Need of Plastic Waste Management & Regulation

Dr. Monika Panchani
**Asso. Prof., Deptt. of Zoology,*
V.G.College.Mandi
Email: monaharipanchani@gmail.com

Reference to this paper should be made as follows:
Received: 02.09.2019
Approved: 01.12.2019

Dr. Monika Panchani

"Need of Plastic Waste Management & Regulation"

Voyager: Vol. X, 2019, pp.1-12

Also available at http:// voyger.anubooks.com

Abstract

Plastic products have become an integral part in our daily life. There is considerable potential for new applications of plastics that will bring benefits in the future.Plastics are playing an increasing role in packaging and consumer products but after useplastics are increasing the percentage of municipal solid waste streams and pose environmental challenges. There arise manyproblems associated with plastic debris and waste management due to their non biodegradable nature.Unorganised methods of waste management result in plastic leakage to the environment with hazardous effects to ecosystems. In the absence of adequate waste collection and segregation process, the management of plastics waste has become a challenging task.Generally plastic waste is either used as landfill, or in incineration and recycling. New methods could be adopted for proper waste management.Regulation of plastics waste, particularly manufacture and use of recycled plastics carry bags and containers must be regulated by the Government. However, in order to reduce the waste plastic problem we have to adopt the principles of waste prevention. We need to create public awareness on the importance of 5R refuse, reduce, reuse, repurpose and recycle.In this paper attempt has been made to explore and assess the different aspects of plastic waste management and regulation of laws and policyfor sustainable use of plastics.

Keywords:*Plastic Waste, Non-biodegradable, Pollution, Hazardous effect,Incineration, Recycling and Waste management.*

Introduction

Plastics are essential materials in modern civilization. It is produced on a massive scale worldwide and its production crosses the 150 milliontonnes per year globally. Almost every aspects of daily life involve plastics.Its broad range of application is in packaging films, wrapping materials, shopping andgarbage bags, fluid containers, clothing, toys, household and industrial products, andbuilding materials.There is considerable potential for new applications of plastics that will bring benefits in the future, for example as novel medical applications, in the generation of renewable energy and by reducing energy used in transport (Andrady &Neal 2009).Plastics will never degrade and remains on landscapefor several years. Generally plastic waste is either dumped in land fill or recycled.Landfills result in plastic leakage to the environment with multiple adverse effects to environment. The recycled plastics are more harmful to the environment than thevirgin products due to mixing of colour, additives, stabilizers, flame retardants etc.The billions of items of plastic waste choking our oceans, lakes, and rivers and piling up on land is harming the plants and wildlife. There is considerable concern about the adverse effects of these chemicals on wildlife and humans (Meeker et al. 2009).Improper waste collection and segregation process leads to unorganised plastic waste management.Accumulation of plastic debris in the environment and the associated consequences can be avoided.Plastic waste can be managed in a wayso as to cause minimum harm to the environment.Considerable immediate reductions in the quantity of waste entering natural environments, as opposed to landfill, could be achieved by better waste disposal and material handling.There must be more strictness on regulation of plastics waste in its manufacture and use of recycled plastics.

Aim

In this paper attempt has been made to explore and assess the different aspects of plastic waste it'smanagement and regulation of laws and policy for sustainable use of plastics.

Methodology

Some areas were visited to observe the presence of plastic waste in the environment & it's management.Various related topics were searched and analysed thoroughly to study the plastic waste,their effects on environment ,plastic waste management and regulations of laws and policyin India.

Discussion:

I.Plastic Waste

II.Environmental Pollution

III.Waste Management

IV.Regulation of Plastics Waste

I.Plastic Waste:

In modern time plastics are becoming an integral and unavoidable part of our life. Thousands of plastic factories are producing tons of plastic goods which are popularly used by the people because of their ease, cheapness and convenience. The word plastic is derived from the greek (plastikos)

meaning capable of being shaped or molded. Plastics are a range of synthetic or semi-synthetic polymerization products that can be molded into a permanent object having the property of plasticity. Plastics are inexpensive, lightweight, strong, durable, corrosion-resistant materials, with high thermal and electrical insulation properties. The diversity of polymers and the versatility of their properties are used to make a vast array of products that bring medical and technological advances, energy savings and numerous other societal benefits (Andrady & Neal2009).

Plastics are generally categorized into two types:

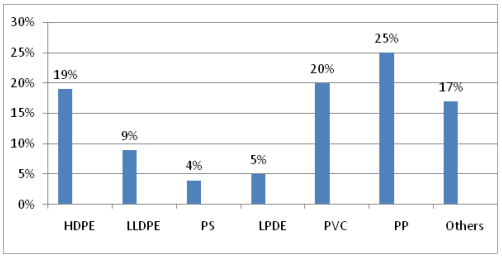
Thermoplastics

Thermoplastics or Thermo-softening plastics are the plastics which soften on heating and can be molded into desired shape such as PET, HDPE, LDPE, PP, PVC, PS etc.

Thermosets

Thermoset or thermosetting plastics strengthen on heating, but cannot be remolded or recycled such as Sheet Molding Compounds (SMC),Fiber Reinforced Plastic (FRP), Bakelite etc. are the examples of the same.

Plastics production in India rises to 4.77MT in 2005–2006, maximum of which are polypropylene (PP) and high-density polyethylene (HDPE). Polyethylene (PE), PP, and polyvinyl chloride (PVC) also contribute a large share in India's polymer market mainly due their low cost and durability. Mainly HDPE -19%, LLDPE- 9%, PS- 4%, LPDE-5%, PVC-20%, PP-25%, & others contribute 17% .On an average, the commodity plastics *viz*. PE, PP, PVC, and polystyrene (PS) accounts 80% of the total plastic consumption in IndiaCPMA, (2000).



(Figure 1).

Figure:1. Consumption of Different Virgin Plastic Resins in India. *Source: Plastics Waste Management in India***.** CPMA, (2000).

It is observed that plastic wastes, including packaging, electrical equipment and plastics from end of-life vehicles, are major components of both household and industrial wastes.Our current use and disposal of plastics is the cause for concern (Barneset al. 2009; Hopewell et al. 2009).

On an average, production of plastic globally crosses 150 Million tonnes peryear. It is estimated that approximately 70% of plastic packaging products are converted into plastic waste in a short span. Approximately 9.4 million TPA plastic waste is generated in the country, which amounts to 26,000 TPD2 . Of this, about 60% is recycled, most of it by the informal sector. While the recycling rate in India is considerably higher than the global average of 20%, there is still over

9,400 tonnes of plastic waste which is either landfilled or ends up polluting streams or groundwater resources.

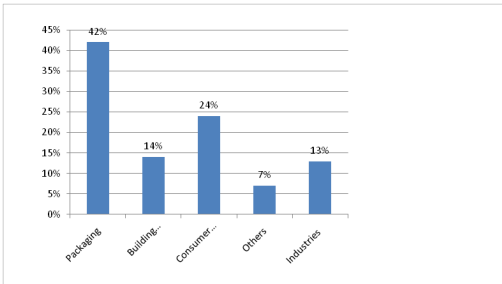


Figure:2 Percentage of Plastic Consumption in India by Different Market Sector.

*Source:Plastics Waste Management in India*SGCCI, (2000).

In a 2008 survey, it was found that 82% of landfills had leaks and were emitting toxins into the surface and ground water ("Waste and Recycling Facts"). Plastics used in packaging sector are more prone to be dispose off and, therefore, produce environmental degradation. Apart from use in packaging, plastics are also extensively used in the consumer products such as furniture and housewares, building and construction, and in industrial sectors. Packaging represents the largest single sector of plastics use in the India representing 42% of total plastics consumption, 14% used in buildings & construction work, 24% in consumer products , 13% in industries & about 7% is used in others (Fig. 2)(SGCCI, 2000).

Lack of biodegradability of commercial polymers, particularly used in packaging, industry, and agriculture, has led to environmental accumulation and pollution problem that could persist for centuries.

II.Environmental Pollution:

Plastic wastes pollute the all types of natural resources and cause environmental pollution of soil, water and air. Due to non-biodegradable nature they cause hazardous negative impact on the environment. Substantial quantities of plastic have accumulated in the natural environment and in landfills. Around 10 per cent by weight of the municipal waste stream is plastic(CPCB, 2015).

Discarded plastic also contaminates a wide range of natural terrestrial, freshwater and marine habitats. They have become the part of food chain and cause hazardous effects on wildlife, marine life andhuman health.The large amounts of plastic waste in marine environments may also lead to toxic metals entering the food chain (Munier, Bendell, 2018).Waste plastic thrown on land mostly enter into municipal drainage lines and chokes it resulting into floods as experienced in 1998 Mumbai, India in 1998. Millions of mammals, birds, reptiles, and fish are reported to be killed every year by the ingestion of plastic bags. According to a study by Laist (1997), plastic debris affects at least267 species worldwide, including 86% of all sea turtle species, 44% of all seabird species, and 43% of all marine mammal species(Laist, D. W., 1997).

In plastic production many carcinogenic, neurotoxic, and hormone-disruptive chemicals are involved. These

chemicals find their way into the environment through water, land, and air pollution. Some of the compounds include vinyl chloride (in PVC), dioxins (in PVC), benzene (in polystyrene), phthalates and other plasticizers (in PVC and others), formaldehyde, and bisphenol-A, or BPA (in polycarbonate). A range of chemicals that are used in the manufacture of plastics are known to be toxic. Body burdens of chemicals that are used in plastic manufacture have also been correlated with adverse effects in the human population, including reproductive abnormalities (Swan et al.2005; Swan 2008; Lang et al., 2008).Chlorinated plastics release harmful chemicals into the surrounding soil, which can then seep into groundwater or other surrounding water sources. Plastic fragments in the marine environment have been reported in scientific reports since the late 1960s (Barnes et al., 2009).The chemical compounds found in plastics are harming and causing biological effects in both humans as well as animals. Bisphenol A can be found in baby bottles, water bottles, canned food liners, and sippy cups. Human exposure occurs primarily through ingestion: diet, sucking/mouthing plastics, and skin contact. There have also been studies that showed bisphenal A increases the occurrence of diabetes, heart disease, birth defects, early puberty, low sperm count, hyperactivity, aggressiveness and high levels of certain liver enzymes. Women affected with this chemical can have an increase in miscarriages, polycystic ovarian syndrome, infertility, baldness, prostate cancer and breast cancer(Jobling, S et al., 1995). Recycled plastic is further increasing the load of pollution as recycled plastic is more injurious to health ..

III.Waste Management:

According to the reports for year 2017-18, Central Pollution Control Board (CPCB) has estimated that India generates approximately 9.4 Million tonnes per annum plastic waste, (which amounts to 26,000 tonnes of waste per day), and out of this approximately 5.6 Million tonnes per annum plastic waste is recycled (i.e. 15,600 tonnes of waste per day) and 3.8 Million tonnes per annum plastic waste is left uncollected or littered (9,400 tonnes of waste per day).There arise many problems associated with plastic debris and waste management due to their non biodegradable nature. Most plastic polymer types are resistant to biodegradation, i.e. degradation by microorganisms, and the two most abundant ones, polyethylene and polypropylene, are extremely resistant to biodegradation (Nicholson, 2006).

Unorganised methods of waste management result in plastic leakage to the environment with multiple adverse effects to ecosystems. In the absence of adequate waste collection and segregation process, the management of plastics waste has become a challenging task. The real problem is the lack or inadequate environment management at a grass root level. The common methods to deal with plastic waste are ***landfill, Incineration and Recycling***. Statistics show that approximately 10% of this plastic

is recycled, 25% is incinerated (destroyed by burning) and the remaining 65% is dumped in landfills(Fig 3).

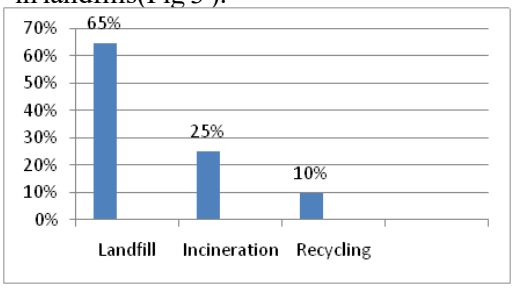


Figure: 3 The common methods of plastic waste management

Presently plastic waste is either used as ***landfill, in incineration and recycling.*** Incineration is an alternative to landfill disposal of plastic wastes, but this practice could result in the formation of unacceptable emissions of gases such as nitrous oxide, sulfur oxides, dusts, dioxins and other toxins. The most effective way to reduce the volume of solid waste is to burn it in a properly designed and operating condition, the process called as incineration. In an ideal incineration process, the hydrocarbon compounds of the combustible residue combine chemically with the molecular oxygen to generate carbon dioxide and water, and as a residue generates oxides of metals and minerals.

Incineration of solid waste materials has a number offavourable attributes, including volume reduction, immediate disposal without waiting for slow biodegradation process, less land requirement, destruction of hazardous materials, and value addition to waste product by energy recovery or by generating electricity(Masters, G.M., 2004).

Landfill space is scarce in many countries which leads to emissions from transportation over long distance, and increasing the landfill area may require valuable land. Emissions from landfills may also contaminate ground and surface water.

Many cities in India lack designed scientific landfills for the disposal of municipal solid waste. Cities choose to dump solid waste in dump yards where waste is either buried or left as it is. In India, dumping is a common practice, particularly due to the lack of awareness and the need for land to discard an enormous amount of wastes generated from our households and surrounding areas.

Landfill areas are constantly piled high with many different types of plastics. As population increases, the amount of total waste produced increases as well. In accordance with more waste, landfills are becoming less available and the hazards involving them are increasing. Although these landfills are predominant today, most of them are unmonitored and still prone to hazards to the surrounding environment.

Alternatives to land filling are ***mechanical recycling, energy recovery, or chemical recovery***. The heterogeneity of plastic products and types obstructs recycling, or makes plastic recycling difficult in many cases (Hopewell, 2009).

The various approaches that have been proposed for recycling of waste plastics mainlyinclude: ***Primary recycling,***

Mechanical recycling, andplastic recycling. Primary recycling is the in-plant process of recycling of waste scraps materials. Mechanical recycling involves the separation of plastic polymer from its associated contaminants and further reprocessed through melting, shredding, and other related processes. During mechanical recycling of plastic compounds the mostimportant aspect is the separation of different types of plastic resins according to their chemical characteristics. Moreover, mechanical recycling mostly operated at a temperature of 200–300æ%C,which also results in the generation of various toxic gases.The third type of plastic recycling process is chemical recycling or feedstockrecycling,which ultimately leads to complete or partial depolymerization of plastics.Roughly, 80% of used plastics are thermoplastics that can be repeatedly formed to a new product by the application of heat. The majorities of house hold plastics comprise polyolefins (polyethylene terepthalate (PET), LDPE, HDPE, or PP), which are thermoplastics and, therefore, are easily recyclable. Polyolefins are a major type of plastic used throughout the world in applications suchas soft-drink bottles, clear film for packaging (PET), packaging, bags, containers, pipes (LDPE), milk and water bottles, housewares, industrial wrappings and film (HDPE), automotive parts, film, battery cases, drinking straws, and electrical components (PP) .

Combustion of plastics may cause emissions of hazardous substances and contributes to global warming (since most plastics are fossil based). Chemical recovery is under development and means that chemicals, e.g. raw materials such as monomers and gases, are recovered/ converted from the plastic material. This can, for instance, be done by controlledthermal degradation such as thermolysis, which is a non-catalytic cracking process (Al- Salem, 2009).

Chemical or feedstock recycling also includes pyrolysis, hydrogenation, and gasification.Pyrolysis is often called as destructivedistillation, as it is an endothermic process in contrast to most combustion processesthat are exothermic.The effective temperature of pyrolysis for waste plastic streams varied from 400–650æ%C or higher. The major compounds generated through pyrolysiscomprises of agas stream primarily with hydrogen, methane, carbonmonoxide, and carbon dioxide,a liquid fraction that consists of a tar oil stream containing mostly acetic acid,acetone, and methanol and a char consisting almost pure carbon with some inertmaterials.

The application of waste plastics as a fuel in cement kilns has a potential to be an effective measure of waste reduction. In Bangalore, India, plastic asphalt is used as an alternative road material. The asphalt is made from churned plastic waste (mainly composed of plastic bags, PET bottles and thin plastic film) which is blended with bitumen. (Khullar, 2009; Gulati, 2010).

The efficient use of waste plastics as a fuel has further environmental benefits,

as no solid or ash residues are produced and air emissions are not greater than fossil fuels. The waste plastics have the potential to be reused as an alternative fuel in the blast furnace and often considered as recycling of waste(Banerjee,T. et al., 2012).

The all type of waste plastic can be converted in to fuel.It works like Petrol, diesel, kerosene and LPG. By implementing this concept can be reduced 80-90% of waste plastic and can be provide 60% oil for diesel vehicles. The fuel does not emit sulphur dioxide.(SO2). It increases machine efficiency. The 5% residue is obtained which is carbon block(Rajaram.T.Karad, Sagar Havalammanavar,2017).

Since, the disposal of waste plastic in landfill has several harmful effects on the environment.For reduction of negative effects of plastic waste in environment we need to focus on the applications of these materials in other industries.

IV.Regulation of Plastics Waste

Plastic Waste Management Rules (PWR), 2011, was introduced under the Environment Protection Act, 1986. Regulation of plastics waste, particularly manufacture and use of recycled plastics carry bags and containers is being regulated in the country as per "Recycled Plastics Manufacture and Usage Rules", 1999 and as amended in 2003(EPA).This has now been replaced by Plastic Waste (Management and Handling) Rules, 2011.Some of the salient features of the new Rules are:

- Ban on use of plastic materials in sachets for storing, packing or selling gutkha, tobacco and pan masala,
- Recycled plastics or compostable plastics, will not be allowed in food stuffs packets.
- Recycled carry bags to have specific BIS standards, colour to the prescription by the Bureau of Indian Standards (BIS),
- Uniform thickness shall not be less than 40 microns in carry bags etc.

The 2011 rules were succeeded by the Plastic Waste Management Rules 2016 which was far more comprehensive and sought to effectively address the issue of plastic waste. This version of the rules extended its purview and applicability to rural areas and plastic importers in the supply chain. Further, the minimum thickness of plastic carry bags was increased from 40 micron to 50 micron.

The 2016 rules were revised to be known as the Plastic Waste Management (Amendment) Rules 2018. Three major changes amongst others have been incorporated in the latter. Firstly, the rules notify that under Section 9(3), the term 'non-recyclable multilayered plastic' has been substituted by 'multilayered plastic which is non-recyclable or non-energy recoverable or with no alternate use'. Secondly, Section 15 dealing with the pricing of carry bags has been omitted. The rule earlier required vendors, who made plastic bags available, to register with the respective urban local

body and pay a fee of 48,000 annually. Thirdly, the new rules attempt to establish a centralized registration system by mandating brand owners and producers operating in more than two states to register with the CPCB. While the rules have been introduced with an attempt to mitigate the plastic menace, some concerns still remain.

The plastic waste (management and handling) rules 2016 state that "every local body shall be responsible for development and setting up of infrastructure for segregation, collection, storage, transportation, processing and disposal of the plastic waste either on its own or by engaging agencies or producers." (TERI)

Specifically, for gram panchayats, the rules say that everygram panchayat GP either on its own or by engaging an agency shall set up, operationalise and co-ordinate for waste management in the rural area under their control and for performing the following functions:

- Ensuring segregation, collection, storage, transportation of plastic waste and channelization of recyclable plastic waste fraction to recyclers having valid registration.
- Ensuring that no damage is caused to the environment in the process.
- Creating awareness among all stakeholders about their responsibilities.
- Ensuring that open burning of plastic waste doesn't take place.

One of the major provisions under the new rules is the explicit recognition of the rule of waste pickers. The new rules require the municipal authority to constructively engage agencies or groups working in waste management including these waste pickers. Municipal or Government authorities and NGOs may play crucial role in recognizing and legitimizing both plastic waste recovery and trading activities and equipping them with state of art designs of waste management technology and system. Developing safe and low cost technology for which SSIs need institutional and scientific support and making mandatory of guidelines related to safety, process and product standards in consultation with plastic associations are one of the few ways(swachh-bharat-cess-budget,2018).

The Government of Himachal Pradesh enacted the Himachal Pradesh Non-Biodegradable Garbage (Control) Act, 1995, to deal with the menace of plastic and other non-biodegradable waste. This Act embodied a move towards scientific disposal of non-biodegradable waste and also imposed a ban on coloured plastic carry bags produced from recycled plastic. In 2009Government of Himachal Pradesh introduced the Sustainable Plastic Waste Management Plan. The Plan focusses on controlling the use of plastic and developing a systematic disposal mechanism.In order to achieve the objectives of its Clean Himachal and Healthy Himachal drive, the Government

also prohibited the use of plastic cups and plates in 2011.It also conducted Information, Education and Communication (IEC) activities to generate awareness about the harmful impact of plastic waste encouraged citizens to stop using plastic products.Further, India could also impose more penalties on producers as implemented in other countrieswhere plastic waste management activities are being funded by the producers.

Conclusion:

Plastics are extremely necessary in our modern society, but some of the current use and misuse is not sustainable. A more sustainable use of plastics can be achieved by many measures.Regulation of plastics waste, particularly manufacture and use of recycled plastics carry bags and containers must be regulated by the Government. However, in order to reduce the waste plastic problem we have to adopt the principles of waste prevention. We need to create public awareness on the importance of 5R refuse, reduce, reuse, repurpose and recycle. Encouraging society to use less plastics bags and promoting manufacturers to use less plastic in packaging sector and by enhancing its potentiality to be reused, can reduce plastics solid waste up to a large extent.There are several constraints such as proper collection, segregation, and transportation of the discarded plastic material. However, increase in public awareness coupled with changes in individual behaviour can be an effective way to reduce the environmentalrepercussions of waste plastics. We also need an approach towards technological development for the minimization of environmental degradation.

References

1. Al-Salem SM, Lettieri P, Baeyens J.,(2009). *Recycling and recovery routes of plastic solid waste (PSW):* A review. Waste Manag 29: **2625–2643.**
2. Andrady, A. L. & Neal, M. A.,(2009). Applications and societal benefits of plastics. Phil. Trans. R. Soc. B 364, 1977– 1984. (doi:10.1098/rstb.2008.0304).
3. Banerjee, T. et al., (2012).11:24 9.75in x 6.5in b1272-ch17 *Handbook of Environmental and Waste Management* Vol. 2 1st Reading.
4. Barnes,D.K.A., Galgani,F., Thompson, R. C. & Barlaz, M.,(2009). *Accumulation and fragmentation of plastic debris in global environments.* Phil. Trans. R.Soc.B364,1985–1998.
5. CPCB 2015 report.
6. CPMA, (2000). *Chemicals and Petrochemicals.* Chemical & Petrochemicals Manufacturers Association, New Delhi, **2**(1): **17–23.**
7. EPA (Environmental Protection Agency)U.S. Available from:http://www.

epa.gov/ waterscience/ criteria/drinking/dwstandards.pdf .

8. Gulati V.,(2010). Indian state uses plastic waste for road construction. One World South Asia. News articlehttp://southasia.oneworld.net/todaysheadlines/indian-state-uses-plastic-waste-for-road construction.
9. Hopewell, J., Dvorak, R. & Kosior, E.,(2009) Plastics recycling: challenges and opportunities. Phil. Trans. R. Soc. B 364, 2115–2126. (doi:10.1098/rstb.2008.0311).
10. https://thewire.in/economy/swachh-bharat-cess-budget-2018; last accessed on May 29, 2018.
11. Jobling, S et al.,(1995). A Variety of Environmentally Persistent Chemicals, Including Some Phthalate Plasticizers, are Weakly Estrogenic. *Environmental Health Perspectives* 10 (6): **582–7.**
12. Khullar, M.,(2009). *Plastic roads offer greener way to travel in India.* The New York Times, 13 November. 2009http://www.nytimes.com/2009/11/14/business/global/14plastic.html.
13. Laist, D. W.,(1997). *'Impacts of Marine Debris: Entanglement of Marine.Life in Marine Debris Including a Comprehensive List of Species with Entanglement and Ingestion Records'*, J M Coe, D B Rogers (Eds.), Marine Debris—Sources, Impacts and Solutions, pp. 99–139. New York: Springer-Verlag.
14. Masters, G.M.,(2004). *Introduction to Environmental Engineering and Science,* New Delhi: Prentice-Hall of India Pvt. Ltd.
15. Meeker, J. D., Sathyanarayana, S. & Swan, S. H.,(2009). Phthalates and other additives in plastics: human exposure and associated health outcomes. Phil. Trans. R. Soc. B 364, **2097–2113.**
16. Munier, B and Bendell L I.,(2018). Macro and Micro Plastics Sorb and Desorb Metals and Act as a Point Source of Trace Metals to Coastal Ecosystems. *PLoS ONE* 13 (2).
17. Nicholson , J.W.,(2006). The chemistry of polymers. The Royal Society of Chemistry, Cambridge.
18. Plastic Waste Management Rules, PWR 2016; refer to http://www.moef.gov. in/sites/default/files/PWM%20Rules%2C%202016.pdf.
19. Rajaram. T.Karad, *Sagar Havalammanavar,(2017).International Journal of Engineering Development and Research* Volume 5, Issue 3 | ISSN: 2321-9939.
20. SGCCI, (2000).*The Indian Plastic Industry, Plast India Foundation, Southern Gujarat Chamber of Commerce and Industry* (SGCCI), India.

21. Swan, S. H. et al.,(2005). *Decrease in anogenital distance among male infants with prenatal phthalate exposure.* Environ. Health Perspect. 113, **1056–1061.**
22. Swan, S. H.,(2008). *Environmental phthalate exposure in relation to reproductive outcomes and other health endpoints in humans*. Environ. Res. 108, **177–184**. (doi:10. 1016/j.envres.2008.08.007).
23. TERI, (1998). *Solid Wastes in Looking Back to Think Ahead: GREEN India 2047*, New.Delhi: Tata Energy Research Institute.
24. The Energy and Resources Institute (TERI). Plastic Waste Management in India. Challenges And Opportunities.