Scientific Reviews
&
Chemical Communications

Sci. Revs. Chem. Commun.: 2(3), 2012, 349-354
ISSN 2277-2669

A SHORT OVERVIEW ON DEVELOPMENT OF THE PLASTIC WASTE MANAGEMENT : ENVIRONMENTAL ISSUES AND CHALLENGES

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(*Received : 28.02.2012; Revised : 15.03.2012; Accepted : 24.03.2012*)

ABSTRACT

The quantum of plastic waste in Municipals Solid Waste is increasing due to increase in population, development activities and changes in the lifestyle. As plastic is non-biodegradable in nature, it remain in environment for several years and disposing plastic waste at landfill are unsafe since toxic chemicals leach out into the soil, underground water and pollute the water bodies. Therefore plastic waste disposal is the major problem for the civic authorities.

Key words: Plastics, Plastic waste management.

INTRODUCTION

Plastics are synthetic substances produced by chemical reactions. Almost all plastics are made from petroleum. 'Plastics' derived their name from their properties to be molded, cast, extruded or processed into variety of forms like solid objects, films and filaments. These properties arise from their molecular structure. Plastics are polymers, very long chain molecules that consist of subunits (monomers) linked together by chemical bonds. The monomers of petrochemical plastics are inorganic materials (such as styrene) and are not biodegradable[1].

In other words plastics are micro-molecules, formed by polymerization and having the ability to be shaped by the application of reasonable amount of heat and pressure or any other form of forces. This great human creation changed the world and brought comfort to our lifestyle. Now plastics are in all human activity ranging from clothing to shelter, infrastructure to communication, agriculture to construction, hardware to packaging and entertainment to health care. Its attractive properties, lightweight and high strength meets a large share of the materials needs of man and that too at a comparatively lesser cost.

Increasing urbanization and industrialization have contributed for increased plastic generation. This increase has been rapid since the middle of the 19th century which has affected the quality of environment. The urban population has grown rapidly during the last two decades. One among the reasons for urban population growth is migration of rural population to cities. Rapid population growth, urbanization and

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industrial growth have led to sever problem of waste generation in urban centers. The characteristics of waste depend on various factors such as food habits, traditions, lifestyle, climate etc. Due to change in lifestyle of people and increase in computerization, there is on increasing trend of paper, plastics, metals and glass in solid waste over the years.

Due to large benefits of plastics in different applications, its use is increasing all around the world industries. The plastic products namely carry bags, blood bags, colored plastics pots are fast becoming popular both in rural and urban areas of India. But in the last ten years due to the widespread littering of plastics on the land, plastic waste has attracted attention in India. The environment hazards due to mismanagement of plastic waste include the following aspects:

- Most common method of disposing of wastes is to dump them in low lying areas on the outskirts of towns which is unhealthy and unscientific.
- This has serious environmental impacts on water and air pollution and soil degradation.
- The major concern for this waste stream i.e. particularly plastic, is that these are non-biodegradable and remains in the environment for several years.
- Clogging of drains by plastic waste is a common problem.
- Garbage containing plastic when burnt may cause air pollution by emitting polluting gasses.
- The paper presents an overview of the plastic waste management over the last years related with the environmental issues and challenges without the claim of completeness.
- The paper is organized as follows: section 2, gives review of literature concentrating on the facts related to plastic waste management. Plastic and its classifications are given in section 3. In section 4, Different methodology of plastic waste management has discussed. Finally, concluding remarks are given in section 5.

Review of literature

The waste generated due to urban activities is known as municipal solid waste (MSW). Global experience shows that when a country's urban population reaches almost 25% of overall population the pace of urbanization accelerates[2]. Table 1 describes the average municipal solid waste production from 0.21 to 0.50 Kg per capita per day in India. The present urban population is expected 341 million in 2010. The waste quantities are expected to increase from 46 million tones in 2001 to 65 million tones in 2010[3]. It is also reported that per capita per day production will increase to 0.7 kg in 2050[4].

Table 1: Municipal solid waste in indian cities

Population range (millions)	Average per capita value kg/capita/day
0.1 - 0.5	0.21
0.5 - 1.0	0.25
1.0 - 2.0	0.27
2.0 - 5.0	0.35
> 5	0.50

Source: CPHEEO Manual on MSW Management

Plastic waste has a significant portion in total Municipal Solid Waste (MSW). The increased uses of plastic products as packaging application in the recent years have increased the quantity of plastics in the solid waste stream to great extent. It is estimated that approximately 15722 tones per day (TPD) of plastic waste is generated on the basis of per capita consumption based on population of India.

The packaging and poly vinyl chloride (PVC) pipe industry are growing at 16-18% per year. The demand of plastics goods is increasing from house hold use to industrial applications. It is growing at an annual rate of 22% annually. The polymers production has reached to 8.5 million tones in 2007. Table 2 provides the total plastics waste consumption in India during last decade. National plastic waste management task force in 1997 projected the polymers demand in the country. Table 3 documents the demand of different polymers in India during years 1995-96, 2001-02 and 2006-07. The comparison of demand and consumption from Table 2 and Table 3 indicates that projections are correct. More than one fourth of the consumption in India is that of PVC which is being phased out in many countries. Poly bags and other plastic items except PET in particular have been a focus, because it has contributed to host of problems in India such as choked sewers, animal deaths and clogged soils.

Table 2: Plastics consumption in India

S. No.	Year	Consumption (Tones)
1	1996	61,000
2	2000	3,00,000
3	2001	4,00,000
4	2007	8,500,000

Table 3: Polymers demands in India (million tones)

S. No.	Type of polymer	1995-96	2001-02	2006-07
1	Polyethylene	0.83	1.83	3.27
2	Polypropylene	0.34	0.88	1.79
3	Poly vinyl chloride	0.49	0.87	1.29
4	Poly ethylene tetrephthalate	0.03	0.14	0.29

Source: National plastic waste management task force (1997)

Table 4: Plastic waste consumption

S. No.	Description	World	India
1	Per capita per year consumption of plastic (kg)	24	6-7
2	Recycling (%)	15-20	60
3	Plastic in Solid Waste (%)	7	9

Table 5: Plastic waste consumption (P/C/Year)

S. No.	Country/Continent	Per Year consumption (Kg)
1	India	6.0
2	East Europe	10.0
3	South East Asia	10.0
4	China	24.0
5	West Europe	65.0
6	North America	90.0
7	World Average	25.0

Source: Plastindia

India recycles about 60% of its plastics, compared to world's average of 22%. Plastic waste contains the calorific value equal to fuel[9]. India has among the lowest per capita consumption of plastics and consequently the plastic waste generation is very low as seen from the Table 4[10]. The comparison of per capita plastic consumption with rest of the word is presented in Table 5.

A study conducted by the National Environmental Engineering Research Institute (NEERI) for the Brihan Mumbai Muncipal Corporation, which handles more than 5,500 metric tones MSW per day shows that plastic waste is 0.75 %. In Europe and U.S.A, plastic waste makes up 8 % of total MSW. The rest is made up of organic materials (33%), paper and paperboards (30%), glass and metals (16%) and others (13%)[11]. The methods of recycling and the technology used for the same at present are quite outmoded and are in need of upgradation. It has also been observed that some of industries even recycle the plastic waste/scrap which is totally unhygienic and such is a health hazard for persons who use items made from such plastics and even used at times for packaging of foodstuff and medicines[12].

Plastics and its classifications

Plastic is the general term for a wide range of synthetic or semi synthetic polymerization products. Their name is derived from the fact that many are malleable, having the property of plasticity. They are composed of organic condensation or addition polymers and may contain other substances to improve performance or economics. There are few natural polymers. Plastic can be classified in many ways, but most commonly by their physical properties. Plastic, depending on their physical properties, may be classified as thermoplastic or thermosetting materials. Thermoplastic materials can be formed into desired shapes under heat and pressure and become solids on cooling. If they are subjected to the same condition of heat and pressure, they can be remolded. Thermosetting materials which once shaped cannot be softened/remolded by the application of heat.

Methodology for plastic waste management

Plastic waste can be controlled on the basis of following factors :

Ban on use of plastics

Several Indian states banned use of plastic. The ministry has also asked state Governments to register all plastics manufacturing units, so that these can be regulated.

Invention turns plastic bags back into oil

Akinori Ito a Japanese inventor has invented a device that will turn ordinary plastic shopping bags into gasoline. Iro's device come from a simple idea. Plastic bags are made out of oil, so there should be a way to change them back and recapture the energy inside them.

The device melts plastic bags, filters and cools the vapors then condenses them back into crude oil which can be used as fuel. An additional step turns the crude oil into gasoline, providing an even more versatile energy source.

Clean Technica reports that Ito's invention uses remarkably little energy to complete this process. Two pounds of plastic bags can be converted into a quart of oil using a single kilowatt of power.

Plastics waste disposal through plasma pyrolysis technology (PPT)

Plasma Pyrolysis is a state of the art technology, which integrates the thermochemical properties of plasma with the pyrolysis process[13]. The intense and versatile heat generation capabilities of PPT enable it to dispose off all types of plastic wastes including polymeric, biomedical and hazardous waste in a safe and reliable manner.

Conversion of plastics waste into liquid fuel[13]

A research-cum-demonstration plant was set up at Nagpur, Maharashtra for conversion of waste plastics into liquid fuel. The process adopted is based on random de-polymerization of waste plastics into liquid fuel in presence of a catalyst. The entire process is undertaken in closed reactor vessel followed by condensation, if required. Waste plastics while heating upto 2700^{o}C to 3000^{o}C convert into liquid-vapour state, which is collected in condensation chamber in the form of liquid fuel while the tarry liquid waste is topped-down from the heating reactor vessel. The organic gas is generated which is vented due to lack of storage facility. However, the gas can be used in dual fuel diesel-generator set for generation of electricity.

Environment related observations during the process

There are no liquid industrial effluents and no floor washings as it is a dry process.

There are no organized stack and process emissions.

Odour of volatile organics has been experienced in the processing area due to some leakages or lack of proper sealing Absolute conversion of liquid-vapour was not possible into liquid, some portion of gas (about 20%) is connected to the generator. However,the process will be improved in full-scale plant.

PVC plastics waste is not used and if used, it was less than 1%. In case PVC is used, the chlorine can be converted into hydrochloric acid as a by-product.

The charcoal (charcoal is formed due to tapping of tarry waste) generated during the process has been analysed and contain heavy metals, polyaromatic hydrocarbon (PAH) which appears to be hazardous in nature. The source of metals in charcoal could be due to the presence of additives in plastics and due to multilayer and laminated plastics.

Monitoring of process fugitive emissions in the work area as well as emissions from the engines/diesel generator sets is necessarily required (where this liquid fuel is used) for various parameters such as CO, HCl, Styrene, Benzene, VOCs.

CONCLUSION

From the above discussion it is concluded that the environmental hazards due to mismanagement of plastic waste can be minimized,

- By providing healthy plastic alternatives like paper bags and bottles which are environment friendly products.
- Requires more research and development to make plastic more environment friendly.
- If we have the will, we can start reducing their use in small ways.
- Educate users to the right disposal methods.
- Recycling plastic bags that you can recycle.
- Buy products with bio-degradable packing such as jute bags, cotton bags, and paper bags.
- Re-use your plastic shopping bags or better still don't use plastic bags.

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