Review on Plastics and It's Reverberation on Society: A Subsequent Ultimatum

Dr. Pushpanjali Singh

Associate Professor, Applied Science Department (Chemistry).

School of Management Sciences, Lucknow.

Email: pushpanjalichem@gmail.com

ABSTRACT

Natural polymers such as rubber, cotton, and silk exist in abundance, but nature's "plastics" have not been involved in environmental spoliation, because they do not persist in the environment. Today, however, the average consumer comes into daily contact with all kinds of plastic materials that have been developed specifically to defeat natural decay processes—materials derived mainly from petroleum that can be moulded, cast, spun, or applied as a coating. Since synthetic plastics are largely non-biodegradable, they tend to persist in natural environment. Though extensive research and new technologies have led to invent of newer and safer plastics, but drawbacks and challenges of plastics have never been resolved and impact is on the rise. Some of the major compounds (vinyl chloride, dioxins, and plasticizers) are causative factors of hormone-disruption, reproductive dysfunction, breast growth and testicular cancers. The harmful effects are also pronounced in new-borns via mothers during pregnancy or young children exposed directly. Recycling is one of the most convenient and easiest ways. Smarter sorting, energy efficient ways, developing smarter plastics and research to develop certain fungi and bacteria that hasten degradation of conventional plastics are some of the present era needs.

***KEYWORDS*:** Environment, Plastics Pollution, Biodegradable plastics, Global warming, virgin plastics.

INTRODUCTION

Plastic is a kind of material that is commonly known and used in everyday life in many forms. It becomes an important part of every one's life. To define plastics at molecular level, it is a kind of

organic polymer, which has molecules containing long carbon chains as their backbones with repeating units created through a process of polymerization[1].

Also, additives are usually added when manufacturing of commercial plastics is carried on, in order to improve the strength, durability or grant the plastic specific characteristics. Many of the controversies associated with plastics are associated with the additives[2].

Plastics have become a vital asset for humanity. Though extensive research and new technologies have led to invent of newer and safer plastics, but drawbacks and challenges of plastics have never been resolved and impact is on the rise. Some of the major compounds (vinyl chloride, dioxins, and plasticizers) are causative factors of hormone-disruption, reproductive dysfunction, breast growth and testicular cancers. The harmful effects are also pronounced in new-borns via mothers during pregnancy or young children exposed directly. Recycling is one of the most convenient and easiest ways. Smarter sorting, energy efficient ways, developing smarter plastics and research to develop certain fungi and bacteria that hasten degradation of conventional plastics are some of the present era needs.

Plastic polymers can come in a variety of forms, such as common plastics, the nylon of a jacket, plastic glasses, plastic plates and bowl etc. Plastic pollution is generally define as accumulation of plastic in the environment , where they create problems for wildlife and their habitats as well as for human populations. In 1907, the invention of Bakelite brought a great revolution in materials by introducing truly synthetic plastic resins into world commerce. By the end of the 20th century, however, plastics were found to be persistent pollutants for many environmental vocations, from Mount Everest to the bottom of the sea.

Natural polymers such as rubber, cotton, and silk exist in abundance, but nature's "plastics" have not been involved in environmental spoliation, because they do not persist in the environment. Today, however, the average consumer comes into daily contact with all kinds of plastic materials that have been developed specifically to defeat natural decay processes—materials derived mainly from petroleum that can be moulded, cast, spun, or applied as a coating. Since synthetic plastics are largely non-biodegradable, they tend to persist in natural environment. Understanding the ways that synthetic plastics degrade ecosystems is an important in taking steps to eliminate this form of pollution[3].

According to the Clean Air Council organization, Americans alone use an estimated 102.1 billion plastic bags -- a synthetic polymer -- each year, and less than 1 percent of these bags are recycled[4].

Not only do these synthetic polymers slowly leach harmful chemicals in the soil, their longevity and non-biodegradability means new landfills will be a constant need as synthetic polymer use continues and grows.

Plastics are very stable and therefore stay in the environment a long time after they are discarded, especially if they are shielded from direct sunlight by being buried in landfills. This waste rots and decomposes, and also produces harmful gases (CO2 and Methane) which are both greenhouse gases and contribute to global warming. Landfills also pollute the local environment, including the water and the soil. It also affects the global warming and the environment. The waste can harm humans, animals, and plants if they encounter these toxins buried in the ground, in stream runoff, in groundwater that supplies drinking water, or in floodwaters, as happened after Hurricane Katrina. Chlorinated plastic can release harmful chemicals into the surrounding soil, which can then seep into groundwater or other surrounding water sources and also the ecosystem of the world. This can cause serious harm to the species that drink the water

Many of the current applications and the predicted benefits of plastic follow those outlined by Yarsley and Couzens in the 1940s. Their account of the benefits that plastics would bring to a person born nearly 70 years ago, at the beginning of this '*plastic age*', was told with much optimism:

It is a world free from moth and rust and full of colour, a world largely built up of synthetic materials made from the most universally distributed substances, a world in which nations are more and more independent of localised naturalised resources, a world in which man, like a magician, makes what he wants for almost every need out of what is beneath and around him[5]. In fact, the predictions were '*how much brighter and cleaner a world*, it would be, *than that which preceded this plastic age*'[6].

HISTORICAL BACKGROUND OF PLASTICS[7-8]

The history of manufactured plastics goes back more than 100 years; however, when compared to other materials, plastics are relatively modern. Their usage over the past century has enabled society to make huge technological advances. Although plastics are thought of as a modern invention, there have always been "natural polymers" such as amber, tortoise shells and animal horns. These materials behaved very much like today's manufactured plastics and were often used similar to the way manufactured plastics are currently applied. For example, before the sixteenth century, animal horns, which become transparent and pale yellow when heated, were sometimes used to replace glass.

Alexander Parkes unveiled the first man-made plastic at the 1862 Great International Exhibition in London. This material—which was dubbed Parkesine, now called celluloid—was an organic material derived from cellulose that once heated could be molded but retained its shape when cooled. Parkes claimed that this new material could do anything that rubber was capable of, yet at a lower price. He had discovered a material that could be transparent as well as carved into thousands of different shapes.

In 1907, chemist Leo Hendrik Baekland, while striving to produce a synthetic varnish, stumbled upon the formula for a new synthetic polymer originating from coal tar. He subsequently named the new substance "Bakelite." Bakelite, once formed, could not be melted. Because of its properties as an electrical insulator, Bakelite was used in the production of high-tech objects including cameras and telephones. It was also used in the production of ashtrays and as a substitute for jade, marble and amber. By 1909, Baekland had coined "plastics" as the term to describe this completely new category of materials.

The first patent for polyvinyl chloride (PVC), a substance now used widely in vinyl siding and water pipes, was registered in 1914. Cellophane was also discovered during this period.

Plastics served as substitutes for wood, glass and metal during the hardship times of World War's I & II. After World War II, newer plastics, such as polyurethane, polyester, silicones, polypropylene, and polycarbonate joined poly-methyl methacrylate and polystyrene and PVC in widespread applications. Many more would follow and by the 1960s, plastics were within everyone's reach due to their inexpensive cost. Plastics had thus come to be considered 'common'—a symbol of the consumer society.

Since the 1970s, we have witnessed the advent of 'high-tech' plastics used in demanding fields such as health and technology. New types and forms of plastics with new or improved performance characteristics continue to be developed.

CAPSULIZATION OF PLASTICS

Plastic is an incredibly useful material, but it is also made from toxic compounds known to cause illness, and because it is meant for durability, it is not biodegradable. As the world population continues to grow, so does the lots of waste produced. Today's style of living requires

easily disposable products, such as plates, spoon, cups or bottles of water, but the accumulation of these products has led to increasing amounts of plastic pollution around the world[9].

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[10]. As a consequence, the production of plastics has increased substantially over the last 60 years from around 0.5 million tonnes in 1950 to over 260 million tonnes today. In Europe alone the plastics industry has a turnover in excess of 300 million euros and employs 1.6 million people. Almost all aspects of daily life involve plastics, in transport, telecommunications, clothing, footwear and as packaging materials that facilitate the transport of a wide range of food, drink and other goods. 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[11-13].

Plastics also play a very vital role in hospitals and medical field. Plastics are used on large scale in hospitals. The daily plastic waste generation includes disposable syringes, I.V sets, glucose bottles, disposable plastic aprons; B.T sets; catheters and cannulas etc. are disposed of on daily basis. Plastics may be easy and convenient for everyday use, but their negative impacts on our health cannot be overlooked. Due to its non-biodegradable nature, it keeps on piling in the environment and is creating tons of trash around the world. Ian Connacher, the director of the film "Addicted to Plastics," once said in an interview with GreenMuze: "I don't think the material is to blame. I think it is our misuse of the material as consumers, the ineffective recycling policies and lack of producer[14]. In coming times also, the applications of plastics definitely are expected to increase as more new products and plastics are developed to meet demands. The increased use and production of plastic in developing and emerging countries is a particular concern, as the sophistication of their waste management infrastructure may not be developing at an appropriate rate to deal with their increasing levels of plastic waste.

Virgin plastic polymers are rarely used by themselves and typically the polymer resins are mixed with various additives to improve performance. These additives include inorganic fillers such as carbon and silica that reinforce the material, plasticizers to render the material pliable, thermal and ultraviolet stabilizers, flame retardants and colourings. Many such additives are used in substantial quantities and in a wide range of products[15-16]. Some additive chemicals are potentially toxic (for example lead and tributyl tin in polyvinyl chloride, PVC), but there is considerable controversy about the extent to which additives released from plastic products (such as phthalates and bisphenol A, BPA) have adverse

effects in animal or human populations. The central issue here is relating the types and quantities of additives present in plastics to uptake and accumulation by living organisms.

Biodegradable plastics[17] are similar to conventional plastics, with the additional quality of being able to naturally decompose and break into natural and safe by-products. Bioplastics, nature derived plastics, are derived from biological sources such as sugar cane, cellulose etc. and these either degrade in open air or are made to compost using fungi, bacteria or enzymes.

Biopolymers and plastics have been mainly used by mankind as food, or for making clothing and furniture. Since the industrial time, fossil fuels such as oil are the greatest source in the development and manufacture of almost every commercial product, such as the plastic, which is currently used at a very large scale.

The Global Bioplastics & Biopolymers Market is poised to grow at a compound annual growth rate (CAGR) of around 12.8% over the next decade to reach approximately $8.9 billion by 2025.

VIRTUE AND FLAWs OF PLASTICS[18-20]

Whether you are aware of it or not, plastics play an important part in your life. Plastics' versatility allows them to be used in everything from car parts to doll parts, from soft drink bottles to the refrigerators they are stored in. From the car you drive to work in to the television you watch at home, plastics help make your life easier and better.

Here are some of the most important benefits of using plastic:

Building and construction industry – Plastics also help to conserve energy in your home. Vinyl siding and windows help cut energy consumption and lower heating and cooling bills. Furthermore, the U.S. Department of Energy estimates that use of plastic foam insulation in homes and buildings each year could save over 60 million barrels of oil over other kinds of insulation.

Modern packaging—such as heat-sealed plastic pouches and wraps—helps keep food fresh and free of contamination. That means the resources that went into producing that food aren't wasted. It's the same thing once you get the food home: plastic wraps and containers keep your leftovers protected—much to the chagrin of kids everywhere. In fact, packaging experts have estimated that each pound of plastic packaging can reduce food waste by up to 1.7 pounds.

Plastics can also help you bring home more product with less packaging. For example, just 2 pounds of plastic can deliver 1,300 ounces—roughly 10 gallons—of a beverage such as juice, soda or water. You'd need 3 pounds of aluminum to bring home the same amount of product, 8 pounds of steel or over 40 pounds of glass. Not only do plastic bags require less total energy to produce than paper bags, they conserve fuel in shipping. It takes seven trucks to carry the same number of paper bags as fits in one truckload of plastic bags.

Lightweight-Plastics engineers are always working to do even more with less material. Since 1977, the 2-liter plastic soft drink bottle has gone from weighing 68 grams to just 47 grams today, representing a 31 percent reduction per bottle. That saved more than 180 million pounds of packaging in 2006 for just 2-liter soft drink bottles. The 1-gallon plastic milk jug has undergone a similar reduction, weighing 30 percent less than what it did 20 years ago.

Electronic – Thermal and insulation properties of plastic made it ideal to become backbone of the electronic industry. Because modern plastic recipes will not change its form after they are heated, manufacturers use plastic regularly for circuit boards, chips, coffee makers, mixers, microwave ovens, hair dryers and even refrigerators.

Today, you can hardly look around you and not spot some item that is made entirely from plastic or has some plastic ingredient. This only proves that from its inception up to now plastic has managed to become popular building material of millions of useful items, but it is not perfect. Plastic has several disadvantages that prevent it from becoming universal building block of modern human civilization, and because of that many governments strictly control its use and create complex law that govern its creation, recycling and environmental impact of waste plastic and chemicals that are used in its creation.

Here are some of the biggest disadvantages of plastic:

Robustness – Plastic is light, mouldable, sturdy, and can have countless forms, but one of the most known features is its longevity. Plastic is artificially produced polymeric compound which can survive many more years. This troublesome ability of plastic doesn’t have great immediate impact on our environment, but its continuous dumping into seas and land will eventually create problems for future generations.

Environmental Detriment – Ever increasing plastic production since 1950s managed to saturate world with waste plastic product that can cause big effects on our environment. Decomposing of plastic product can last from 400 to 1000 years with newer "degradable" compounds, but before that degradation can happen waste plastic will continue to clog our waterways, oceans, forests, and other natural habitats that are filled with animals who mistake dangerous plastic for food. Chemical dangers are also high, because both creation and recycling of plastic produce toxic materials of many kinds.

Chemical Risk – Not only that creation and recycling of plastic can cause serious environmental risk, but some of the additives that are infused in plastic can cause permanent harm to our metabolism. Chemicals such as phthalates and BPA are widely used as an additive that prevents degrading of plastic structure, but they also interfere with our natural hormone levels which can cause serious problems to both males and females (lower testosterone levels in men, and premature girl puberty).

Choking Hazard – Plastic is one of the most popular building materials for small items. This is most evident in toy industry, where vast majority of children toys is manufactured with plastic. These toys and small plastic objects of many uses can easily get into children's hands (especially babies and toddlers) that unknowingly put them in their mouth. To prevent these serious accidents, governments have implemented detailed set of rules which force manufacturers to clearly label their plastic products and warn users of the possible chocking potential. Another problematic plastic product that can cause serious injuries or death are plastic bags (grocery or trash bags) who can sometimes end up wrapped around children faces, disrupting their breathing.

SUBSEQUENT OF PLASTICS[21-22]

The Future of Global Rigid Plastic Packaging to 2020 forecasts that the global rigid plastic market will reach $226.4 billion by 2020, with a growth rate of 4.4% annually for the next 5 years. Increasing demand for these applications has augmented the plastics market growth. The **plastic manufacturing industry** is facing unprecedented challenges as well as exciting opportunities thanks to changing consumer behaviours and innovative advances. These are the most prominent trends in the plastic industry in the years to come.

There are generally four inclinations in the plastic industry-

The fragmented industry- Most manufacturers tend to be small in size, as they offer products for specialised / customised applications that are produced in low volumes.

Increased use of plastic-Industry growth has been fuelled by the expanding use of plastic in high growth industries (such as construction, automotive, aerospace and electronics).

Innovation-Companies are finding new uses for existing plastic, or are producing newer plastics with novel physical properties that make them suitable for new uses.

Environmentalism-Fears of environmental damage have led to an increased focus on biodegradable plastic manufactured from renewable materials.

Now days plastic industry is suffering from four basic challenges-

Seasonal demand-Some plastic products have seasonal demand. Vinyl producers, for instance, build inventories in the early part of the year for the spring and summer building season.

Shortened product lifecycle-Product lifecycle has decreased from years to months, affecting the entire supply chain of plastic goods. Quick turnaround on customer choices is critical for plastic companies to stay competitive**.**

Volatile raw material prices-As plastic is derived mainly from oil and natural gas price and availability of plastic depends on the price of these. Manufacturers may have to pass on the price fluctuations resulting from the volatility of oil prices.

Environmental concerns-Manufacturers are subject to growing regulations that govern the production, disposal, and cleanup of hazardous chemicals, as plastic products usage contributes to environmental pollution.

END LIFE OF PLASTICS[23-24]

Recycling of plastic saves money and energy, reduces the amount of plastic in the landfills or seas, reduces the amount of greenhouse gas emissions that are created during production of "virgin" plastic, and more.

Recycling of post-consumer plastics packaging began in the early 1980s as a result of state level bottle deposit programs, which produced a consistent supply of returned PETE bottles. With the addition of HDPE milk jug recycling in the late 1980s, plastics recycling has grown steadily but relative to competing packaging materials.

Roughly 60 percent of the U.S. population—about 148 million people—have access to a plastics recycling program. The two common forms of collection are: curbside collection—where consumers place designated plastics in a special bin to be picked up by a public or private hauling company (approximately 8,550 communities participate in curbside recycling) and drop-off centers—where consumers take their recyclables to a centrally located facility (12,000). Most curbside programs collect more than one type of plastic resin; usually both PETE and HDPE. Once collected, the plastics are delivered to a material recovery facility (MRF) or handler for sorting into single resin streams to increase product value. The sorted plastics are then baled to reduce shipping costs to reclaimers.

Reclamation is the next step where the plastics are chopped into flakes, washed to remove contaminants and sold to end users to manufacture new products such as bottles, containers, clothing, carpet, plastic lumber, etc. The number of companies handling and reclaiming post-consumer plastics today is over five times greater than in 1986, growing from 310 companies to 1,677 in 1999. The number of ends uses for recycled plastics continues to grow. The federal and state government as well as many major corporations now support market growth through purchasing preference policies.

Chemical recycling is a special case where condensation polymers such as PET or nylon are chemically reacted to form starting materials.

CONCLUSION

To conclude, it is not the plastics to blame, but it is the misuse of plastics. The present time need is to look for biodegradable measures and effective policies and their implementation.

Some of the early synthesized plastics were made from naturally occurring materials such as casein (from dairy) that was used for simple items such as buttons. The development of petroleum-based plastics has been a major distraction from such materials.

However, in the last couple of decades, bio derived plastics have become available that provide good replacements. These include starch-based plastics such as polylactide (PLA), which is produced from corn starch, cassava roots or sugarcane and processed in the same way as petroleum-based plastics. Such plastics can be foamed or used to make drink bottles. Recycling plastics is another essential step towards reducing the environmental load.

We need more research into controlling biodegradability, taking into account different applications and the need for infrastructure to deal with biodegradable plastics at the end of their life. Obviously, we don't want our planes biodegrading during their 20 years of service, but one-use water bottles should break down within a short time after use.

The planet doesn't have to become a toxic rubbish dump. In the short term, this will need some government action to encourage bio-derived, recyclable and biodegradable plastics to allow them to compete with petroleum-based products.

There are signs of improvement: increasing awareness of the harm plastics cause and a willingness of consumers to pay for plastic bags or to ban them. We need to stop dumping in our own backyard and remember that the environment is where we live.

Given the global scale of plastic pollution, the cost of removing plastics from the environment would be prohibitive. Most solutions to the problem of plastic pollution, therefore, focus on preventing improper disposal or even on limiting the use of certain plastic items in the first place. Fines for littering have proved difficult to enforce, but various fees or outright bans on foamed food containers and plastic shopping bags are now common, as are deposits redeemed by taking beverage bottles to recycling centres, So-called extended producer responsibility or EPR, schemes make the manufacturers of some items responsible for creating an infrastructure to take back and recycle the products that they produce. Awareness of the serious consequences of plastic pollution is increasing, and new solutions, including the increasing use of biodegradable plastics and a "zero waste" philosophy, are being embraced by governments and the public.

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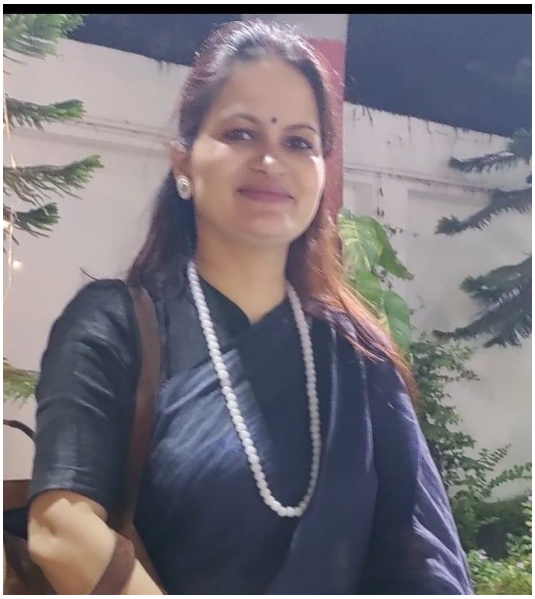
About Author:



Dr. Pushpanjali Singh, holds a Ph.D. degree in Chemistry from Kanpur University in the area of Chemical Kinetics. Since 2006, she is actively engaged in the field of Chemical Kinetics and Applied Chemistry. She is having more than 16 years of experience in teaching, mentoring and research. She has more than 9 years of teaching and research experiences in abroad, have worked with Addis Ababa University (Ethiopia), Ambo University (Ethiopia) and other apex institutes in India. She has been teaching varieties of Chemistry Courses (Industrial Chemistry, Engineering Chemistry, Environmental Chemistry & toxicology) to Post graduate, Graduate & Engineering students since 2004.

She has coordinated so many seminars and has given invited lectures in various institutes. She has been published two reference books for the Engineering and research students.

She was awarded with Dr. Sarvepalli Radhakrisnan Award-22, Chankya Award-22, Shiksha Ratan Award-22, Indian Youth Icon Award-2023, Baba Saheb Dr. B.R Ambedkar Award-2023 for her contribution towards the empowerment of the Society and education fraternity.

She is a life time member of 'The Asian Association of Sugar Cane Technologists" and ICERT, Delhi.

Presently working as Associate Professor with School of Management Sciences Lucknow.

Her interest areas are Engineering Chemistry, Environmental Sciences, Industrial safety and quality control & Green Chemistry. She has more than 19 published papers in different journals and magazines of National and International repute and presented papers in National & International Conferences/ seminars.