



## Single use plastics: A miracle or curse

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### Abstract

The production of plastic has outpaced that of almost every other material. While plastic has many valuable uses, we have become addicted to single-use or disposable plastic with severe environmental consequences. In total, half of all plastic produced is designed to be used only once- and then thrown away. Plastic pollution is the accumulation of plastic objects and particles in the earth's environment that adversely affects wild life, wild life habitat. Our ocean and array of species that call it home are succumbing to the poison of plastic. Plastic pollution on land poses a threat to the plants and animals including humans based on the land. Plastic bags are popular with consumers and retailers as they are functional, light weight, strong, cheap and hygienic way to transport food and other products. Most of these go to landfill and garbage heaps after they are used, and some are recycled. The immortal waste (plastic waste) has to be treated to sustain a healthy life to the planet and its inhabitants. To do so we need to take into serious consideration on 4 R's of waste management. Reduce, Reuse, and Recycle, Recovery. For a better future we need to create and work in the present.

**Keywords:** single use plastics, pollution, waste management

### 1. Introduction

Single use plastics is usually referred as disposable plastics, commonly used for plastic packaging and include items intended to be used just one occasion before they are thrown away or recycled. These include grocery bags, food packaging, bottles, straws, containers, cups and cutlery (UNEP, 2016) [24].

Since 1950, the production of plastic has outpaced that of almost every other material (Geyer *et al.*, 2017) [10]. Much of the plastic we produce is designed to be thrown away after being used for once. As a result plastic packaging accounts for about half the plastic waste within the world most of this waste is generated in Asia while America Japan and the European Union are the largest producers of the plastic packaging waste per capita. Our ability to cope up with the plastic waste is overwhelmed. Most plastic do not biodegrade instead they slowly breakdown into smaller fragments known as Micro-plastics. If current consumption pattern and waste management practices continues then by 2050 there will be around 2 billion tonnes of plastic litter in landfills and the environment (UNEP, 2018) [26].

#### 1.1 Types of plastics

There are two main categories of plastics and their single use applications

- Thermoplastics
- Thermosets

#### Thermoplastics

The most common thermoplastics are Polyethylene Terephthalate (PET), polypropylene (PE), low density polyethylene(LDP), High density polyethylene (HDP), Polystyrene (PS), Expanded polystyrene (ES), Polyvinylchloride (PVC), Polycarbonate, Polypropylene (PP), Polylactic Acid (PLA), Polyhydroxyalkanoates (PHA). Thermoplastics are a family of

plastics that can be melted when heated and hardened when cooled. These characteristics which led the material its name are reversible. That is it can be reheated, reshaped and frozen repeatedly.

#### Thermosets

The most common thermosets are Polyurethane (PUR), Phenolic resins, Epoxy resins, Silicones, Vinyl esters, Acrylic resins, Urea formaldehyde (UF) resins.

Main polymers utilized in the production of single-use plastics:

LDPE – bags, trays, containers, food packaging films.

PS – Cutlery, plates and cups.

HDPE – milk bottles, freezer bags, shampoo bottles, ice-cream containers.

EPS – hot drink cups, insulated food packaging, protective packaging for fragile items.

PET – Bottles for water and other drinks, dispensing containers for cleaning fluids, biscuit trays.

PP – Microwave dishes, ice-cream tubs, potato chip bags, bottle caps (UNEP, 2018) [25].

### 2. History

In 1869, John Wesley Hyatt invented first synthetic polymer (Science Matters 2020) [16].

In 1907, Leo Baekeland invented Bakelite, the first fully synthetic plastics. It contains no molecules found in nature (Science Matters 2020) [16].

In 1933, chemists in Norwich, England accidently produced polyethylene.

In 1960, Celloplast a Swedish company found out the way to make bags using thin film polyethylene.

By 1965, Celloplast engineer StenGustafThulin had perfected the process and invented what is known as t-shirt plastic bag. Single use plastic bags first made available in US in 1979 (Shirley S, 2018) <sup>[17]</sup>.

In 1997 sailor and researcher Charles Moore discovered the great pacific garbage patch, the largest of several Gyres in the world's ocean where immense amount of plastic waste have accumulated, threatening marine life (Captain Charles Moore, 2009) <sup>[17]</sup>.

In 2002, Bangladesh was the primary country to implement a ban on thin plastic bags, after it had been found they played a key role in clogging drainage systems during disastrous flooding (UNEP, 2018) <sup>[20]</sup>.

### 3. Epidemiology

While plastic has many valuable uses, we have become hooked in to single-use or disposable plastic with severe environmental consequences.

Around the world, a million plastic drinking bottles are purchased every minute, while up to 5 trillion single use plastic bags are used worldwide per annum. In total, half of all plastic produced is meant to be used only once- and then thrown away.

Plastic waste is now so ubiquitous within the natural environment that scientist have even suggested it could serve as a geological indicator of the Anthropocene era.

#### 3.1 So how did we get here?

From the 1950s to the 70s, only a small amount of plastic waste was relatively manageable.

By the 1990s, plastic waste generation had quite tripled in 20 years, following an identical rise in plastic production.

In the early 2000s, our output of plastic waste rose more in a single decade than it had in the previous 40 years

The world produces about 400 million tons of plastics every year. The largest (i.e. 36%) industrial sector is plastic packaging, single use material designed for immediate disposal. Other than this, 16% used for building and constructions, 14% in textiles, 10% in consumer and institutional products, 24% in transportation, industrial machinery, electronics and others altogether. The North East Asia produces 26% of the world's total single use plastics whereas North America 21%, Middle East 17%, Europe 16%, Asia and the Pacific 12%, Central and South America 4%, Former USSR 3%, Africa 1% are the rest of the producers respectively. Today, we produce about 300 million tons of plastic waste per annum.

The earth policy institute said that trillion single use bags were used every year- about 2 million each minute.

One single use plastic bag is estimated to have a life span of 12 minutes, according to environment Massachusetts (UNEP 2018) <sup>[22]</sup>.

#### 4. Why do we need single use plastic?

Plastics have been used for years to hold various household items that we use every day, from bathroom to kitchen and beyond. Single use plastics packages can be used in so many ways that it can be easy to overlook how they help, hold and preserve cosmetics, food and chemical household items (Sims T, 2019) <sup>[18]</sup>.

Plastics packaging is employed within the food supply chain because it supports the safe distribution of food over long distance and minimises garbage by keeping food fresh for

extended. Plastic packaging may be a necessary evil to reduce the high level of food waste. A number of factors must be taken into account when determining how useful plastic packaging is in food supply chain, as it has the potential to preserve food and prevent its wastage.

Plastic is extremely versatile material and is flexible and lighter than alternatives such as glass and card. This reduces transportation cost and the carbon emission that come with them. It helps in presenting the product in an attractive way and conveys key information such as use by dates, allergen information and recycling information (Barrett A, 2019) <sup>[2]</sup>.

Single use plastics helps in modern healthcare remain affordable for all and helps provide a safe and hygienic environment in hospitals. Such as gloves, blood bags, syringes, a vial, pipettes, sample bags and the list goes on. These items are used for their strength and resilience, and since they prevent cross contamination of sampling. As with medical applications many substitute materials do not provide the protection or stability that single use plastics do. Single use plastics are a key part of infection control (Harvey P, 2018) <sup>[11]</sup>.

### 5. Mass plastic begone

Plastic pollution is that the accumulation of plastic objects and particles within the earth's environment that adversely effects wild life, wild life habitat. Plastic that acts as pollutants are categorised into micro, meso or macro debris based on size. However the chemical structure of most pliable renders them immune to many natural processes of degradation and as a result they are slow to degrade. Together these factors have led to high prominence of plastic pollution in the environment. It can take thousands of years for plastic bags to decompose, thus contaminating the soil and water in the process. The noxious chemicals used to produce the plastics get transmitted to animal tissues and finally enter the human food chain (Chauhan D, 2019) <sup>[7]</sup>.

#### 5.1 Effect on wildlife

It has a big impact on wildlife. Birds usually confuse shreds of plastic bags for food and end up eating the toxic debris. Plastic kills an estimated 1 million sea birds every year and affects around 700 species which get infected by ingesting plastics (Business Today, 2019) <sup>[5]</sup>.

#### 5.2 Effect on marine life

Our ocean and array of species that call it home are succumbing to the poison of plastic. According to the United Nations, at least 800 species worldwide are affected by marine debris, and as much as 80 percent of that litter is plastic. Fish, seabirds, sea turtles, and marine mammals can become entangled in or ingest plastic debris, causing suffocation, starvation, and drowning. Plastic waste can encourage the growth of pathogens in the ocean (Reddy S, 2018) <sup>[15]</sup>. According to a recent study, scientists concluded that corals that come into contact with plastic have an 89 percent chance of contracting disease, compared with 4 percent likelihood for corals that do not (Wilcox C *et al.*, 2018) <sup>[27]</sup>.

#### 5.3 Effect on humans

Some compounds used for manufacturing of plastics pollute the environment by releasing chemicals into the air and water. Some

of such compounds that are used in plastics phthalates, Bisphenol A (BPA), Polybrominated Diphenyl ether (PBDE) are under close statute and might be harmful. The large dosage of these compounds are hazardous to humans, destroying the endocrine system. BPA imitates the female's hormone called oestrogen. PBDE destroys and causes damage to thyroid hormones (Thomsan RC *et al.*, 2009) [19]. Although the exposure to many of these chemicals causes dermatitis upon contact with human skin (Brydson JA, 1999) [4].

#### 5.4 Effects on environment

The distribution of plastic debris is highly variable as a result of certain factors such as wind and ocean currents, coastline geography, urban area and trade routes. Human population in certain areas also plays a major role in this. Plastics are more likely to be found in enclosed regions such as the Caribbean. It serves as a means of distribution of organisms to remote coasts that are not their native environments. This could potentially increase the variability and dispersal of organisms in specific areas that are less biologically diverse. Plastics can also be used as vectors for chemical contaminants such as persistent organic pollutants and heavy metals (Barnes DK *et al.*, 2009) [11].

In 2019 a new report plastic and climate was published according to the report in 2019 plastic will contribute greenhouse gases in an equivalent of 850 million tons of CO<sub>2</sub> to the atmosphere. In the current trend annual emissions will grow to 1.34 billion tons by 2030 (CIEL, 2019) [8].

Plastic pollution on land poses a threat to the plants and animals including humans based on the land (Berlin F, 2018) [3]. Estimates of the amount of plastic concentration on the land are between 4 and 23 times that of ocean (UNEP, 2018) [23].

### 6. Plastic waste disposal and management

#### 6.1 Reduce, reuse, recycle and recovery

Plastic bags are popular with consumers and retailers as they are functional, light weight, strong, cheap and hygienic way to transport food and other products. Most of these go to landfill and garbage heaps after they are used, and some are recycled. Although plastic bag make a small percentage of all litter, the impact of these bags is nevertheless significant. Ways to manage plastic waste:

Reduce: Lowering the amount of waste produced. (Most favoured option)

Reuse: Using materials repeatedly.

Recycle: Using materials to make new products.

Recovery: Recovering energy from waste.

Landfill: Safe disposal of waste to landfill (least favoured option)

#### 6.2 Reduce

Plastic of course is uniquely problematic because it is non-biodegradable and therefore sticks around for a lot longer than the other forms of waste. Few small steps in day to day life would help to keep plastic a possible out of the waste stream. Some of these steps may include:

1. Discourage the use of disposal plastics 90% of plastic items in our daily lives are used once and then abandoned: Grocery bags, plastic wrap, Disposable cutlery, Coffee cup lids, Straw. Take note on how often we rely on these products and replace them with reusable versions. It only takes a few times of bringing our own bags to the store, silver ware to the

office, or travel mug to office tea areas before it becomes habit.

2. Minimize buying water: Making a habit of using reusable water in the bag, use of water from office, home and work areas where the quality of the water can be trusted.
3. Minimize use of plastic cutlery: Making a habit of using metal utensils instead of plastic cutlery would help saving a lot of plastics that is thrown in thrash every year.
4. Purchase item second hand: The newer items come with a lot of packaging materials instead try to use second hand materials until it is very necessary.
5. Support a bag tax or ban: Support legislations, and by loss which put taxes on ban of single use plastics.

#### 6.3 Reuse

Reuse is a step up from recycle. It diverts plastic and takes pressure of the recycling services. In fact, Reuse is the middleman between reduce and recycle and some would be surprised at how many opportunities for reuse there really are.

One can reuse plastic- produce bags for sandwiches for plastic grocery bags for small trash bags, and reuse plastic silver ware. Most people skip this step and go directly to recycling, but reusing plastic can reduce the demand for new plastic to be created.

For instance, since refillable plastic container can be used for many times, container reuse can lead to a substantial reduce in the demand for disposable plastic and reduced use of materials and energy, with the consequent reduced environmental impacts.

#### 6.4 Recycle

Recycling and reutilization of waste plastic have several advantages. It leads to a reduction of the use of virgin materials thus have economic benefits, and the use of energy which reduces use of fossil fuels, thus also a reduction of carbon dioxide emissions.

##### 6.4.1 Benefits of Recycling

- Reduces environmental pollution
- Energy savings:40-100MJ/kg(depends the polymer)
- Economic Benefits
- Reduces demand for virgin polymer
- Preferred to landfilling
- Generates employment
- Reduces depletion of Fossil fuel reserves

##### 6.4.2 Difficulties in Recycling

- Hard separate from non-plastics(no 'magnet' equivalent)
- Differing composition of plastic resins means they are largely incompatible
- Degradation of polymer is of lower quality than virgin polymer

#### Municipality in dealing the issues of plastic waste. It Includes technology like

1. Mechanical Recycling
2. Feedstock Recycling
3. Plastic Road construction
4. Plastic To toilet/ Pavement Blocks
5. Recycling of multi-layered plastic (Ministry of Housing and Urban Affairs, Govt of India, 2019) [14]

Different industries are creating new ways to address challenges by making it more profitable to recycle a plastic product than it is to litter or landfill it. Examples include:

- Trex: This decking company uses recycled grocery bags, bread bags, dry cleaning bags and more to make environmentally responsible outdoor products.
- BD: One of the world's largest medical device company manufactures a no. of products using a variety of recycled material for its Recykleen brand.

**Brand Pledges:** Some of the world's largest companies have pledged to eliminate the amount of waste they send to a landfill or to use more recycled material in their products and packaging, Their by creating a bigger market for recycled content and incentivizing recyclers to expand their operations to collect more material.

- Coca cola: Pledged to collect and recycled the equivalent of every bottle or can it sells throughout the world by 2030.
- PepsiCo: Created a goal of designing all its packaging to be recyclable, compostable or biodegradable while increasing its views of recycled material and decreasing its packaging's carbon impact.
- SC Johnson: Has set a goal to send 0 manufacturing waste to landfill from its factory by 2021, a process that will include increased reusing and recycling.
- Ford motor company: Set a five year goal of reducing waste to landfill by 40% per vehicle and continuous to extend the use of recycled content in its vehicle, particularly in the development of new upholstery fabrics.
- Toyota environmental challenge 2050: committed the company towards creating a recycling based society through the use of eco-friendly material, the use of auto parts longer, the development of recycling technologies and the manufacture of new vehicles from end of life once (Environment, 2018) <sup>[9]</sup>.

### 6.5 Recovery

Another alternative is the energy stored in residual material. That means turning waste into fuel for manufacturing processes or equipment designed to produce energy. Various mechanical, biological, and caloric systems and technologies can convert, reprocess or break up wastes into new materials or energy (Ministry of Housing and Urban Affairs, Govt of India, 2019) <sup>[14]</sup>.

### 6.6 A running list of action on plastic pollution taken world wide

The world has a plastic pollution problem and it's snowballing-but so is public awareness and action.

- Canada Aims to Ban SINGLE- USE plastics by 2021: June 10, 2019.
- Peru Restricts Single-use plastic: January 17, 2019.
- San Diego bans Styrofoam food and drink containers: January 11, 2019.
- D.C. Plastic Straw Ban Begins: January 1, 2019.
- Plastic Fact named stat of the year: December 20, 2018.
- Aquarium band together for "No Straw November."
- 250 Groups Launch massive plastic partnerships: The initiative is called the New Plastics Economy Global commitment, and it includes a diverse group of members

including the city Austin, Clothing Company H&M, Unilever, Pepsico, L'Oreal, Nestle, and Coca- Cola.

### The global commitment touts a number of high-profile partnerships. It's collaboration with the United Nations and is being led by the Ellen McArthur Foundation.

- EU Parliament approves single- use plastic ban: Oct 26, 2018.
- American airlines cuts plastic from lounges: Oct 19, 2018.
- Food service companies phase out single-use plastic: Oct 18, 2018.

Some 13,000 schools, workplaces, and venues will be plastic bag and stirrer free by 2019, thanks to a new sustainability push by foodservice company Sodexo.

- California approves bill to limit straw use in restaurants: Sept 20, 2018.
- Giant Trash Collector heads to pacific garbage patch.
- United airlines ban plastic straws from flights.
- Disney announces ban on plastic straws: July 27, 2018.
- National geographic travel partner bans single-use plastics: July 26, 2018 (Howard BC *et al.*, 2019) <sup>[12]</sup>.

### 6.7 Decision by United Nations

In Geneva, 11 May 2019 decision on plastic waste have reached today as approximately 180 governments adopted a raft of decisions aimed at protecting human health and the environment from harmful effects of hazardous chemicals and waste. Pollution from plastic waste, acknowledged as a major environmental problem of global concern, has reached epidemic proportions with an estimated 100 million tonnes of plastic now found in the oceans, 80-90% of which comes from land based sources. Governments amended the Basel Convention to include plastic waste in legally-binding framework which will make global trade in plastic waste more transparent and better regulated, whilst also ensuring that its management is safer for human health and the environment. At the same time a new Partnership on plastic waste was established to mobilise business, government, academic and civil society resources, interests and expertise to assist in implementing the new measures, to provide a set of practical supports –including tools, best practices, technical and financial assistance- for this ground- breaking agreement (UNEP, 2019) <sup>[21]</sup>.

### 6.8 Actions taken by Indian Government

India Pledges to Beat Plastic Pollution by 2022: 5 steps that are fast tracking it already here are five initiatives taken across the country where municipalities, the state administration and the common public joined hands to tackle the plastic crises at their own level:

1. Reusable in govt offices (Using ink pens and steel cutlery, no longer use of plastic water bottles, disposable tea cups, plastic carry bag).
2. Fishing for plastic waste from water bodies.
3. Crackdown on plastic usage (imposed ban on plastics).
4. Utilizing plastic for road surfacing (done by Prof. Rajagopalan Vasudevan).
5. Up-cycling plastic for better purposes (Lexmipriya S, 2018) <sup>[13]</sup>.

## 7. Conclusion

Being the stonebreaker in the pathway of evolution single use plastic has been the milestone in the development. It has served as a miracle in many ways but at the same time it has been a curse to the environment. From waking up in the morning (using toothbrush) to going to sleep (drinking water from bottles) we encounter plastic at every minute of our life. The miracle of the early 90's which changed the lifestyle of all is now endangering the life of our planet in late 20th century. The immortal waste (plastic waste) has to be treated to sustain a healthy life to the planet and its inhabitants. To do so we need to take into serious consideration on 4 R's of waste management. Reduce, Reuse, and Recycle, Recovery. For a better future we need to create and work in the present.

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