

# Study of Design and Development of Plastic Recycling System: A Review



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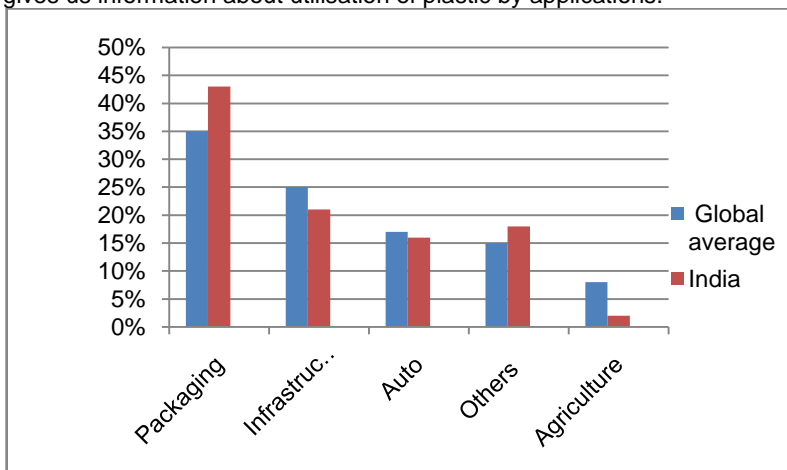
**Abstract**

Plastic becomes crucial part of human life. In India plastic waste comprises major part of the MSW. Plastic products like plastics in packaging applications, plastics for one time use-like cups, plates etc. Create management problem when not disposed properly. It has adverse effects on environment, human health, and marine life. Land filling is the easiest way to dispose plastic, but with increase in population there is scarcity of land also it pollutes land. There is needed to look for other alternatives. Recycling is one of the best options to handle this problem, in India 3.6 MnTPA plastic waste is recycled. With proper plan and strategy it is possible to increase recycling rate. This paper reviews the plastic consumption and methods of recycling.

**Keywords:** Plastic Consumption, Forth Float Separation, Shredding.

**Introduction**

Plastic is widely used in both everyday life and manufacturing processes since their commercial development in the 1930s and 1940s. [9]. India's plastic consumption is expected to touch 16 to 20 million tonnes by 2015-16 (plastic India foundation the apex body of major associations, organisations and institutions connected with plastic). Following figure gives us information about utilisation of plastic by applications.



(Source: Analysis by Tata Strategic)

**Fig.1 Plastic consumption rate according to applications**

Plastic have become a crucial part of the lifestyle. Traditional plastics are very strong and not degrade in the ambient surroundings. It is the fact that plastic will never degrade and remains on landscape for several years. [1] Plastic polymers and products are extremely diverse both in terms of chemical composition, properties, and products and possible applications. Several hazardous substances may be released during the life cycle of plastic products. [8] The earth is also experiencing problems because of this plastic waste. In study it is found that greenhouse gases that are being emitted by the fossil fuels as methane gases have global warming potential. But the waste which is being created on a daily basis has much more potential to emit carbon dioxide as greenhouse gases. It is worth noted that carbon dioxide is having 21 times more global warming potential than methane.

The proportion of plastic waste in municipal solid waste has increased significantly to now comprise around 10% of municipal solid waste (euro stat 2015). One of the best options for managing the plastic solid waste is recycling rather than incineration to decrease the waste volume and reduce environmental issues. Although plastic recycling is

important, only about one-fourth of plastic solid waste is recycled and reminder is disposed in the landfills. One of the main reasons for the low recycling rate is that most recycled plastic cannot be used for the same application for reasons of health and environmental protection. Another is due to the fact that the plastic obtained from landfills are often blends of numerous polymers and it is not economically feasible to separate them [2]. It becomes necessary to provide practical and feasible solution for plastic recycling to the society. This paper reviews various methods of plastic separation and recycling.

**Types of Plastic Waste and there Separation**

Some commonly used plastics and their applications from Narinder Singh et al [1].

**Table No 1 Plastic Type and their Applications**

Plastic	Application
PVC(polyvinyl chloride)	Construction, Medical, Electrical, Automobile, Packaging, Clothing.
PLA (polyactic Acid)	Decomposable Packaging Material, Cups And Bags. Disposable Garments, Awnings, Feminine Hygiene Products, And Diapers.
ABS (acylonitrile butadiene styrene)	Drain-waste-vent Pipe Systems, Musical Instruments, Automotive Trim Components.
Polystyrene	Disposable Plastic Cutlery And Dinnerware, CD Cases, Smoke Detector Housings, License Plate Frames.
Polyster	Staple fibre (PSF), Bottles for CSD, water, beer, juice,detergents,Technical yarn and tire cord.
PET (polyethylene terephthalate)	Packaging film, PET Bottle, Carpet Yarn, Engineering plastic, Filaments, Non-woven, Packaging stripes, staple fibre.
LDPE (low density polyethylene)	Packaging for computer hardware, such as hard disk drives, Trays and general purpose containers.
HDPE (high density polyethylene)	Toys, utensils, films, bottles, pipe and processing equipment. Wire and cable insulations.

**Separation Technique of Plastic Waste**

**Laser Introduced Break Down Spectroscopy**

In this technique a laser-produced plasma emission is recorded for spectral analysis of various kinds of plastics in order to fingerprint these plastics. Mainly 6 numbers of plastic materials (Low density polyethylene (LDPE), High Density Polyethylene (HDPE), Polypropylenes (pp), Polystyrene (PS), Polyethylene terephthalate (PET) and Polyvinyl

chloride (PVC)) can be identified by this technique. Calibration is done by striking laser beam of Nd:YAG laser of specific wavelength on to the some previously identified plastic waste material [1].

**Tribo-Electric Separation**

Narinder Singh et al [1] mentioned in their review paper that among the separation techniques used in industry, the Tribo electric separation of insulating particles using rotary tube is an efficient technology employed in waste recovery and mineral industries. A tribo electric based separation device sort's materials on the basis of surface charge transfer phenomenon.

**X-Ray Fluorescence**

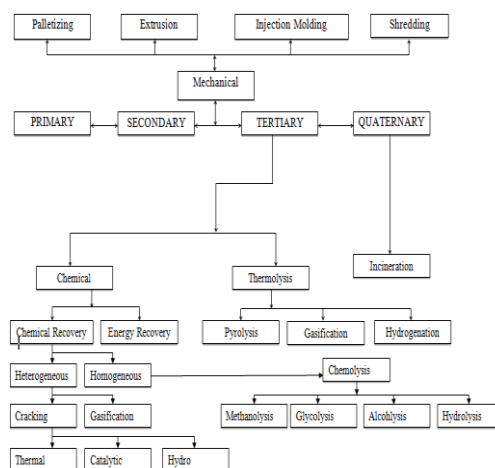
This technique use to determine the chemical composition of all kinds of materials covers a very wide range, like metal, cements, oil, polymer, plastic and food industry comes under non destructive testing. Very high accuracy can be expected by this technique if good standard specimens are available. This technique uses x-rays produced by a source, then irradiating a sample with it [1].

**Forth Flotation Method**

This is one of the simplest and lowest costs methods [1]. Though application of floatation to the plastic separation is further step of ores floatation, plastics floatation exhibits a number of specific features are related to the distinct properties of plastic, such as low density and low surface energy. The features can provide some insights into plastics floatation [3].

Among this many methods manual separation is labour-intensive, low efficient and poor in working conditions. Due to similar properties of plastics, tribo electrostatic separation and gravity separation are significantly limited for separation of plastic wastes. In case of selective dissolution, the toxic organic solvents associated with costs makes alternative methods more attractive [3].

**Recycling Methods**



**Fig. 2 Various Recycling Techniques (Source: As Per ASTM, 2000)**

Primary recycling is known as re-extrusion, is recycling of uncontaminated, single type of polymer having properties near to virgin material. This process utilizes scrap plastics that have similar features to the

original products. MSW contains excess contamination so not suitable for primary recycling. Secondary recycling involves cutting, shredding, contaminant separation, flake separation by floating. After these steps single polymer plastic material is processed and milled together to form granulated form. Then pre washing followed by drying is done to remove all kinds of glue particles. Some time chemical washing by using caustic soda is done for glue removal. Then the product is collected stored and sold after addition of pigments and additives. Further extrusion of plastic strands is done by making pallets according to requirement and then final products are made.

Primary and secondary recycling techniques are some time appears difficult to process, since it includes identification and sorting of material by various methods. These both techniques do not contribute towards the principle of energy sustainability. But tertiary recycling contributes towards energy sustainability. Because it leads to the generation of the raw materials from which the plastics are originally made, therefore attracting attention of recyclers. It involves various methods of recycling including pyrolysis, cracking, and gasification. After a number of recycling cycles of PSW by primary, secondary and tertiary techniques material starts losing its properties. The only way to discard it is to land fill. [1] Further, the recycling of plastic material can be done 2 to 3 times only, because after every recycling, the strength of plastic material is reduced due to thermal degradation.

It is possible to recycling of the plastic by using any one of the method mentioned above. But it is major challenge in front of us to implement such systems in practice. There is need to create awareness among the people with proper strategy.

1. Mindset- relatively underdeveloped knowledge and motivation among the people is needed, educating households to change behavioural patterns by providing information and encouraging compliance of non-recycling households is essential to seek participation and interest.
2. Behaviour and culture- it deals with establishing sustainable solid waste management emphasising on 3Rs reduce, reuse, and recycle.
3. Collaboration and synergy- it focuses on continuous development solid waste services and public cleansing.

With this above principles we lead towards the society which provides trash to treasure [5].

#### **Aim of the Study**

It is required to collect information regarding plastic recycling and study its various methods.

#### **Conclusion**

Literature review of above study concludes for survey of plastic bag and plastic recycling material used for various applications. So our study suggests for the convenient system to be design and implemented to provide recycling of plastic material. This paper provides idea about the current plastic consumption rate, which is increasing per year, and thus major contribution to the MSW. Recycling is one

of the best options to handle this plastic waste problem. This paper gives short idea about various plastic separation and recycling methods.

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