Waste Plastic Separation - A Comparative Feasible Study

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***Abstract*: The various scientific techniques used in the municipal solid waste management system to separate waste plastic from municipal solid waste are described in this paper. Municipal solid waste is a diverse and mixed waste stream that includes organic and inorganic wastes, biodegradable and non-biodegradable wastes, animal waste, street waste, hazardous waste, and so on. These wastes must be treated in order to have a lower impact on the environment and humans. The waste must be separated and sorted based on its type and nature. The main issue these days is waste plastic, which must be separated from municipal solid waste dumps. The waste plastic is separated from municipal solid waste first, and then according to the type and nature of the plastic.**

***Keywords*: Waste, Plastic, Waste plastic, municipal solid waste, separation technique, Solid Waste Management**

Introduction:

In today's world, economic growth and changes in consumption and production have resulted in a rapid increase in waste plastic generation. Society's changing lifestyles have increased the rate of solid material rejection from various sectors such as domestic, industrial, commercial, agricultural, institutional, and so on. Many urban areas throughout the country are plagued by solid waste problems. Garbage and its management have become a persistent problem as a result of municipal authorities' avoidance and lack of effort. There has been a relative decline in service standards for municipal solid waste collection and disposal. Unattended solid waste causes insanitary conditions in densely populated slums in many cities, resulting in an increase in infestation in all segments of the population, with waste handlers being the most affected.

Feasibility analysis entails a number of steps that must be completed in order to complete an assessment of the project. There are numerous online resources that describe the steps for conducting a feasibility study, but the majority of them provide similar information. The C.R.A.P. test was used to select one resource for the feasibility study, which evaluates resources in four major categories: currency, reliability, authority, and purpose/point of view (Colorado Community Colleges, n.d.). Once the feasibility study was completed, it was carried out based on the information gathered about the resources available for successfully establishing the Plastic Recycling Centre. [1]

Plastic Waste Separation Method:

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 separation of waste plastic is a labor-intensive process. Rag pickers and kabari-walas are the media who sort waste based on its type and characteristics. Workers collect plastic, paper, cardboard, and plastic bottles for recycling. It is the most widely used method in all types of situations. [2]

Figure 1: Manual sorting process

2) Sorting by density: The overall density of a plastic material can be significantly altered by the addition of fillers or foaming. Ground waste plastics are frequently separated by density in float-sink tanks or hydro cyclones. Because of the small difference in densities, the polyolefins most commonly used in packaging applications, PP, LDPE, and HDPE, are notoriously difficult to separate efficiently.

3) Air classifications: Using air streams, it is possible to sort materials based on a combination of density and shape. The process is known as air classification or air sorting. It can be used to separate film plastics and paper residues from ground plastic flakes, for example. Low velocity air is used to separate lighter materials from heavier materials (such as aluminium and plastics) (glass).

4) Electrostatic separations: Different plastics can be separated using electrostatic charging. There is a wide range of equipment available. Triboelectric charging, in which particles are tumbled against one another, is the most common method of charging materials. Some materials become positively charged as a result, while others become negatively charged. After that, the materials can be sorted by allowing them to fall freely through an electric field.

5) Sensor-based sorting techniques: Sensor-based sorting systems begin with a feed section that distributes the material evenly across a conveyor belt or chute in a single layer. The material is then moved so that it is beneath or in front of a light source. In the case of NIR technologies, the illuminated object reflects a distinct infrared spectrum that is unique to each material type. A laser signal is reflected off the material in a similar way to how the laser technique works. Different objects reflect different laser signals, allowing them to be identified and separated.

Objectives:

1. To study the present available techniques to separate the waste plastic from municipal solid waste before its disposal.
2. Perform feasibility analysis for implementing a Plastic Recycling Center Explain the processing techniques for reducing the volume and size of wastes.
3. Carry out separation of various components.
4. Assess technical viability of various processing techniques.

Review Of Literature:

Since the invention of various routes for the production of polymers from petrochemical sources, the plastics industry has grown significantly. Plastics have significant advantages over many other material types in terms of weight, durability, and cost (Andrady & Neal 2009; Thompson et al. 2009a). In 2007, total polymer production was estimated to be 260 million metric tonnes per year, including thermoplastics, thermoset plastics, adhesives, and coatings, but not synthetic fibres (PlasticsEurope 2008b). This corresponds to a historical growth rate of about 9% per year. Thermoplastic resins account for roughly two-thirds of this production, and their use is increasing at a rate of about 5% per year globally (Andrady 2003). [3-6]

Plastics are now almost entirely derived from petrochemicals derived from fossil oil and gas. Approximately 4% of annual petroleum production is directly converted into plastics from petrochemical feedstock (British Plastics Federation 2008). Because the production of plastics requires energy, it is responsible for the consumption of a similar amount of fossil fuels. However, it can be argued that the use of lightweight plastics can help to reduce the use of fossil fuels, such as in transportation applications where plastics replace heavier conventional materials like steel (Andrady & Neal 2009; Thompson et al. 2009b). [7-8]

Research Methodology:

The study of waste plastic separation techniques is conducted by consulting research articles, journals, publications, and the municipal solid waste management handbook. The reference papers considered provide guidance for implementing the methods and techniques.

To investigate the current techniques for separating waste plastic from municipal solid waste before disposal. For evaluating WPI's plastic waste management strategy, this study used both qualitative and quantitative research methods. These methods included document analysis, community interviews, field visits and data collection, and community engagement. As a solution to the assessment's limitations, the establishment of a plastic recycling centre on the WPI campus was proposed. A feasibility study was conducted to determine whether the solution could be implemented.

Books, educational and development journals, government papers, and print and online reference resources were among the secondary sources we used to learn about the composition, use, and consequences of waste plastic separation techniques.

Result And Discussion:

Based on the research of the separation techniques listed above, methods such as air classifications and sensor-based sorting techniques can be widely used because they provide easy access and lack complexity. Air classifiers can be used as a separation technique in a wide range of projects.

Plastic Recycling Centre Feasibility Analysis:

The Plastic Recycling Centre was evaluated using the Feasibility Analysis method discovered during the research in three categories: finance, technology, and management.

Finances: PRC was determined to be financially feasible with the availability of $9200, as shown in Table 1, from various grants and programmes at WPI. Finances are typically a bottleneck in the completion of any project. The proposed plastic recycling centre will cost approximately $4550 based on the Bill of Materials obtained from the Precious Plastic Project and revised with the prices of the same materials to reflect current prices. Table 1 displays the cost breakdown.

Table 1: Budget breakdown for setting up the Plastic Recycling Centre

PRC Budget	Amount
Collection Station	$1150
Shredder Station	$2500
Injection Molding Station	$400
Miscellaneous Cost	$500
Total	$4550

Technology: To recycle plastic waste at the Plastic Recycling Center, the project will require two large machines, a plastic shredder and injection machine, as well as a desktop computer for data collection and team communication in the event that the machines malfunction.

plastic Recycling Centre Management: Similar to the Technology feasibility assessment, having an enthusiastic and technically inclined WPI community makes establishing a PRC feasible in terms of the availability of manpower to carry out the PRC's operations. [9]

The material reflects a laser signal. Different objects reflect different laser signals, allowing them to be identified and separated.

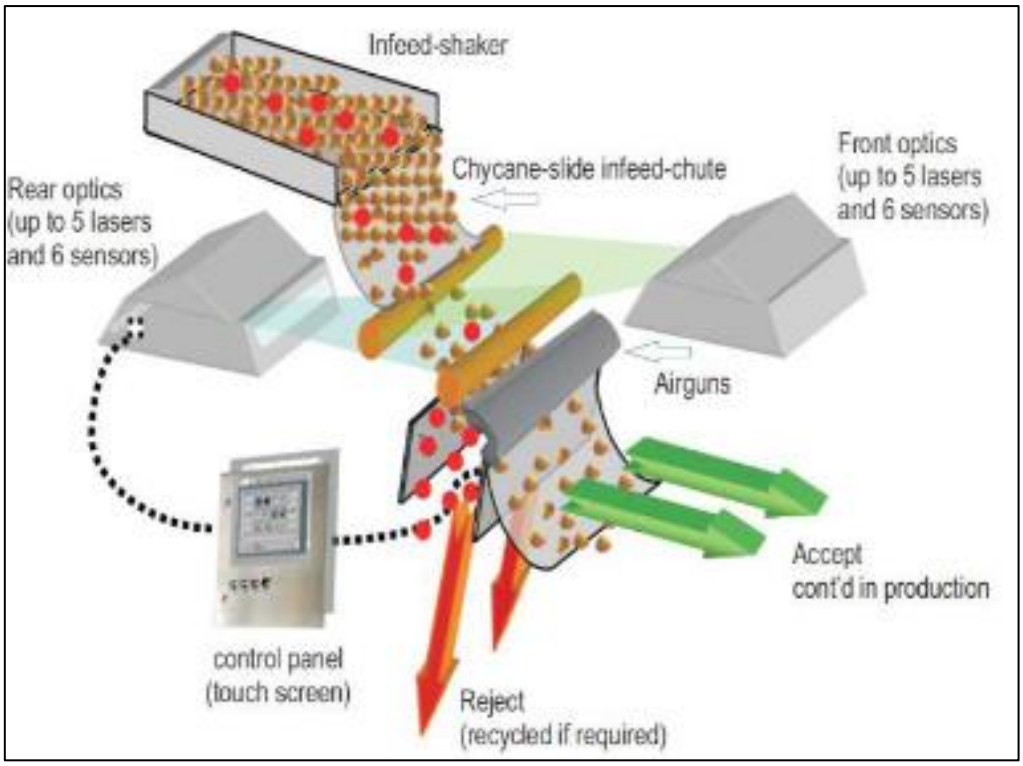

Figure 2: Laser Sorting Technique

Figure 2 depicts the use of a laser sorting technique. Sensor-based sorting techniques are typically used in larger projects with high capacity collection. [10]

Conclusion:

We investigated the various scientific techniques for separating waste plastic from municipal waste systems. Few of the methods described above can be usefully applied and have a proper impact on selection for specific recycling and reuse. Waste can be properly separated based on its type, density, nature, and so on. The separated waste plastic can be used in a variety of other processes. Currently, research is being conducted on how to convert waste plastic into energy.

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