Plastic Waste Segregation from Non-Plastic Wastes

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Abstract **- This paper explains the technologies which can be used to segregate different types of materials efficiently for the recycling of wastes of all the recyclable materials. From the study of the separation techniques listed, the methods like eddy current separator and air classifiers with sensor-based sorting techniques can be widely used as it gives easy access and there is no complexity. The air classifiers can be applied as a separation technique in almost all variety of projects. Here we have studied the various scientific techniques of waste plastic separation from municipal waste systems. Among all methods described, few of the methods can be usefully applied and have a proper impact on selection for particular recycling and reuse. The waste separated can be divided properly according to their type, density, nature, etc. The separated waste plastic can be used for many other useful processes. Now-a-days study has been going on how to convert the waste plastic into energy.**

Index Terms **- Plastic waste, air classifiers, eddy current separator, Inductive sensor, Capacitive sensor, (NIR)Near Infrared moisture sensor.**

I.INTRODUCTION

Plastics which have wide application in day-to-day human life generate large amount of waste, which is a serious environmental problem. The sorting of plastics is very crucial in plastic recycling for energy recovery since separated resins have higher values and are preferred by most reclaimers. Manual sorting is very laborious and human error is considerable. Nowadays there are many different types of automated sorting systems on the market that employ some kind of detection signal and sensor to detect and analyze chemical or physical characteristics of different plastics. It has been observed that whatever sorting methods are existing, have associated drawbacks. Manual sorting is not cost effective and automated systems are sensitive to dirt and produces high level of loss when set-up to deliver high purity. A good sorting technique should be very sensitive to small differences in gravity and can be performed on a laboratory and commercial scale without having high investment.

Plastics have made significant contribution in almost every field of human activity today – agriculture, medical, transportation, piping, electrical and heat insulation, packaging, manufacturing of household and electronic goods, furniture and other items of daily or specific use. Plastics in medical products like disposable syringes, blister packing of tablets and capsules, joint replacement prostheses, inter venous (IV) fluid bottles, blood bags, catheters, heart valves, etc., have significantly helped supporting the human life. Medical devices made of plastics are implanted into the human body. Packaging is one of the most important applications of plastics. In fact, about 40plastic materials worldwide are used in packaging applications. Plastics have contributed in creating a sustainable, hygienic, energy efficient, cost effective and environmentally friendly packaging system. Versatility of plastics has allowed creating an efficient pilfer proof, hygienic and cost-effective packaging of food products like milk, spices, edible oil, bread, confectioneries, rice, wheat flour, snack foods and various types of medicines. Plastics are used for packaging of toiletries, cosmetics and host of other consumer products of daily and special purpose use required all – rich or poor in urban cities or in the villages.

This has been possible due to the following attributes of plastic materials: i. Safe and hygienic – inert and chemical resistance, ii. Light weight and non-breakability, iii. Excellent barrier properties – enhancing shelf-life, iv. Superior impact resistance, v. Sterilizable and resistance to bacterial and other

microbial growth, vi. Lower fuel consumption and product loss during transportation. Contribution of plastics to human health is difficult to ignore. Plastic based packaging with the above-mentioned properties ensures reaching the best, hygienic and unadulterated product to the masses. Despite all these benefits, plastics packaging in general, and plastic bags / carry bags – which are a part of the packaging system, are under the scanner. Plastics are blamed for series of health, safety and environmental problems. Nonbiodegradability of plastics is attributed towards causing waste management problems and choking of the drains in urban cities.

The solution to waste management problem lies in segregation of dry and wet solid waste at the source for which an effective mass awareness campaign is very important. Creation of efficient solid waste management infrastructure coupled with encouraging establishment of recycling centers would help address the MSW problem. Plastics can be recycled to produce articles for mass use augmenting the concept of resource management. Many useful products have been developed with recycled plastics and large number of people is employed in these activities in small, micro and informal sectors. An informal industry estimate put the recycling figure of India at around 1.5 Million Tons – close to 50high recycling ratio. Recycling ensures that the unwanted and discarded plastics waste does not remain in road side nor it is carried to the landfill.

II. PROBLEM STATEMENT

- A growing population and economy, which means increased volumes of waste generated.
- This puts pressure on waste management facilities, which are already in short supply.
- Increased complexity of the waste stream because of urbanization and industrialization. The complexity of the waste stream directly affects the complexity of its management, which is compounded when hazardous waste mixes with general waste.
- A historical backlog of waste services for, especially, urban informal areas, tribal areas and rural formal areas. Although 61households had access to kerbside domestic waste collection services in 2007, this access remains highly skewed in favor of more affluent and urban communities. Inadequate waste services led to unpleasant living conditions and a polluted, unhealthy environment.
- Limited understanding of the main waste flows and national waste balance because the submission of waste data is not obligatory, and where data is available, it is often unreliable and contradictory.

III. OBJECTIVES

The overall objective of the project is to reduce plastic in waste streams saving nonrenewable resources and enabling carbon neutral energy production from waste. More specifically, the project aims at:

- To identify the major types of plastics through various technologies.
- To segregate the plastic waste from other non-plastic wastes easily.
- To accomplish the techniques to sort out various types of plastic.
- Identifying the main challenges and barriers for reducing plastic waste in mixed waste and residual waste streams, hereby stimulating prevention and recycling of plastic waste
- Promoting recycling of plastic polymers as a substitute for virgin plastic
- Diverting waste plastic from the residual waste going to incineration (creating a carbon neutral energy source) and landfill.

An important feature of the Plastic segregation project is to set up cooperative forums involving public and private stakeholders, by bringing stakeholders together with shared responsibility. The forums and networks will identify and analyze relevant interfaces between the partners in the value chain, and provide the necessary production technology, infrastructure, physical planning, information, waste services, and technologies for reprocessing. By involving all stakeholders in the value chain there will be an opportunity to rethink product design through cradle-to-cradle methods.

IV. LITERATURE SURVEY

[1] This research studied the flotation technique of PET and effects of parameters based on a designed flotation column in laboratory. The species and concentrations of wetting agents have a great influence on flotation separation of mixed plastics. The two stages of flotation screening achieved the optimal effect when using 70mg/L sodium dodecyl sulphate and 8mmol/L dibutyl sebacate as wetting agents, respectively. According to the flotation process established by experiments, 90.91separated from the mixture of PET/PVC/PC/PS [1].

[2] Solid waste management has become one of the main issues in both urban and rural areas all over the world. With the progress of civilization, the waste generated become more complicated in nature. Now-a-days the wastes are dumped as landfill, in some cases some chemicals are added to it to decompose the waste and the major problem in solid waste disposal is plastic separation and they are separated manually and recycled. At present there is not a proper scientific waste treatment plant as well as suitable land for the disposal of wastes. So, it is necessary to have a suitable solid waste treatment plant. Installing a good solid waste management system will aid in achieving good environmental sanitation around urban habitat. This paper is a proposal for a proper technology for the municipal solid waste management. The new technology adopted is Automatic Plastic Separating Technology (APST). The new technology solves all the above problems [2].

[3] Due to industrialization and urbanization the rapid rise in the volume and amount of hazardous waste and the disposal of it is becoming a burgeoning problem that the world is facing today. One of the best ways out for this problem is to collect, sort and reuse or recycle these wastes. So, this paper proposes an architecture which sorts waste materials into plastic and non-plastic using Convolutional Neural Networks (CNN). CNN is one among the efficient machine learning techniques, which is able to provide maximum learning efficiency. This technique requires less parameter for training compared to the standard neural network. A dataset of waste materials required for our setup is collected. They are trained and tested using CNN. The proposed architecture with CNN gives an accuracy of 0.978. The proposed design also consists of a prototype, which acts as a real-time classifier. This system reduces the human efforts in separating plastics from non-plastics [3].

[4] The European Union advocates a plastic waste recycling rate of more than 55recycling plastic waste of households, it will still be a challenge to meet this target. The preferred solution to fulfil this target in the Netherlands is implementing separate collection schemes at the curb side, although some municipalities invested in post-separation. We show, based on data for 2013– 2014, that post-collection separation is an advisable alternative, with an increased separation of plastic waste compared with home separation. This is even slightly the case if home separation is combined with a unit-based pricing system for unsorted waste and with a frequent door-to-door collection of plastic waste. Moreover, there are indications that the cost effectiveness of recycling plastic waste increases if post separation is chosen. In addition, some claim that unit-based pricing of unsorted waste is important to create an awareness effect to buy less packaging material. However, based on the combination of post separation and unit-based pricing, we have no indication for such awareness effect as the price effect on the amount of plastic waste is insignificantly small [4].

[5] In order to deal with the problems facing the plastics processing industry research, work is focused primarily on designing, developing and testing a variety of separation and sorting techniques able to recover plastics from wastes, which can be re-used or re-processed to form new products. In this regard, technologies developed in mineral processing can be of great help. Various techniques for separating plastics materials have been recently developed. These techniques can be divided in two main categories, i.e., wet separating techniques and dry separating techniques. This paper presents the recent progress in separating plastics reviewing the potential of the available techniques [5].

[6] Plastic separation from municipal waste technology is a very difficult to handle. Only possible way is to destroy the plastics, they will burn or dump in ground. As the population of a country increases, the waste produced by them also increases tremendously. There are lot of methods for disposing the wastes such as landfills, incineration, etc. Machines which assist these methods are readily available in the market. The major problem with these types of machines is that they need a lot of space and also cost of the machine is high. This technology requires 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 [9].

[7] This paper contains the various scientific techniques adopted in the municipal solid waste management system to separate the waste plastic from municipal solid waste. The municipal solid waste contains variety and mixture of wastes including organic and inorganic wastes, biodegradable and nonbiodegradable wastes, animal waste, street waste, hazardous waste, etc. There is a need to treat these wastes to reduce their impact on the environment and human beings. The waste needs to be separated and sorted according to their type and nature. The major problem now-a-days is waste plastic which needs to be separated from the municipal solid waste dumps. The waste plastic is firstly separated from the municipal solid waste and further is separated according to the type and nature of the plastic [10].

V. METHODOLOGY

The prototype we are going to propose is the combination of eddy current separator and air classifiers with three types of sensors such as inductive, capacitive and NIR moisture sensors as we are concentrating on three types of waste segregation such as metal, plastics (dry wastes) and wet wastes at a time with the automation process.

A. PROPOSED PROTOTYPE:

Here, we are using the combination of eddy current separator and air classifiers together to sort out wastes into three different types as ferrous metals, non-conductive metals and non-ferrous metals effectively. The waste materials are fed on the vibrating feeder and then it moves through magnetic separator for the separation of magnetic waste materials from other type of wastes. The remaining wastes are dumped in the vibrating feeder which moves to the conveyor belt in order to segregate all three type of wastes at a time, by the help of magnetic rotor we can collect the remaining ferrous metals which has not been segregated at the first step and by adjustable splitter gate we can collect all non-conductive and non-ferrous metals separately.

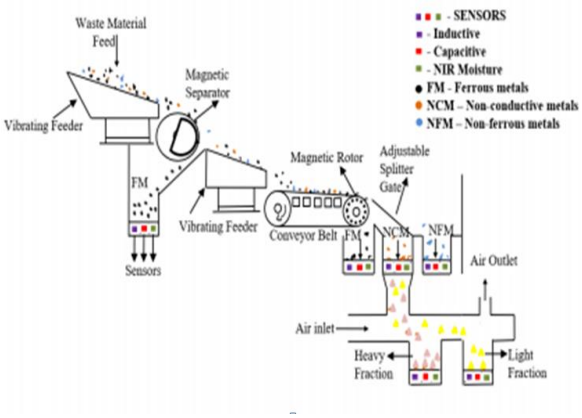

Fig. 1. PROPOSED MODEL

The non-conductive metals undergo another process of operation such as air classification to segregate heavy fraction (coarse particles) and light fraction (fine particles) in order to sort out wet wastes and dry wastes respectively, the main objective of this process is to segregate plastic from other types of mixed waste (non- plastic waste) more efficiently. In all the waste collected bins, we are placing three sensors which are capacitive, inductive and NIR moisture sensors to sense plastics, metals and wet wastes respectively in order to monitor the presence of other type of waste collected in the bin so that it can be further segregated to have a proper segregation of wastes precisely, which provides accuracy to the system of waste segregation in case of any improper collection of wastes.

VI. CONCLUSION

The above combination of eddy current separator and air classifiers with sensors prototype reduces the manual work in the waste recycling industry. The proposed methodology helps to improve automation in the segregation process. Compared with the existing system, the proposed arrangement is compact and is possible to implement in all recycling industries. This system helps in segregating plastic wastes from other types of wastes. Waste segregation ultimately known as waste management is the process of disposing, reprocessing, recycling and refining materials that were thought as waste. This model of waste segregation and disposal system is beneficial in protecting the environment and people from biohazards. Segregating and disposing of waste properly will reduce the amount of toxins entering the atmosphere and it is a way of saving the planet and lives of people. This system helps in reducing

environmental pollution by keeping the environment clean and fresh, which saves the earth and conserves energy by promoting a sustainable lifestyle.

A. FUTURE SCOPE

- Can implement this prototype has a product/model in the projects related to waste segregation.
- The above technologies can be used in different ways in further projects to segregate different types of materials such as plastics, metals, etc. from wastes.
- Can be implemented in the large-scale industries for wastes segregation which helps to recycle the different types of waste easily.

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