life. It is only reasonable to find out a considerable amount of plastic solid waste in the final stream of municipal solid waste. Thermoplastic are used of the total plastic consumption nearly 80% and are used for usual plastics applications such as covering but also in non-plastic applications such as plastic fibre and coating S.M. Al-Salem et al. [1]. With the development of social economy, the demand for electronic products increases rapidly and simultaneously, the fresh speed of these products is becoming progressively faster. Actually, Waste electrical and electronic equipment has one of the waste streams of increasing fastest in municipal solid waste Xiaoning Yang et al. [2]. The ability of landfills to handle our waste is limited due to space required and resulting pollution to soil, water, and air. JeongIn Gug, et al. [3].

The utilization of plastic products has considerably and profoundly changed the structure of material research. Some of the advantages of using plastics include high resistance to corrosion, high flexibility to process and low manufacturing cost. With the unprecedented development of industrial society, the production of plastic waste has been an overwhelmingly growing domain and accordingly, it reasonable to find that the increasing research focus has been drawn to post consumer plastic products including thermoplastic such as polypropylene, polyethylene, polyethylene terephthalate and high density polyethylene. In essence, plastic form a considerable portion 5-15% of the municipal solid waste by weight, this equals to 20-30% volumetric proportion. These statistics reveal that beneath the convenience due to wide use of plastic products, people should be alarmed about the challenges of pollution and accompanying environmental issues created by plastics waste Junaid Saleem et al. [4].

Given the versatile properties of plastics, such as being light weight, durable and strong, the world population and usage of plastics has increased sharply .For example waste patches in the Atlantic and the pacific oceans are estimated to be in the order of 100 mt, approximately 80% of which is plastic. Once in the environment, particularly in the marine eco system, plastic waste can persist for hundreds of years. Hence considerable concerns have been focused on plastic waste management Eva Sevigné-Itoiz et al. [5].

The dumping of waste plastic in open areas is still the most commonly used disposal methods for municipal solid waste in developing countries. Rapid exhaustion of available space for disposing wastes and public opposition against developing new waste disposal site are creating crisis in waste management operation. An approach involving the practice of waste minimization and recycling is needed to extend the service time of existing waste disposal site. Waste mining provides opportunity to provide disposal space for new coming waste and recycle of valuable materials. It

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evolves the excavation, transfer and processing of buried wastes taken from, an active or closed landfill or dumpsite. This will also help eliminating potential contaminating sources, cost reduction in post closure monitoring. Refuse – derived fuel is a well-known substitute fuel produced from the combustibles in municipal solid wastes which are composed of waste plastic and other material such as textiles, wood, soil etc. Energy recovery as RDF is a preferred option for utilizing plastic wastes when their potential recycling as raw material for product manufacturing is not possible because their physical properties have been damaged during long exposure to sunlight. Biomass usually has fibrous structure and contains oily sticky components which facilitates to form a more dense bulk should be increased to a degree at which transportation expenses become less and used facilitate ease of feeding for incineration. For Refuse-derived fuel utilization, gasification technology has been applied to production of energy from solid wastes. The thermo-chemical process converts solid carbon based materials into combustible gaseous product containing carbon dioxide, carbon mono oxide, hydrogen, methane and other trace gases. These gases can be used for heating, lighting and power generation Chart Chiemchaisri et al. [6].

Polyolefin a common plastic is less biodegradable which poses a long term negative effect to the environment after being disposed as solid waste. Studies of the biodegradation of various plastic such as high density polyethylene, low density polyethylene, polypropylene, and polystyrene in neutral soils revealed that same soil microorganism including fungi and bacteria showed a specific metabolic capacity to assimilate these plastics as carbon and energy sources for their growth. For example, some fungi degraded the high density polyethylene of a molecular weight of up to 2800 Sutharat Muenmee et al. [7].

Plastic waste can be a cost effective source of chemicals and energy, the recycling of mixed plastic wastes containing poly vinyl chloride not only in the results in the formation of chloro–organic compounds in volatile products but also cause serious emissions pollution in their applications. It is undesirable to dispose waste plastics by landfill due to high cost and poor biodegradability. Two main chemical recycling routes are the thermal and catalytic degradation of waste plastic Yeuh-Hui Lin. [8].

The widely used traditional landfill is becoming an undesirable way of disposal due to rising cost and poor biodegradability of commonly used petroleum based products. The alternative incineration has been criticized for generating large amounts of bottom ash and various toxic air pollutants, like polycyclic aromatic hydrocarbons, as well as dioxins in case of halogen containing plastics Zhigui He et al. [9]. The Thermal degradation of plastic wastes is one of the prospective ways to solve the problem. This way the plastic wastes are converted into fuel for the petrochemical industry. Polyethylene, polypropylene and polystyrene is the targeted polymers. Because their cracking resulted with favourable properties for further application. According to results the products of polyethylene, polypropylene and even polystyrene cracking have the most favourable properties for further energetic applications. Polyethylene derived fuel has very cetane and octane numbers Andra's Angyal et al. [10].

The dependency of landfilling and appropriate waste disposal has been creating the environmental, health and safety problem for the public Sie Ting Tan et al. [11]. Mechanical recycling involves the process of physical treatment while chemical recycling produces chemicals for chemical industry and energy recovery which involves oxidation of the material, producing heat, power and gaseous fuels and oils S.M. Al-Salem et al. [12]. The disposing of waste is a major problem in most of the developing countries. The effective utilization of waste plastic is that it can be used as oil in diesel engines. Plastic waste oil mixed with heavy oil reduces the viscosity of mixed oil mass significantly and improve the performance of engine M. Mani, et al. [13].

The management of plastic waste is very difficult and most important issues in today's scenario. Plastic waste is a light weight, reusable material and there is lot of scope to utilize the plastic waste. Plastic waste material is helpful in saving the energy and carbon dioxide gas emissions. Plastic waste material has hidden energy content and large quantities of plastic waste are landfilled and incinerated. Space of landfill sites are limited and incineration results in emission of harmful compounds. The degradation of plastic waste is very important process to determine the suitability for waste plastic recycling to fuels N. Miskolczi et al. [14]. So that separation of plastic waste from the municipal solid waste is necessary.

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III. ENGINEERING DESIGN

CREO Elements/Pro offers a variety of tools to allow the generation of an absolute digital representation of the product being designed. In addition to the general geometry tools there is also the ability to generate geometry of other integrated design disciplines such as industrial and standard pipe work and complete wiring definitions. Tools are also available to support joint development. A number of concept design tools that grant up-front Industrial Design concepts can then be used in the downstream practice of engineering the product. These collections from theoretical Industrial design sketches, carry out engineering with point cloud data and complete free-form surface tools. We created 3D model of this project by using CREO software. The model is shown in the fig.1 given below.

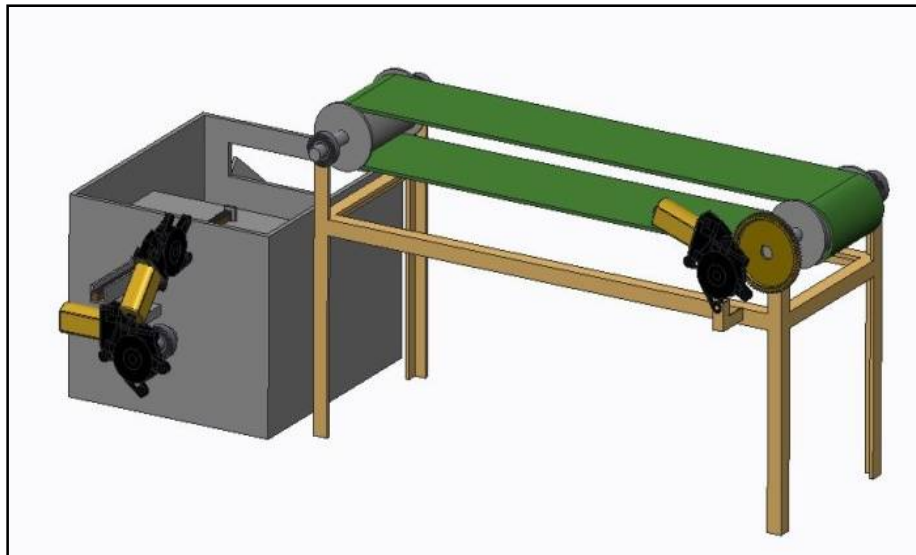


Fig 1: Design Concept

The design concept of the solid waste crushing and separation of plastic waste machine is shown in the fig 1. It consists of spur gear, bearing with bearing cap, rack and pinion, conveyor setup, dc motor. There is a 12V 7A rechargeable battery which is used for the operation of dc motor. The whole parts are mounted on the frame structure with suitable arrangement and it is made of mild steel material.

IV. WORKING PRINCIPLE

The experimental setup of our project consists of a roller on which the conveyor rests. Near to the conveyor a container in which the thrasher is provided. This thrasher is used to separate the wastes easily. The motion to the thrasher is delivered with the help of the DC motor. The conveyor is operated by using the DC motor and the spur gears. Another motor is used to operate the rack and pinion arrangement which separate the wastes that are crushed. The end of the rack is attached with a block which moves along with the rack and pinion assembly. The power to all the motors is supplied with the help of the lead acid battery. The image of the experimental setup is shown in the fig 2 given below.

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Fig 2: Image of the setup

The wastes irrespective of their type are fed to the conveyor manually. The wastes from the conveyor are automatically fed to the crushing container. The thrasher which is operated by a motor crushes the wastes and reduces its sizes. That is the larger pieces of the wastes are broken down into smaller granules. The waste whose weight is more just stays down the container. The waste which is light enough jumps up the thrushes as the crushing process is carried out. At this time, the rack and pinion is operated. The rack and pinion helps to convert the rotary motion of the motor to the linear motion. Hence the rack and the block moves linearly and pushes away the light weight wastes which comes out of the space at the side of the container. Thus the heavy weight and the light weight wastes are separated which can be either recycled or disposed away.

V. CONCLUSION

This project work has provided us an excellent opportunity and experience, to use our limited knowledge. We gained a lot of useful knowledge about, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries. We are proud that we have completed the work with the limited time successfully. The DESIGN AND FABRICATION OF WASTE SEPARATING MACHINE USING BELT CONVEYOR DRUM is working with satisfactory conditions. We can able to understand the difficulties in maintaining the tolerances and also the quality. We have done to our capability and skill making most use of obtainable facilities. In conclusion comments of our project work, let us include a few more lines about our impression project work. Thus we have developed a “WASTE SEPARATING MACHINE USING BELT CONVEYOR DRUM” which helps to separate the wastes with simple mechanisms and components at an affordable cost. By using additional techniques, they can be modified and developed according to the applications.

REFERENCES

- [1] S.M. Al-Salem P. Lettieri, J. Baeyens, Recycling and recovery routes of plastic solid waste (PSW): A review ,waste management, 29(10):2625-43, 2009.
- [2] Xiaoning Yang, Lushi Sun , Jun Xiang, Song Hu, Sheng Su Xiaoning Yang e, Pyrolysis and dehalogenation of plastics from waste electrical and electronic equipment (WEEE): A review, waste management, 33(2):462-73, 2013
- [3] JeongIn Gug, David Cacciola, Margaret J. Sobkowitz- Review JeongIn Gug, Processing and properties of a solid energy fuel from municipal solid waste (MSW) and recycled plastics,wastemanagement,35,283-292, 2015.

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- [4] Junaid Saleem , Chao Ning , John Barford , Gordon McKay, Combating oil spill problem using plastic waste, waste management , 44, 34-38, 2015.
- [5] Eva Sevigné-Itoiz , Carles M. Gasol , Joan Rieradevall , Xavier Gabarrell Eva Sevigné-Itoiz et al, Contribution of plastic waste recovery to greenhouse gas (GHG) savings in Spain, waste management,46,557-567, 2015.
- [6] Chart Chiemchaisri, Boonya Charnnok , Chettiyappan Visvanathan , Recovery of plastic wastes from dumpsite as refuse-derived fuel and its utilization in small gasification system, Bioresource Technology 101 , 1522–1527, 2010.
- [7] Sutharat Muenmee, Wilai, Chiemchaisri, Chart Chiemchaisri, Microbial consortium involving biological methane oxidation in relation to the biodegradation of waste plastics in a solid waste disposal open dump site, International bio deterioration & Biodegradation, 102,172-181, 2015.
- [8] Y.-H. Lin, M.-H. Yan, T.-T. Wei, C.-T. Hsu, K.-J. Wu, S.-L. Lee, Acidcatalyzed conversion of chlorinated plastic waste into valuable hydrocarbons over post-use commercial FCC catalysts, 2009.
- [9] Zhigui He, Guiying Li , Jiangyao Chen, Yong Huang , Taicheng An , Chaosheng Zhang, Zhigui He, Pollution characteristics and health risk assessment of volatile organic compounds emitted from different plastic solid waste recycling workshops, Environment Intl,77,85-94, 2015.
- [10] Andra's Angyal, Norbert Miskolczi, La'szlo' Bartha Andra's Angyal, Petrochemical feedstock by thermal cracking of plastic waste, 2007.
- [11] Sie Ting Tan , Wai Shin Ho , Haslenda Hashim , Chew Tin Lee , Mohd Rozainee Taib , Chin Siong Ho Sie Ting Tan , Energy, economic and environmental (3E) analysis of waste-to-energy (WTE) strategies for municipal solid waste (MSW) management in Malaysia, 2015.
- [12] S.M. Al-Salem, P. Lettieri, J. Baeyens Review S.M. Al-Salem, The valorization of plastic solid waste (PSW) by primary to quaternary routes: From re-use to energy and chemicals, 2010.
- [13] M. Mani, G. Nagarajan, S. Sampath M. Mani, Characterization and effect of using waste plastic oil and diesel fuel blends in compression ignition engine, 2011.
- [14] N. Miskolczi, R. Nagy N. Miskolczi et al, Hydrocarbons obtained by waste plastic pyrolysis: Comparative analysis of decomposition described by different kinetic models, 2012.