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Dr. Manorama Singh

Associate Professor and Head,
Department of Chemistry, S.M
College, Bhagalpur, Bihar, India

Dr. Manoj Kumar Pathak

Professor and Head,
Department of Forensic Medicine
and Toxicology, AIIMS, Patna,
Bihar, India

Srishti Rai

Senior Research Fellow,
Department of Forensic
Medicine, Institute of Medical
Sciences, BHU, Varanasi, Uttar
Pradesh, India

Microplastic: Devil of the Era

Dr. Manorama Singh, Dr. Manoj Kumar Pathak and Srishti Rai

Abstract

Plastic is defined as a polymeric material. The term applies to a vast variety of material, these material at some stage of their manufacture have capacity to flow. Plastic is capable of being shaped or molded or layered as a coat, spun or casted under adequate heat and pressure. It is a well-known fact about plastic that it is resistant to degradation. Owing to this property of plastic it can travel far away from the source as waste and get accumulated in the environment. It is estimated that more than eight million tons of plastic enters the ocean annually. Despite of the knowledge of how plastic is damaging the environment only a small fraction of plastic waste (around fourteen percent) is collected for recycling. The rest enters the environment as waste. Presence of this non-biodegradable small particles of plastic is so strong that it is also present in the food that we eat and in the water that we drink. Their impact on the living world is so strong that it is known to affect almost all the levels of biological organization.

Keywords: Microplastic, plasticene, health impact, primary microplastic, secondary microplastic

Introduction

Bakelite was the first synthetic polymer. It was produced in 1907. In 1909 it was patented by Leo Baekeland. The purpose of the invention was to fulfil consumer demand for those items which were becoming difficult to obtain as they were expensive or unavailable, these included silk and ivory. Plastic became the cheap alternative and was lionized as “material of thousand uses”^[1]

Plastic is defined as a polymeric material. The term applies to a vast variety of material, these material at some stage of their manufacture have capacity to flow. Plastic is capable of being shaped or molded or layered as a coat, spun or casted under adequate heat and pressure. Synthetic polymers are a result of polymerization of monomers. These monomers are derivative of oil or gas. Plastics are made up of these units along with numerous chemical additives. The prosperity of plasticity along with other special features which include low electrical conductivity, toughness, low density, transparency makes plastic a substance of choice for manufacturing of great variety of products. polymethyl methacrylate, polystyrene, polyethylene terephthalate, polyvinyl chloride are some of the examples of plastics. This diversity of plastic combined with its versatility has added to numerous social benefits^[2,3].

The plastics which are being used in the modern era are classified into 7 groups

1. Polyethylene Terephthalate (PET or PETE or Polyester).
2. High-Density Polyethylene (HDPE).
3. Polyvinyl Chloride (PVC).
4. Low-Density Polyethylene (LDPE).
5. Polypropylene (PP).
6. Polystyrene (PS).
7. Other^[4].

How vast is the problem of plastic waste?

It is a well-known fact about plastic that it is resistant to degradation. Owing to this property of plastic it can travel far away from the source as waste and get accumulated in the environment. It is estimated that more than eight million tons of plastic enters the ocean annually. It not only possesses danger to the marine environment but is equally dangerous for humans. This calls for urgent need to rethink the issue of plastic waste management. Plastic has become dominant material of our modern society economy. It is expected that their production will double over the next two decades.

Corresponding Author:

Dr. Manorama Singh

Associate Professor and Head,
Department of Chemistry, S.M
College, Bhagalpur, Bihar, India

Despite of the knowledge of how plastic is damaging the environment only a small fraction of plastic waste (around fourteen percent) is collected for recycling. The rest enters the environment as waste ^[5].

The era of Plastic

Plasticene (not to be mistaken as plasticine, which is a popularly known molding clay) is a term used to define an era in the history of Earth, within Anthropocene, commencing in 1950s, it is stratigraphically marked by depositional record of formation of new and growing layer of Plastic. With the beginning of this geological era in mid-20th century to the current times, there has been a many fold increase in manufacturing, utilization, and disposal of plastic products. This immense disposal has led to observable deposition of plastic in fossil records. It is no surprise that researchers are assuming the incorporation of plastic in geologic strata ^[6,7].

Microplastic

As per the U.S. National Oceanic and Atmospheric Administration (NOAA) and the European Chemicals Agency, microplastics is term applied to small pieces of plastic which are less than 5mm in dimension. Microplastic is accumulating in our environment as a result of human activities leading to plastic pollution.

There is abundance of plastic in our world today, for example in cosmetics, plastic bottles, bags and synthetic clothing etc. They readily find their way in environment as waste.

Just like plastics, microplastics also consist of carbon and hydrogen atoms. These atoms are held together in polymer chains.

Chemical compounds like polybrominated diphenyl ethers, Phthalates, and tetrabromobisphenol A are also present in these microplastics. These chemical additives leach out in the environment from the plastic.

Types of Microplastic

Microplastic has been classified in to two main categories

Primary Microplastic: Use of microbeads in personal care products is very common these days, this is one of the contributing sources of primary microplastic in our environment. Plastic pellets are part of various industrial manufacturing. Now a day's use of synthetic textiles is also very common thus making the entry of microplastic in environment directly very easy. Activities like washing off of toiletries in wastewater system of households, Spills due to carelessness during the manufacturing or transportation process, laundering of cloths made of synthetic fibers are part of daily life activities.

Secondary Microplastics: secondary microplastics are formed due to degeneration of larger plastics. This degeneration may be caused due to abrasive action of temperature changes, wind, water, ultraviolet radiation etc. ^[8] The major chunk of microplastic found floating in ocean comprises of polyethylene (54.5%), polypropylene constitutes 16.5%, the rest is known to consist of polyvinyl chloride, polystyrene, polyester, and polyamides. Among these polyethylene and polypropylene have lower density when compared to marine water hence it floats affecting the surface of ocean. The sea floor is affected by materials which have higher density and sink.

Plastic is escaping in the environment every day, with time

there is increased productivity, slow decomposition of plastic is another key factor which is adding to accumulation of plastic in environment. The plastic which has entered the environment stays undegraded for hundreds and thousands of years, even in the long run it does not degrade but simply breaks into smaller particles (microplastic < 5mm; nano plastic < 1µm) ^[9]

Microplastic and Human Health

Microplastic is omnipresent, it is everywhere, in the deepest depth of ocean to the air we inhale. Owing to its small size they get transported easily by wind or through water therefore it is not surprising that they can be found in the remotest areas of the earth which include highest peak of the mountains to Polar Regions.

Presence of this non-biodegradable small particles of plastic is so strong that it is also present in the food that we eat and in the water that we drink. Their impact on the living world is so strong it is known to affect almost all the levels of biological organization.

The composition of plastic varies widely as it is known to have a wide range of additives, some of the additives include:

- pigments
- ultraviolet stabilizers
- flame retardants
- water repellents
- stiffeners e.g., bisphenol A
- softeners –phthalates

Due to this rise in the micro and nano-plastic in the environment and their intake into the human body through water, food and air researchers fear potential metabolic disturbance, carcinogenic effect and neurotoxicity. Microplastic are known to cause endocrine disruption leading to hampering of normal hormone function which may lead to weight gain. Certain microplastics, for example, flame retardants, are thought to interfere with fetal brain development, and likewise, they can affect normal brain development in children ^[10].

It has been hypothesized by the researchers based on studies that due to exposure of microplastics, human bodies can have oxidative stress, DNA damage, inflammation and other health problems.

Inflammation in particular when becomes chronic paves the way for other serious health problems. The other cause of concern is that not only does the microplastic cause harm to the body but also the surface of the plastic is colonized by many microorganisms, which are pathogenic to humans.

A study suggested that human pathogens have a strong affinity to the surface of plastic waste, this affinity is stronger in comparison to that of natural surfaces. According to research published in 2016, the human pathogen *Vibrio cholera* known to cause cholera in humans was found attached to microplastic sampled from the waters of North and Baltic Seas ^[11].

Studies conducted earlier had warned that microplastics cause allergic reactions and cell death when experimented at laboratory level.

The damage includes allergic reactions and cell death. Further research is required to understand for how long does plastic remain in human system before being excreted out. It has also been established that irregular or oddly shaped microplastic cause more damage to humans than spherical microplastics.

The experiments conducted in laboratories is usually through use of spherical microplastics therefore the results obtained are not accurately estimating the further extent of damage these microplastics can cause^[12].

The Current Scenario

For the very first time microplastic has been detected in human blood. When analyzed, microplastic was found in 80 percent of people who had been tested.

This study emphasized that these tiny particles of microplastic can travel via blood through body and these tiny particles can also get lodged in different organs. This fact is petrifying as we already know how other pollutions like air pollution are cause of early death in millions of people every year. The extent of damage microplastic causes is yet to be estimated and many other serious effects remain unknown^[13].

Scientists around the world can say with certainty that we are consuming microplastics on daily basis. It is a shocking fact that a person consumes around 5 grams of microplastic in a week.

Recent studies have found plastic in human lungs. What is more alarming is that microplastic has been identified in placenta of babies, raising concerns of how the microplastic can affect the development of fetus?^[14]

What can be done

We need understand the need of switching to sustainable products. We need to return to our old ways. Plastic has always been a threat to environment but its only now that we have started to realize that it is directly impacting human health too. Using plastic as it is a cheaper alternative to our various needs is costing us our health and wellbeing. When we cause damage to environment, we tend to forget that we ourselves are an integral part of the environment and if something is damaging environment then it is damaging for us too.

Sustainable living, reusing and recycling, going for eco-friendly options and minimizing plastic use to the maximum extent possible is the need of the hour. We need to understand that it is only us who can prevent the damage.

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