

## Plastic Waste Management - Present practice and future possibilities

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**Abstract**-Plastic is undoubtedly to reign among the variety of materials for its varied applications; engineering machinery parts to domestic appliances to packaging's. Warning bells are now sounding aloud against the deterioration of the eco-system; witnessed by the over use of plastics.

From environmental sustainability perspective, literature survey suggests, efforts are focused mainly on formulating methods to achieve maximum plastic waste recycling targets. Still, all plastic waste collection and even whole recycling of collected plastic can't be ensured. However, plastic recycling does not prove economical due to collection and sorting difficulties. Moreover, Single use plastic waste remains at large from collection and hence recycling. It is dumped in the landfill sites along with solid food waste.

This research paper enlists the shortcomings in the existing literature and proposes a renewed scope in achieving; resource, economic and environment sustainability by managing a complete plastic forward and reverse supply chain.

**Keywords:** *plastic waste, sustainability, recycling, supply chain management*

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### I. INTRODUCTION

Growth of petrochemical industry, around 1920s, witnessed the rapid consumerization of plastic in the world; although, its commercialization initiated quite a century ago [1]. It is a universal truth that plastic facilitated the mankind with a comfortable alternative to wood, leather, glass, metals, etc. [2]. Plastic proves compatible when it comes to working condition; it acts neutral in heterogeneous working environmental situations. Plastic products are featured with multi-colour; also, the single colour with different shades on colour bandwidth is possible. Plastic products can be formed into complicated shapes which otherwise is difficult and not economical with other materials. Plastic can be moulded into products; exhibiting desired mechanical and physical properties by blending it with performance enhancer additives. Plastics are durable and also offer a wide range of aesthetic appearance. Plastics have become so versatile in its functioning that it is making inroads in all sorts of applications; may it be consumer, industrial, utilities, civil structures, etc. If any new product is foreseen for development, plastic is revived first because it facilitates the purpose. Once hailed as a 'savior material', now plastic is being realized to the intensity of disastrous it can cause to the planet earth in terms of its environmental and health hazard due to its non-biodegradable nature [3]. One research author had rightly remarked that, if the corrective steps are not initiated with immediate effect, we may require one planet to dump the non-degradable plastic waste while another to procure the resources. Such is the extent of concentration of plastic waste on the planet earth that satellite images of oceans shows big white spots signifying the accumulation of floating plastics on its surface. Creation

of more and more landfill sites is spoiling the occupied fertile land for no use [4, 5]. Soil microbiological activity is disrupted by plastic. Presuming it to be the food, animals consume the loose plastic along with the food waste. There are examples over recovery of loose plastic junk from cow's stomach, dying marine creatures due to plastic ingestion. Foodstuffs get contaminated; taste and odour of water changes due to leaching of plastic when exposed to sunlight for longer period. Due to excessive urbanization, fast changing living styles, use and throw culture of essential commodities and hence adherence to cheap single use packaging like polyethylene bags makes the situation worse after it becomes waste. Not all of this light weight plastic waste is collected and recycled, but a significant part remains strewn in the form of litter on the streets and the fields. These litters are carried away by the wind to create horrible sanitation problems when the drains get chocked.

### II. PLASTIC INDUSTRY PROFILE

In India, plastic industry is progressing at a rapid rate; the growth rate is remarkable; although, as compared to the developed countries per capita consumption of plastic is very less [6]. Consistent growth of the plastic industry is observed in furniture sector, agriculture, sanitation and electronic household and industrial appliances sector. Growth potential is catching up very fast in the packaging sector; plastic is being preferred over wooden, paper and glass packaging. HDPE and PVC plastic are predominantly used in furniture, agriculture and sanitation sector while LDPE, PET plastic are widely used in foodstuffs packaging. Indian market trends suggest plastic in packaging sector has a promising growth in the years to come.

### III. SOURCES OF PLASTIC WASTE

Durable plastic products, after its efficient use is sold by the consumer or industry to the scrap vendors, who, after sufficient collection sells it to the recycling plant. Recycled plastic granules are then mixed in certain proportion with the virgin material to form the finished or semi-finished product in the moulding shop. Plastics can be recycled for atleast six times before being discarded as waste in the landfills. Plastic wastes of this kind are refrigerator cabinets, washing machine parts, grinder parts, furniture's, television and computer cabinets, etc. generated from household whereas; storage tanks, crates, barrels, computer cabinets, etc. is generated in larger amounts from industries [7]. Another type of plastic waste is from a light weight, single use plastic items whose source of generation is at the household, apartments, community centers, hotels, canteen, event venues, and commercial markets. Plastic wastes of this kind are PET bottles, packaging films, cups, carry bags, milk pouch, etc. Among other sources of generation of plastic waste are agriculture, civil construction sites, hospitals and automobile service centers.

#### 3.1. PROBLEMS RELATED TO PLASTIC WASTE

Plastic waste derived out of durable and single use light weight items is collected by rag pickers from municipal dumpsites and landfill sites while the durable plastic waste is purchased by the street vendors from the households and industries. Rag pickers and street vendors earn their livelihood by selling it to the collection centers. All these collected plastic waste is sorted according to their grades, washed and dried. The particular grade of cleaned plastic waste is then crushed into fine chips before being transported to the recycling units for extruding it to form pellets in a pelletizer. Plastic recycling is a sensitive process in the way that if two different grades of plastic get mixed in slightest of the proportion, the whole batch of production gets spoiled for secondary or no further use. In India, recycling units are not technically advanced to run in a safe procedure; release of toxic fumes and unhygienic working conditions is a serious concern. Achievement of planned collection targets of light weight plastic waste is a difficult task since the litters are carried away by the wind and are also strewn on the streets and open fields by the animals. Plastic litters get accumulated in the drainage lines which lead to blocking of the streams, raising the hazards of health, hygiene and environmental safety [8]. Plastic litters are mistakenly ingested by the animals along with the food contained in it leading to its death. Several reports are public about the cows being operated for removal of junk of plastic waste from its stomach. Plastic waste when subjected to sunlight and extreme weather conditions for long duration,

starts losing its properties thereby disintegrating into minute invisible fragments. These minute particles contaminate the ocean and soil microbial structure leading to the death of marine creatures and reducing the fertility of the soil. Although plastics put in only about 7% w/w to municipal solid waste, they may add 15% or more to the total heat content of municipal solid waste.

#### 3.2. ALTERNATIVES TO REDUCE THE IMPACTS OF PLASTICS WASTES

Source Reduction: There are number of ways of achieving source reduction. Examples include:

- Modify design of product or package to decrease the amount of material used.
- Utilize economies of scale with larger size packages.
- Utilize economies of scale with product concentrates.
- Make material more durable so that it may be reused.
- Substitute away from toxic constituents in products or packaging.

Potential plastic markets that may be considered for source reduction include packaging, building and construction, consumer products, electrical and electronic, furniture and furnishings, transportation, adhesives, inks, and coatings.

Recycling: India ranks highest in terms of plastic recycling percentage (60%) in the world, whereas the world average is only 20% [1]. Recycling methods could be classified by following types [2]

- Primary Recycling: Melting, molding and solidification.
- Secondary recycling: Melting and extrusion or injection.
- Tertiary Recycling: Physical and chemical methods that include thermolysis (pyrolysis, catalytic cracking, hydro cracking, etc.) and depolymerisation (alcoholysis, hydrolysis, acidolysis, aminolysis, etc.).
- Quaternary Recycling: Incineration with energy recovery.

Phases of Plastic Recycling: Recycling plastics from MSW encompass four phases of activity collection, separation, processing/manufacturing and marketing [3].

Collection: Collection of plastics involves formal (municipal) sector and informal sector comprising of wastepickers, kabariwala, scrap dealers and bulk buyers. The municipality derives its funds for waste management either through funds designated by the Central Government and funds derived from property taxes.

Separation: It involves both formal and informal sector. Plastics segregated from MSW include a variety of resins. It

is not necessary to separate plastics by resin type to allow their recycling, but separation by resin allows the production of the highest-quality recycled products.

There are many problems for the plastic recycling industry in India. The supply of recovered plastic is rather volatile due to the decrease in the recovery rate year by year and the dependency on the fluctuating international market. Most plastic recycling enterprises are small and medium sized factories with obsolete equipment and technologies. Financial limitations are a constraint to the technical improvements needed to satisfy market demand. Plastic cannot be recycled indefinitely. In continuous recycling, plastic becomes too contaminated and degraded for use as a secondary material. Secondly pollution occurs during the recycling process. Some factories cannot afford to install pollution control facilities and must therefore discontinue production [5].

#### IV. DEGRADABLE PLASTICS

Bioplastics are biodegradable plastics, whose components are derived from renewable raw materials. These plastics can be made from abundant agricultural/animal resources like cellulose, starch, collagen, casein, soy protein polyesters and triglycerides [6]. Large scale use of these would help in preserving non-renewable resources like petroleum, natural gas and coal and contribute little to the problems of waste management. Biodegradable plastics degrade over a period of time when exposed to sun and air [7]. Though the demand for biodegradable plastics is increasing, acceptance of biodegradable polymers is likely to depend on factors like [8]

- Customer response to costs.
- Possible legislation by Governments.
- The achievement of total biodegradability.

Immediate application areas identified in India for biodegradable plastics are agricultural mulch, surgical implants, industrial packaging, wrapping, milk sachets, foodservice, personal care, pharmaceuticals, medical devices, recreational, etc. However, the legal framework for the utilization of biodegradable materials is still very unclear. Within waste management, local authorities in many parts of the world including India don't treat bioplastics as compostable material [9].

#### V. ADDITIONAL EFFORTS TO MITIGATE IMPACTS OF PLASTIC WASTE

- Environmental tax on plastic bags.
- Incineration with energy recovery.

- Landfilling, this will still be needed for disposal of plastic and other wastes.
- Reorganization of the recycling sector.
- Extended producer responsibility [10].
- Increasing educational initiatives.

#### VI. CONCLUSION

In the perspective of environmental, health and resource sustainability, plastic waste collection and recycling will remain the area of focus. Green house gas emissions at the recycling units can be regulated to minimum by using the advanced state of art recycling methods and equipments. As strong technical and economical substitute to petroleum based plastic is not yet available, it is advised to implement the forward and reverse supply chain very effectively to attain maximum recycling targets. Product redesigning are some solutions to reduce plastic waste at the source.

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