Plant Archives Vol. 20, Special Issue (AIAAS-2020), 2020 pp. 53-56 *ISSN 0972-5210*

A REVIEW PAPER ON PLASTIC, IT'S VARIETY, CURRENT SCENARIO AND IT'S WASTE MANAGEMENT

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Abstract

Plastic, with numerous advantages and disadvantages, has now become an integral part of daily human life playing an important role in every aspect. This review paper summarizes the scientific research data by previous studies and developments on Plastics, it's variety, current scenario of plastic waste, recent developments and use of plastic fibre in concrete mix for construction use and future prospectus. It also briefs the noxious affect of microplastic and other plastic debris on the marine life on different tropic levels. There's an urgent need for the unbiased study of plastic in order to know about the judicious use of plastic instead of exploiting this man-made miracle resource.

Key words: Plastics, Construction, Marine pollution, Environment.

Introduction

Worldwide, in the year 2012 alone, it was computed that about 280 million tonnes of plastic has been produced. From that amount, about 130 million tonnes of the plastics were land filled or recycled. Of the leftover 150 million tonnes, plastic will discover their place in daily lives of Human being. Meantime, the rest of the plastic fraction find their final way as litters in the oceans or land filled (Rochman, 2019). Accordingly, the plastic waste brings grave environmental menace to modern guild because it is made up from several toxic chemicals, and therefore plastic pollutes soil, air and water if not properly managed or treated.

The plastic waste mass may obstruct the ground water movement (Silva *et al*., 2014). Plastic waste may usually in the form of film and hard plastic may contains harmful metal based elements such heavy metal, at which when mixed up with water or rain water can impede soil and receive water. In any case, plastic garbage can impede the pace of percolation and in turns would crumble the soil fertility if it is mixed with soil. Plastic waste is derived from hydrocarbon-based material, its exert comparatively high calorific value which can be used for incineration or boiler. However, burning of plastics at lower temperature may liberate deadly and poisonous chemical gases into the air, including dioxins which is corrupting to the Human being. Plastic waste can also be used to produce new plastic based products after submitting to reprocessing line (Saiki and Brito, 2012).

In general, plastic is lightweight, water retainer and resistant, expandable, strong, and very cheap to produce. These are the attractive qualities that contribute to over-consumption of plastic based goods. Alternatively, if plastic is 100% made from hydrocarbon intermediates, it is very serviceable and leads to slow degradation. According to Plastic-Pollution Organization, plastic materials that are used in our daily consumption has become attractive that initiate an indisputable behavioral needs which led to over-consuming. This behavior at the same time pollutes the environment at earnest. Previous review on application of plastic waste in concrete manufacturing has been reported previously (Kamaruddin *et al*., 2017).

Plastic bags which are usually used for packing, carrying vegetables and meat etc creates a serious environmental job. Plastic bag lasts in environment for up to 1000 years and because of these plastic bags lasting so long and not getting decomposed the number of plastic bag accumulated increases each year. Disposal or somewhat accumulation of large quantity of plastic bag causes pollution of land, water bodies and air, destroying the biosphere and indirectly affecting the organisms surviving there (Raghatate, 2012).

Plastic and it's variety

Plastics are low-budget, lightweight, strong, durable, corrosion-resistant materials, with high thermal and electrical insulation properties (Andrade *et al*., 2016). 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 goodness (Thompson *et al*., 2009). 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 at present (Saxena and Singh, 2013).

Properties of plastic

Plastic have many great characteristics which view versatility, low weight, hardness, and resistant to chemicals, water and impact and all these make plastic is one of the most disposable materials in the modern world. It makes up much of the street side litter in urban and rural areas. It is rapidly filling up landfills as choking water bodies (Jalaluddin, 2017). Plastic

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bottles make up approximately 11% of the content landfills, causing serious environmental consequences.

Due to the outcome, some of the plastic facts are:

1. There's an idea that 100 million ton of plastic is produced every year around the globe.
2. He average European throws away 36 kg. of plastics each year.
3. Plastics packaging totals 42% of total consumption and every year little of this is recycled.

Reported to ENSO Bottles, in the 1960's plastic bottle production has been negligible but over the years there was an alarming increase in bottles produced and sold but the rate of recycling is still very low.

1. Plastics packaging totals 42% of total consumption and every year little of this is recycled. According to ENSO Bottles, in the 1960's plastic bottle production has been negligible but over the years there was an alarming increase in bottles produced and sold but the rate of recycling is still very low.
2. More than 20,000 plastic bottles are needed to acquire one ton of plastic.

Disadvantages of plastic:

i. Plastic is nonrenewable source of energy.
ii. It takes millions of years to decompose naturally.
iii. Converting raw plastic into useful material is not an easy process.
iv. Plastic is difficult to recycle (Andersen *et al*., 2006).

Plastics also present many public health benefits. They facilitate clean drinking water supplies and enable medical devices orbiting through surgical equipment, drips, aseptic medical packaging and blister packs for pills. They provide packaging that reduces food wastage, for instance in the use of modified atmosphere packaging that extended the life of meat and vegetables (Andrady and Neal, 2009).

Owing to their light weight, plastics reduce transportation costs and therefore, atmospheric carbon dioxide emissions. Public and private transportation vehicles can now contain up to 20% plastics typically as parcel shelves, door liners, steering wheels, electrics and electronics, and recent aircraft such as the Boeing Dreamliners is designed from up to 50% plastics (Shah *et al*., 2008).

Plastics can also be used to improve the performance and trim the costs of building materials; examples of this include lightweight fixings, window and door frames, fixtures and insulation materials. Plastics deliver unparalleled design versatility over a wide range of operating temperatures. They have a high strength-to-weight ratio, stiffness and toughness, ductility, corrosion resistance, bio-inertness, high thermal/electrical insulation, non-toxicity and outstanding durability at a relatively low lifetime cost compared with competing materials; hence plastics are very resource efficient (Chatterjee and Sharma, 2019).

Impact of plastic on marine environment

Plastics are a class of artificial organic polymers composed of long, chain-like molecules with a high average molecular weight. Many common classes of plastics are composed of hydrocarbons that are typically, but not ever, derived from fossil fuel feed stocks. During the transition from resin to product, a wide variety of additives-including fillers, plasticizes, flame retardants, UV and thermal stabilizers, and antimicrobial and coloring agents-may be added to the resin to heighten the plastic's performance and appearance. Talking about micro plastics, these tiny (micro) plastic fragments are persistent in the marine ecosystem and due to their micron sized molecule nature, these fragments are mistaken as food and ingested by a range of marine biota which includes corals, phytoplankton, zooplankton, sea urchins, lobsters, fish etc. and ultimately get transferred to higher tropic level. The impact of micro plastic on marine biota is an issue of concern as it leads to the entanglement and ingestion which can be fatal to marine life. The micro plastic fragments mainly arrive from terrestrial source and thus coastal ecosystems which incorporate of coral reefs are in great threat due to micro plastic pollution.

The result is a class of materials that have extremely versatile and desirable properties (including strength, durability, light weight, thermal and electrical insulation, and barrier capabilities) and can take many variety (such as adhesives, foams, fibers, and rigid or flexible solids, including films. In the intervening decades, hundreds of publications have documented encounters between marine debris and nearly 700 species of marine wildlife. For particular species or populations, documented encounters occur frequently. For example, 95% of 1,295 beached seabird carcasses in the North Sea contained plastic in their stomachs, and 83% of 626 North Atlantic right whales examined in 29 years of sighting photographs had evidence of at least one entanglement in rope or netting.

It was reported that 85% of publications about marine debris encounters described incidences of entanglement by or ingestion of debris, with at least 17% of affected species categorized as near threatened to critically endangered on the International Union for Conservation of Nature and Natural Resources (IUCN) Red List of Threatened Species. The vast majority (92%) of the debris in reported encounters with individual organisms was plastic. Entanglement has now been reported for 344 species, including 100% of marine turtles, 67% of seals, 31% of whales, and 25% of seabirds, as well as 89 species of fish and 92 species of invertebrates. Animals that consume plastic debris may also be at risk of contamination by chemicals associated with plastics that are incorporated during manufacture or that accumulate from contaminated environmental matrices such as sediment or seawater. Many of these substances are known to be Persistent, Bio accumulative, and Toxic (PBT), with at least 78% of the priority pollutants identified by the US EPA known to be associated with plastic marine debris (Lin, 2016).

PBT substances are typically hydrophobic and therefore readily absorb out of seawater onto other hydrophobic substances, such as sediment, organic matter, and now plastic. In fact, because of their strong attraction to PBT substances, some plastics are utilized as passive sampling devices to measure chemical contaminants in a variety of environmental matrices (Hiremath *et al*., 2014).

Uses of plastic in Construction

Fibers have been used to reinforce brittle materials since ancient times. The use of straw to strengthen bricks and stabilizes their dimensional instability has been practiced for centuries. Fiber reinforced concrete (F.R.C) is relatively new construction material developed through extensive research and development work during last three decades (Patil *et al*., 2016). It has found a wide range of practical applications and has proved as reliable construction material having superior performance as compared to conventional concrete. Incorporation of various fibers in concrete has been found to

improve several of its properties like tensile strength, cracking resistance, impacts wears resistance, ductility and fatigue resistance, due to which FRC is now being used in structures such as airport pavement, bridges decks, machine foundations, blast resistance structure, sea-protective structures etc.

It was concluded that reusing the plastic bottles as the building materials can have substantial effects on saving the building embodied energy by using them instead of bricks in walls and reducing the CO_2 emission in manufacturing the cement by reducing the percentage of cement used. It is counted as one of the foundation's green project and has caught the attention of the architecture and construction industry. Generally the bottle houses are bio climatic in design, which means that when it is cold outside is warm inside and when it is warm it is cold inside. Constructing a house by plastic bottles used for the walls, joist ceiling and concrete column offers us 45% diminution in the final cost. Separation of various components of cost shows that the use of local manpower in making bottle panels can lead to cost reduction up to 75% compared to building the walls using the brick and concrete block (Shoubi and Barough, 2013).

Plastic fiber reinforced concrete (PFRC) is a type of special concrete in which various types of plastics are added or replaced with the constituents of concrete. This has been done in order to reduce the disposal of plastics and for effective utilization of waste plastics that are hazardous to environment. This study attempts to give a contribution to the effective use of domestic wastes (plastics) in concrete as fibers in order to prevent the environmental strains caused by them, also to limit the consumption of natural resources (Ramadevi and Manju, 2012). The experimental studies on a M20 mix with addition of polythene fibers (domestic waste plastics) at a dosage of 0.5%. The cube compressible strength of concrete increases to an extent of 0.68% and 5.12% in 7 and 28 days, respectively. The cylinder compressible strength of concrete increases to an extent of 3.84% in 28 days. The split tensile strength of concrete increases to an extent of 1.63% in 28 days. Katte et al. studied the partial replacement of natural sand by plastics with different percentage 0% to 50%. In concrete, Natural sand can be replaced with plastic waste by 10% to 20% to achieve green concrete. Sand can also be replaced up to 30% in the members of building which do not carry high load (Ananthi *et al*., 2017).

Future Prospectus and conclusion

Plastic, even though being something that's destroying the biomes, is something that can be of precious use in the field of construction if the waste is processed and used and then recycled judiciously as per needs. The production, use and waste generation of plastic products is expected to increase in the future and thus it is urgent to increase the re-use and recycling of plastic waste for transitioning to a resource efficient circular economy in Sweden. For increasing plastic recycling, there is a number of per-conditions that need to be met, summarized in the following:

1. Appropriately established schemes for the separate collection of plastic waste.
2. Steady supply of plastic waste in adequately high volumes.
3. Well-functioning markets for plastic waste with clear signals of secondary raw material demand.
4. Quality guarantees by the recycling industry for uptake in plastic manufacturing processes.

To achieve this, recyclable plastic waste would have to be gradually phased out from incineration facilities for energy production (Law, 2017). This would be a great challenge, as incineration plants contribute significantly to the heating needs of municipalities. However, prohibiting the incineration of recyclable plastic waste would lift one of the major barriers of plastic recycling, the supply of waste plastic. It could provide a large quantity of waste of variable quality. Therefore, a ban on incineration would necessarily need complementary measures of sorting and recycling technology development, as well as capacity expansion (Government of Sweden, 2015). This highlights the need for 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 (Milios *et al.,* 2018).

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Table 1: Variety of Plastics and their characteristics (Kamaruddin *et al*., 2017)

Plastic	Characteristic
Polyester (EPS)	Lightweight, foamed and energy absorbing plastic
Low Density Polyethylene (LDPE)	Milky white, soft and flexible plastic
High Density Polyethylene (HDPE)	Relatively of high grade and used in white
Polystyrene (PS)	Stiff but brittle plastic with clear look and glossy surface
Plasticized Polyvinyl Chloride (PPVC)	Clear type with flexibility
Polypropylene (PP)	Hard, but flexible plastic
Unplasticized Polyvinyl Chloride (UPVC)	Clear type, hard stiff plastic
Polyethylene Terephthalate (PET)	Hard plastic suitable for fibre production

Table. 2: Effect of plastic on the properties of concrete (Raghatate, 2012)

S. No.	Effect of plastic
1.	Compressive strength of concrete is affected by addition of plastic pieces and it goes on decreasing as the percentage of plastic increases addition of 1% of plastic in concrete causes about 20% reduction in strength after 28 days cu ring.
2.	The splitting tensile strength observation shows the improvement of tensile strength of concrete. Up to 0.8% of plastic improvement of strength recorded after that addition of strength of concrete decreases with addition of plastic.
3.	Thus it i s conclude that the use plastic can be possible to increase the tensile strength of concrete.

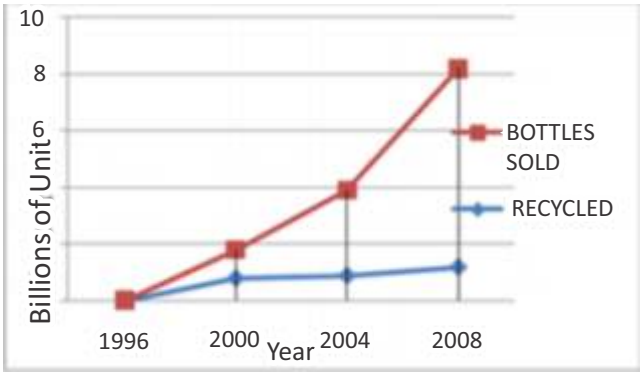

Fig. 1: Bottles sold versus bottles recycled (Ananthi *et al*., 2017)

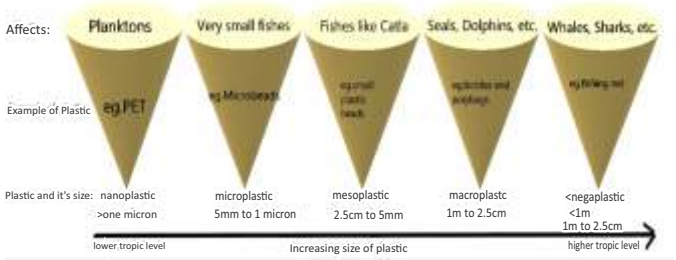

Fig. 2: Different types of plastic and their effect on marine life