Waste Plastic Separation – A Comparative Feasible Study

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***Abstract*—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 non-biodegradable 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.**

Keywords*— *Waste plastic, municipal solid waste, separation techniques

I. INTRODUCTION

The economic growth and change in consumption and production have resulted into rapid increase in waste plastic generation in today's world. The change in lifestyles of societies have increased the rate of rejection of solid materials regularly from different sectors like domestic, industrial, commercial, agriculture, institutional, etc. Many of the urban areas around the country are plagued by the problems related to solid waste. Due to avoidance and lack of efforts by the municipal authorities, garbage and its management has become a persistent problem. Relatively there has been a decline in the service standards with respect to the collection and disposal of municipal solid waste. In many of the cities the unattended solid waste give rise to the insanitary conditions in densely populated slums which results in an increase in infestation in all segments of population with the waste handlers being more affected.

Municipal solid waste has several sources such as residential areas, commercial areas, institutional environments, construction and demolition areas, municipal services, etc. The waste classification is based on types, i.e. physical, chemical and biological characteristics of wastes like garbage, ashes and residues, combustible and non-combustible wastes, bulky wastes, street wastes, biodegradable and non-biodegradable wastes, dead animals, abandoned vehicles, farm wastes, hazardous wastes and sewage wastes. After food waste and paper waste, plastic waste is the major constitute of municipal and industrial waste in cities. Even the developing cities having low economic increment have started producing more and more plastic waste due to plastic packing, plastic bags, plastic bottles and other manufactured goods made of plastic. Due to improper management of solid waste, most of the waste plastic is difficult to collect and dispose of in proper manner which causes negative impacts on environmental and public health.

II. OBJECTIVE

The municipal solid waste contains mixture and a variety of materials including paper, plastic, wood chippings, animal dead bodies, vegetable leftovers, etc. In today's world these wastes create a big problem as it is produced in a large amount daily. Among all the waste materials generated, waste plastic is the major product which needs to be paid attention for its separation from other municipal wastes. Hence the main objective of this paper is to study the present available techniques to separate the waste plastic from municipal solid waste before its disposal.

III. METHODOLOGY

The study regarding the separation techniques of waste plastic is done by referring to the research articles, journals, publications, and the municipal solid waste management handbook. The reference papers considered give the guidance to adopt the methods and techniques.

A. Separation Techniques for Plastic Waste

Mechanical recycling of plastics usually requires that the plastic material that is considered worthwhile to recycle is separated from other materials. In many cases, there is also a need to separate different plastic types (e.g. PVC, PET and polyethylene) from each other. In several cases, plastics are also sorted by color in order to improve the physical appearance of the products derived from post-use material. The following methods can be adopted to separate the waste plastic from other wastes.

1) Manual sorting: The process of separating waste plastic is based on labor-intensive. The rag pickers and kabari-walas are the media who sort the waste according to the types and characteristics. The workers pick the plastic, paper, cardboards, plastic bottles and collect it for recycling. It is the most common method applicable in all types of areas. [8].

Fig. 1. Manual sorting process.

2) Sorting by density: The overall density of a plastic material can however be altered significantly by the incorporation of fillers or by foaming. Separation of materials by density in float-sink tanks or hydrocyclones is commonly applied to ground waste plastics. The polyolefins most commonly used in packaging applications, PP, LDPE and HDPE, are notoriously difficult to separate efficiently because of the small difference between their densities. [8].

3) Air classifications: It is possible to sort materials by a combination of density shape using air streams. The technique is called air classification or air sorting. It can be used to sort e.g. film plastics and paper residues from ground plastic flakes. Low velocity air is used to separate lighter materials (e.g., aluminum and plastics) from heavier materials (glass). This can be accomplished by.

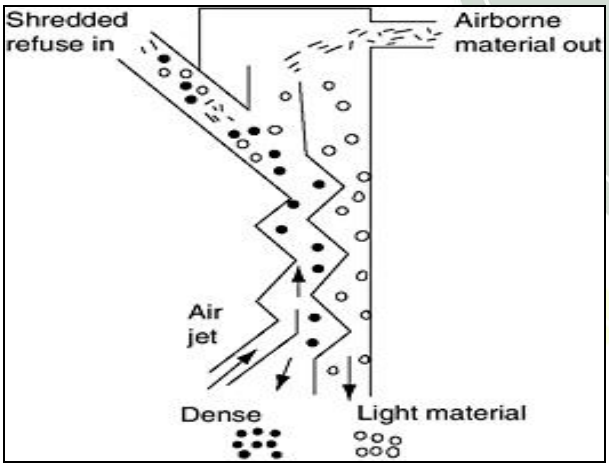

Fig. 2. Air Classifier.

- Blowing the lighter materials across an air knife to another conveyor at a conveyor tail pulley (heavier materials drop over the tail pulley); or
- Using suction above a commingled container stream on a conveyor to remove the lighter material (heavier material stays on the conveyor). Once removed, the lighter materials are directed to a separate sorting conveyor. In the vacuum system, air velocities within the pickup unit can be adjusted to create multiple pressure drops. Heavier items will drop out first and lighter second. Vacuum systems are popular for conveying materials, such as film plastic, PET and HDPE containers and aluminum cans, from sorting stations to a remote cage or bunker. [8]

4) Electrostatic separations: Electrostatic charging of different plastics can be utilized to achieve separation. A wide variety of equipment exists. The most common way of charging the materials is by triboelectric charging which means that particles are tumbled against one another. This causes some materials to become positively charged and others to become negatively charged. The materials can then be sorted by letting them fall freely through an electric field. [8].

5) Sensor based sorting techniques: Sensor based sorting systems start with a feed section which distributes the material evenly in a single layer across a conveyor belt or chute. The material is then transported so that it moves under or in front of a light source. In the case of the NIR technologies, the illuminated object reflects a characteristic infrared spectrum which is unique for each type of material. The laser technique works in a similar way, in that a laser signal is reflected off the material. Different objects reflect different signals from the laser, therefore enabling them to be identified and separated.

The next step in sensor based sorting is the detector which receives the signal from the illuminated object. This is then converted into a digital signal, which can be sent to a computer where software identifies the detected material and decides whether the object/particle needs to be removed based on what the system has been set up to eject.

If it is decided that the object/particle needs removing, the computer activates the air jets in the machine and the chosen objects/particles will be ejected from the main stream and form the eject fraction. The material which is not ejected falls into the reject fraction. There is usually a splitter plate positioned between these two fractions to keep the fractions apart. [4]

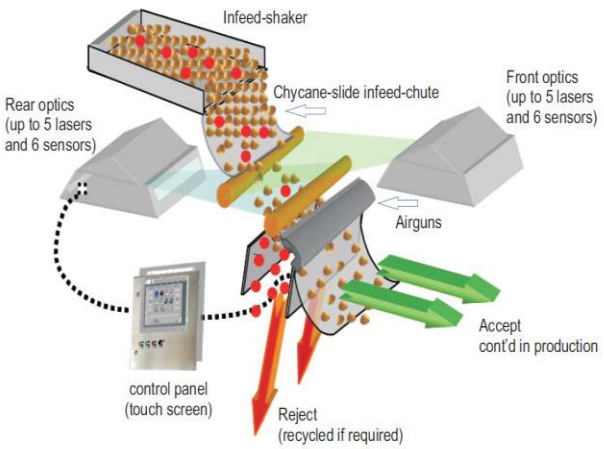

Fig. 3. Schematic layout of Laser Sorting.

IV. Result And Discussion

From the study of the separation techniques listed above the methods like air classifications and 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. Likewise

the sensor based sorting technique can be used in mostly bigger projects having high capacity collection.

CONCLUSION

Here we have studied the various scientific techniques of waste plastic separation from municipal waste systems. Among the all methods described above 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 is been going on how to convert the waste plastic into energy.

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