Research Article

Impacts of Effluents from Plastic waste on Environment and Precautions

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Abstract

Incineration of plastic waste in an open field is a major source of air pollution. Many dangerous chemicals, like Bisphenol A (BPA), phthalates, flame retardants of Bromine and poly fluorinated chemicals are found in plastics and pose a major risk to human, animals and environment. During the process of incineration of plastic a large amount of toxic substances like Dioxins, Polychlorinated Biphenyls, Mercury and Furans releasing into the environment are creating severe health risks. In today's world plastic waste management has become quite important. Plastic recycling is the only solution for dealing with plastic trash. Various strategies are being launched in India to reduce the negative effects of plastic trash. It makes increasing economic sense and environmental caring and current trends show a notable increase in the rate of plastic waste recovery and recycling. Recycling requires public engagement and thereby citizens must separate plastic waste at the source. Plastic garbage will be separated from other debris to prevent it from being land filled. When conditions are perfect, pyrolysis is an alternative to combustion and incineration and also to produce less toxic chemicals with varied degrees of potentially beneficial by-products. Hence there is an urgent need to create awareness among public on the importance of sustainable environment, developing new drop-off places (land fills) and a system for limiting trash generation at the source, alternative disposal ways and incineration mechanisms, plastic recycling facilities, effective policies and implementation is recommended.

Keywords: Toxicity, BPA (Bisphenol A), Dioxins, Polychlorinated Biphenyls, Furans, flame retardants of bromine, phthalates and hazardous substances

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Introduction

Plastic is a common material in daily life. Polymerization produces plastics, which are synthetic organic materials and generally have a high molecular weight, contains additional ingredients along with polymers to develop performance and cost control. Plastics can be classified into many types based on its synthesis methods, structure of molecule, density and also based on some other properties. The Society of Plastic Industry (SPI) created an identification code system which can separate plastics into the following seven types based on structure of molecule and application in order to aid recycling of waste plastic shown in **Figure 1**.

1. Polyethylene Terephthalate (PET)
2. High Density Polyethylene (HDPE)
3. Polyvinyl Chloride (PVC)
4. Low Density Poly Ethylene (LDPE)
5. Poly Propylene (PP)
6. Poly Styrene (PS)
7. Others

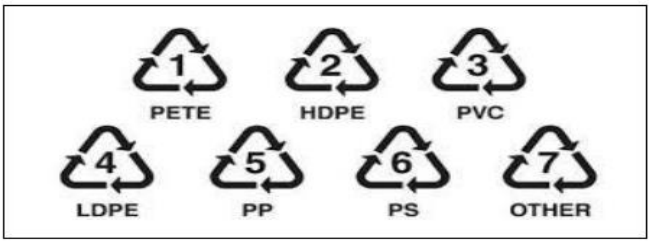

Figure 1 SPI code

Plastic is playing a significant role on our regular life in many forms, but it is causing a great damage to our ecosystem, approximately 85 % of all plastic bags are discarded in landfills. In fact a bag in the soil can survive up to 1000 years, preventing biodegradable things from breaking down around it. Landfills are responsible for roughly 20 % of greenhouse gas emissions. Plastic accounts for about 10% of household waste, most of which is land filled [1-3]. According to the Central Pollution Control Board (CPCB), India consumes 8 million tonnes of plastic per year, with 5.7 million tonnes of plastic trash generated each year [4]. Plastics are generally non-biodegradable and their low density causing unsuitable to dispose them in landfills [5]. Burning of plastics is highly toxic and also create hazardous air pollutants. Environmental conditions and increased temperatures can affect plastic to breakdown and form secondary micro plastics like BPA (Bisphenol A), Dioxins, Polychlorinated Biphenyls, Furans, flame retardants of bromine, phthalates, which can physically damage the organs, hormonal imbalance, disrupting immune function, stymie growth and reproduction.

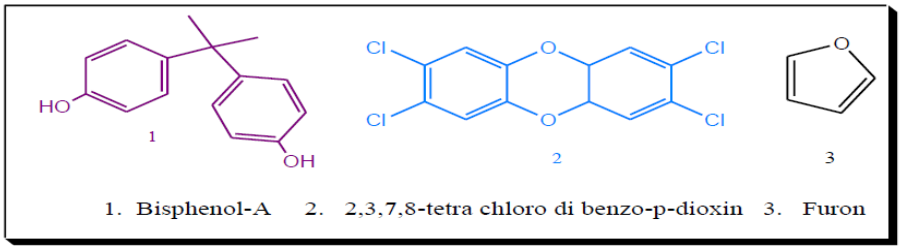

Figure 2 Structure of toxic molecules from plastic

Plastic Toxicity on Environment

Municipal Sewage Waste (MSW) containing 10-12 percent plastics releasing toxic gases like polychlorinated biphenyls, dioxins and furans into the environment upon burning. Furthermore, the combustion of polyvinyl chloride emits harmful halogens, which pollutes the air and also causing climate change. As a result the harmful compounds emitted are creating threat to the environment, human, animals and to the ecosystem. For example every year due to open burning of landfills and municipal sewage waste nearly 10 Kilograms of furans and dioxins emitting into the lower atmosphere of Mumbai [6, 7]. Due to incomplete combustion of poly propylene, poly ethylene and poly styrene producing a significant levels of carbon monoxide and toxic discharges, while PVC produces dioxins, aromatic substances like pyrene and chrysene and carbon black.

Presence of plastic garbage can alter the temperature of the surrounding atmosphere and the pH of the water. These wastes can be minor or insignificant, but their accumulation can be harmful to animals and the environment. Plastic particles can consume or become entangled in aquatic species, birds, and even some land animals, causing them to die or starve shown in **Figure 3**.

Figure 3 Animals eating plastic waste

Polystyrenes are most dangerous to central nervous system and the toxic compounds of bromine are carcinogenic and mutagenic. Dioxins are deposited on crop and in water streams, where they generally entering into food and thus into body systems. These dioxins are deadly perpetual organic toxics and its dangerous component, 2,3,7,8-tetra chloro dibenzo-p-dioxin (TCDD) is a toxic substance is cancerous and causes nervous damage, disrupts the respiratory system and reproductive thyroid. Also burning of these plastic waste improves the threat of heart problems, saviour respiratory problems like emphysema, asthma, skin rashes and nausea. Pure PVC(Poly Vinyl

Chloride) consists of 58% of chlorine while plasticizers are added, then it consists of approximately 49% of Chlorine. Burning these plastic baggage releases toxic chemical substances into the environment, inflicting critical lung harm and different saviour health problems.

Figure 4 Incineration of plastic at dumping yards and evolution of toxics

The usage of plastics results in substantial environmental contamination, including soil, water, and air pollution. High levels of persistent free radicals in solid residual ash and soot are thought to play a key role in the development of saviour health effects, particularly in human lungs [8]. Volatile Organic Compounds and semi Volatile Organic Compounds, mainly aldehydes, paraffins, olefins and light hydrocarbons were discovered during the combustion of Poly Ethylene (both LDPE and HDPE) at various operating settings. Benzene is a recognised carcinogen that is generated during the combustion of plastics. Eye irritation, impaired vision, breathing trouble, respiratory issues, liver damage, cancer, skin illness, lung problems, reproductive impacts, cardiovascular, headache, dizziness and gastro intestinal tract problems are all examples of human health problems.

DEHP (di(2-ethylhexyl) phthalate) is one of the plasticizers utilized in the manufacturing of plastics that has classified by the United States Environmental Protection Agency(USEPA) as an expected carcinogens, a strong endocrine disruptor and also trusted to be harmful by inhalation, posing potential health risks. Incineration is one method of dealing with garbage. Incineration must be complete, otherwise burning plastic in garbage might release significant amounts of harmful substances shown in Figure 3. Styrene in Poly Styrene and Vinyl chloride in PVC are toxic. In order to manufacture brilliantly coloured plastics, heavy metals like Copper, Chromium, Lead, Cobalt, Cadmium, and Selenium are frequently utilised as pigments or colorants. Yellow, red and orange colours contain cadmium. Heavy metals like cadmium, tin, lead, and barium are utilised as heat stabilisers. Plastic bags can be mistaken for jellyfish by sea turtles [3, 9].

According to a recent submission of plankton-eating fish in North Pacific Gyre [10], 35 percent had swallowed plastic, with an average of 2.1 pieces per fish. However, meso pelagic fish prevalent in the North Pacific were discovered in 9.2% of the plastic samples. Plastic debris were found in the stomachs of 18 to 33 percent of cat fish in an estuary in north-eastern Brazil [11]. Cat fish, which are both prey and predators to large fish, could be an excellent species to monitor plastic consumption in rivers [12-15].

Precautions for sustainability

- The first step is to reduce our use of plastic because this reduces the amount of plastic we consume, which is accomplished through the use of cloth bags.
- The toxic chemicals found in plastic like Bisphenol A and phthalates, have been banned.
- To transmit information about harmful compounds used in plastic, a coordinated industry-wide effort is required.
- Plastics' hazardous impact on the environment, animals and human can be reduced by enforcing suitable rules and regulations for their manufacturing and use.
- In terms of illegal dumping, littering and disposal, the polluter pays approach should be implemented.
- Work on beach cleanups to prevent the disposal of plastic garbage at sea, set goals for efficient and proper waste management, and recycle plastic into valuable items.
- In terms of auto parking fees, tourist taxes, port reception, and ship berthing costs, the user pays principle can be used to fund beach cleaning and infrastructure improvements.

- Incentives for fishermen to remove garbage from the water while fishing and reporting on it. Excessive use of plastics in manufacturing, use, and disposal should be made illegal to some extent, and dumping of plastics in open spaces should be penalised like remaining offences.
- Manufacturing standards should be respected, and excessive manufacturing should be avoided.
- Keeping our environment clean is just as vital as keeping our homes clean, and each person should be responsible for their own plastic trash disposal.
- Development of biodegradable and bio-based plastics that utilise starch, poly lactic acid and cellulose as raw ingredients for temporary use products is one of the tenable alternatives that might be advised to deal with plastic waste.
- Implementing 4R's of waste management, i.e., Recover, Reduce, Reuse and Recycle by creating awareness among people.
- Converting plastics waste to fuel is advantageous since it not only allows waste plastic to be disposed of, but it also allows for the development of a fossil fuel alternative.

Conclusion

Burning plastics, open combustion, and incineration generate toxic substances that are harmful to the environment, including plants and human health. Proper policy development in regards to chemical exposure produced by plastic is required, as is supporting research in this area. Plastic garbage will be separated from other debris, preventing it from being land filled and allowing it to be recycled alongside other plastics of the same type. When conditions are perfect, pyrolysis is an alternative to combustion and incineration, has been demonstrated to produce less toxic chemicals with varied degrees of potentially beneficial by-products. Recycling is a better way of reducing resource stress and utilising by-products while also enhancing sustainability. The introduction of recycling programmes and research will have a significant impact.

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