

IMPACT OF PLASTIC ON MARINE ENVIRONMENT: A SHORT REVIEW

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Abstract- The non-biodegradable plastic wastes ejected from several sources are uninterruptedly mixed in the oceanic environment from different parts of the world, which are persevering in the marine world even thousands of years and moved one region to another within the ocean, imparts negatively to marine fishes, mammals, birds and other huge variability of diversified species surviving in oceanic climate. The ocean is treated as the hotspots or dumping yard of vast amounts of plastic wastes ejected by human beings after use and these wastes of plastic materials either through ingestion or entanglement both in micro and macro forms into the various kinds of marine species and cause of hazards to oceanic climate. The waste plastic products undergo bioaccumulation in the food chains and also in food web within oceanic climate and cause of danger to most of the aquatic life. The marine plastic contamination is now considered as an vital global issue and not only influences the global ecological condition, but also interferes with the economic condition and social issue throughout the globe.

Keywords: Marine species; Oceanic climate; Ecosystem, Plastics contamination, Global issue

I. INTRODUCTION

Almost 70% of our earth is filled by oceanic water, where various kinds of biotic species are living. Large number of species is living in the oceanic climate, which is not yet discovered by researchers. The existence and impact of unused plastic waste materials in the oceanic climate is one of a great concern for environmentalist as well as leaders around the world. [1] The impact of unused plastic waste debris in sea ecosystem was noticed since 50 years ago, when the synthesis and application of plastic products around the world is nearly fifty million metric tons. Then, after that, subsequently the demand of plastic materials in different sectors amplified continuously and the industrial production of plastic materials increases in a rapid rate and expected that it may increase to be more than 500 million tons per year nearer to 2020.[2] A large number of biotic species existing in the oceanic climate are affected severely or sometimes even killed because of hazardous plastic wastes which, threatened the existence of the marine biota and interrupts the biodiversity in sea ecosystem. The fishes, birds, mammals and other marine biota are uncomfortable due to creation of a waste plastic layers at the bottom part of sea [3]. It was assessed that more than 300 million tons of plastic product materials are manufactured at every year and among which more than 50% is single used plastic items including shopping bags, carrying bags, cups, plates, outer packaging materials and straws. [4] Among the

used plastic materials (discarded plastic waste), more than 85% are non-biodegradable in nature and are synthetic petroleum based polymeric materials. More than 8 million tons of plastic wastes enter into the oceanic environment at every year and due to light weight, the plastic waste products are floating abundantly over the surface of sea water and in the present situation these materials are the major marine litters. Marine environment plays a major role over the climate change and if, it is covered by the plastic waste materials, then not only oceanic ecosystem but, also the whole world is affected [5].

Impact of plastic waste on Marine Sea Birds and Mammals

It was found that in some shores of remote islands a large number of seabirds and marine mammals are identified and later on it was recognized that all these birds and mammals are dying due to the microplastic materials in their stomach. The accumulation of the plastic materials is continuously increasing, rapidly causing a significant threat to sea birds, fishes, marine mammals, turtles, crustaceans, marine wildlife and some endemic species present in the marine world. Due to eating of plastic debris, most of the marine biota is suffering suffocation, starvation and this is the cause of killing of millions of sea birds and mammals at every year and continuously increasing day by day [6]. Thousands and thousands of sea birds eaten the plastic waste materials at every day and due to the ingestion of the non-degradable plastic

materials the volume space of stomach is reduced which results starvation and ultimately death. It was observed the stomach of 60% of the dead seabirds and mammals are full of plastic materials and it was estimated that it should be increased more than 90% by 2050. It was practically found that tons and tons of plastic debris are found in the habitat of critically endangered species (Hawaiian monk seals). The non-biodegradable plastic debris is also cause of hazards even death of endangered Steller sea lion, the dead blue whales have also been found with bellies and stomach full of plastic waste materials. The consumed waste plastic materials have the possibility of blocking the digestive tracts and can damage the stomach linings and forced seabirds and mammals to death. It was studied that about 98% of Laysan albatross are facing death because of obstruction in their digestive system and stomach due to eating plastic debris materials. Plastic wastes affects adversely to the survival of some common sea birds like pelicans, gulls, and some other marine mammals and birds whom in mistake takes plastic debris as their food [7, 8]

Impact of plastic waste on Marine Sea fishes

The waste plastic debris in the marine environment is gradually converted into the microplastic and nanoplastic forms and during the process of respiration these are consumed by fishes and some other small marine biota through their gills along with water and entered into their body. These waste plastic materials not only impacts adversely to marine fishes and other marine biota, but also it has a great impact on the human health because, marine fishes are found to be popular tasty food for the people of most of the countries. Some researchers observed that microfibers from the waste plastic debris materials are commonly consumed by human beings such as perch, Cisco and brown trout, hence the plastic contamination in the marine world not only affects marine life, but also impacts on the food chain and food webs of marine ecosystem. There are many tiny particles of microplastic materials, which are the major cause of decreasing fishes in the marine environment because larvae of these fishes’ favor to eat the microplastic particles rather than their genuine food. [9] It was estimated that, if this trend of addition of plastic debris in the marine environment continued, then after some years the weight of fishes in the ocean becomes equal to weight of plastic wastes in the marine world. Many researchers said that the mortality rate of the perch gradually increased in a rapid rate because usually baby perch will aggressively choose to eat microplastic materials rather than plankton, which is normally favorable food for these species. All the fishes consumed

sufficient plastic debris of microplastic are facing death within 48 hours. The plastic pollution in the oceanic environment affects adversely at least 267 marine species globally, which includes 86% of sea turtle and fishes, 44% of seabird, and 43% of all marine mammals. [10, 11]. Fig-1 shows the different ways of degradation of plastic waters.

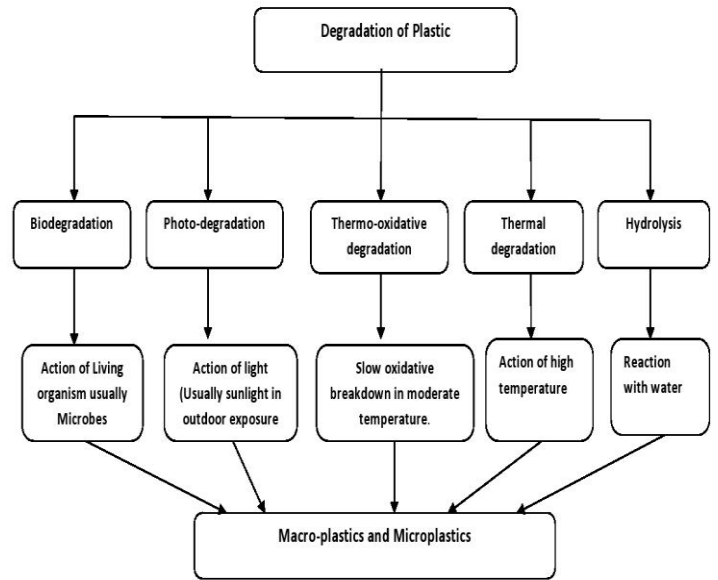


Fig-1: Degradation of plastic in Marine Environment

Impact of plastic debris on Sea Turtles

It was found that an uncountable number of marine turtles is either injured or even dies at every year due to entanglement within synthetic commercial fishing nets made of plastic materials or some other kinds of plastic waste products added into the sea by manmade activities. Many oceanic species including sea turtles consumes small floating plastic particles or macroplastic by mistake as food and these plastic materials directly enters into the stomach of the turtles and bring them into death [12]. The incorporated plastic debris results obstruction of the digestive system turtle and becomes danger for their life. Although many factors are responsible for the death of sea turtles, but 50% is due to only plastic pollution in the marine ecosystem. It was found that Juvenile green turtles are seriously affected by the plastic debris of marine environment. Many Plastic bags that floating over sea water looks like jellyfish; the discarded fishing nets are always looks like seaweed, which is the tasty food for sea turtles. Hence, easily sea turtles take these plastic materials because they thought that they are consuming their primary favorite and tasty food, but these sea turtles are unknowingly ingesting harmful plastic materials in their digestive system and cause of

blockage of the digestive tract and normally the turtle ultimately facing death [13]. The plastic debris that eaten by turtles directly causes blockage in the intestinal track causing malnutrition, reduces growth rate, internal bleeding and finally results in death. The fishing industry is a serious threat to both turtle and reptiles, because these two species are expert in swimming, therefore easily caught by plastic nets during fishing by a fisherman. One single plastic piece is sometimes able to kill a turtle and globally, it was predicted that about approximately 52% of marine turtles are killed and injured by eating plastic debris by mistake. [14]

Impact of plastic waste on marine Dolphins and Whales

Like sea turtles, some other marine animals and mammals such as Whales and Dolphins also by mistake consume the waste swallow plastic products as their food and sometimes they take small sized plastic wastes along with the fishes as their primary food source accidentally or unintentionally, these plastic wastes are ultimately accumulated in their digestive system, ultimately causing death. The postmortem report of many dolphins and whales reflects huge volume of plastic wastes in their digestive system, which causes starvation and finally death. Hence, a huge species of cetaceans is severely affected by plastic contamination in the marine environment. The floating plastic wastes when ingested into the body of Dolphins and Whales it first hinders and then block the digestive pathway and finally accumulated in the stomach, which turn out to be starvation and then death [15]. The various plastic wastes such as plastic bags, fishing hooks, packaging materials, ice cream wrappers, plastic bottles, shotgun cartridges are found within the body of dead Dolphins and Whales during the post mortem checkups. The microplastic is one of a hazardous material present in the marine environment. It is generally of very small plastic granules, fibers, pellets and fragments having the diameter size less than 5mm and always available in very thin forms like human hair. Although, many marine species are facing health hazard problems and even death due to microplate and nanoplastic materials, but its impact on dolphins and whales is insignificant. The products of macroplastics are comparatively larger in size of visible plastic pieces including plastic bags, straws, containers and bottles. The microplastics are any plastic materials having size less than 5mm having the length of the almost same seed. The microplastic materials are not directly entered into the sea, but it is used for improving the quality of paints, skin care creams and products. Both these kinds of products end their life cycle in the ocean mouth and a comparable amount of it finally

accumulated in the stomach of dolphins and whales. Worldwide, it was estimated that in 2018 almost 60% of stranded cetaceans are consuming waste plastic materials by mistake as their food which results risk of the population of dolphins and whales. The microplastics although not directly taken by dolphins and whales, but both of these marine animals unintentionally capture the plastic wastes alongside their prey and they eat both prey (fish or squid) along with plastic wastes. Although the entire mechanism of the impact of plastic ingestion is not fully known, but it is clear that most of marine animals and endemic species are in trouble due to the dangerous plastic pollution. [16, 17]. PCBs are one of a highly toxic substance, which is banned by UN, since from 2004, but unfortunately due to the failure of government and proper administration, it is still now used widely as building materials and about 14 million tons of PCBs contaminated plastic materials still entering into the sea at every year throughout the world. The dangerous chemical PCBs undergo bio-amplification through the food chain and pass from the primary consumer to the top predators like dolphins and whales in the marine ecosystem and impacts worst and usually cause of barrenness and drastically destroying the population's marine mammal. PCBs are generally stored at the areas of fatty tissues of dolphins and whales and it gradually increases, if they consume more plastic contaminated fishes. The PCBs entered into the bodies of both female, male whales and dolphins and increases till they become sexual maturity. After the sexual maturity the absorption of PCBs by the males is continued, but in case of females it drops off until the first calf because the PCBs pass into their first-born calves and sometimes become fatal to their new born species [18, 19].

Impact of plastic wastes on Sea Lions and Seals

Sea lions and seals are the rare species of the marine environment and now day these endemic species of animals are a threat of their life due to the drastic increase in marine plastic pollution. The different waste plastic debris mainly lures, nets, fishing lines, Plastic bags and packing bands and due to entangle of it, seal fishes and sea lions causing health hazard problem and sometimes death. Some of the children and young seal fishes and sea lions are found of play, normally they are playing with the floating plastic materials and due to unawareness they consume these plastic materials and made their life in danger. The rubber products such as rubber tyres and tubes, packaging plastic materials, plastic bands fishing nets severely affect Steller Sea Lions even in some remote areas [20]. The packing bands are looking like a big ball in the

marine environment, sea lions and seal are playing with it without knowing the harmful effect caused by it. When these waste plastic materials come in contact with these marine animals it causes infection in their body and later on it becomes fatal for them. Finally, it was concluded that most noticeable and alarming impacts of marine plastic wastes are the suffocation, ingestion and entanglement of an uncountable number of marine biota. Hence it was found that a number of marine species along with marine wildlife such as whales, seabirds, dolphins, turtles and large fishes by mistake unknowingly consumes some plastic materials along with their food and finally died due to starvation in their stomach filled by plastic debris. These marine animals and wildlife suffer from lacerations, infections, reduction of ability to swim and injuries in the internal parts. The floating plastics are the cause of invasive marine species and bacteria which may result the interrupt of marine ecosystems. [21, 22]

Impact of plastic waste to marine coral reefs

Coral reefs are one of the rare and important creations of marine environment, which maintain the ecological biodiversity in the marine world. These species required clean and uncontaminated clear water for their healthy growth and survival. The waste plastic materials and other solid waste products finally end at the ocean and deposited in the form of marine sediments. Since, the waste plastic product facilitates the microbe attack; therefore it poses greater threat to the population of coral reefs. When the sediments and other plastic debris enter into the ocean, then it prevents the growth of coral reefs whereas the cause of increasing the growth of marine algae, therefore decreases the quality of the water. The plastic pollution is comparatively more susceptible to diseases, obstruction of growth, reproduction capacity, and change in the quality and structure of the food of coral reefs. Coral reefs are usually relying on marine algae and this phenomenon is known as 'zooxanthellae [23]. If the temperature of the surface of the sea increases coral reef eject colorful algae and loss of this algae is the cause of bleaching and turns white. Recently, it was found that about 80% of the coral reefs in some regions of the Great Barrier Reef are killed due to bleaching the plastic waste debris. It was found that 0.2% of the bottom parts of the sea are covered by coral reefs, but, however, these species are responsible about 25% biodiversity in the marine ecosystem. Due to increase in global warming the temperature over the sea increases, which causes enhancements of diseases and facilitates the coral bleaching and finally coral reefs are facing death, which causes

difficulties in fishing and coastal management. The impact of plastic contamination on a coral reef is mostly observed in the countries like Indonesia, Myanmar, Australia and Thailand. It was estimated that the probability of affecting diseases potentially increases from 5% to 90% if the coral reefs are in interaction with plastic debris of the marine environment. Coral reef are a natural wonder of the world and is a substance of beauty and usually covers about 0.1% or less than that of the ocean surface of the world, but it supports an indispensable home for more than 25 % of total marine life. These species play an important role for the protection of the coastal communities and serves as a barrier for cyclones and increasing level of sea. But, now this beautiful and wonder species of the marine world are in danger due to huge plastic pollution, increase in temperature of ocean, climate change, overfishing and a wide range of land-based activities. The new study says that these wonderful and useful species are under the threat from plastics. As every year about 8 million tons or more that that plastic wastes are entering into the oceanic climate which is equivalent to draining one garbage truck of plastic per minute. The plastic waste debris starves corals of vigorous light and oxygen with the release of toxins that enables viruses and bacteria to attack in a greater rate. There is countless evidence where the wildlife of the marine ecosystem is in fatal by consuming plastic debris by mistake, especially by taking microplastic as food. But, however on certain analysis, it was found that plastic debris in the oceanic environment is the house of many kinds of bacterial contamination, which causes diseases to coral reefs and finally results death. In research it was found that the risk of producing diseases in the reefs by plastic contamination is almost twenty-two times more than the reefs on the preserved state or uncontaminated by plastic materials. [24]. The most important coral diseases are white syndromes, skeletal eroding band, growth anomalies, black band, brown band and atramentous necrosis, among which three of these are cause of greater coral mortality and are comparatively more predominant on reefs contaminated by the plastic wastes. Hence it was found that the effect of plastic debris directly causes the diseases and damages the tissue of coral species causing the increase in rate of infection. The more danger is that probably the coral species are more attracted towards the plastic wastes because of the taste of the chemicals present in the plastic materials which is commonly called as chemoreception mechanism. Hence, finally it was concluded that the diseases developed due to plastic debris is the major contribution in the degradation of coral reefs. [25, 26]. Figure-

2 shows the technique of determining the meso, micro and nano plastics in marine environment.

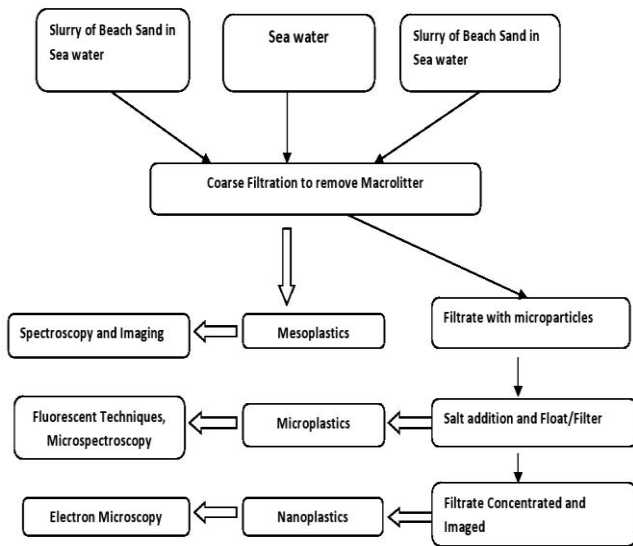


Fig 2 Technique for determining Meso, Micro and Nano plastics from sea water

Conclusion

The plastic contamination in oceanic climate is now a vital and emerging global problem, which is the cause of danger to marine biota and indirectly impacts to our ecosystem and survival. The oceanic plastic contamination influences adversely to both aquatic and terrestrial ecosystem in our globe. We are the sole cause of plastic contamination in oceanic world and earth. It was observed that the waste plastic materials are now found in soil, air and most of the aquatic environment including lakes stream, river dam. It was also exist in every part of our life and even the air used in breathing. Although polymer and plastic materials are treated as a versatile material because of its low cost, versatile use, but however its excessive use brings worst environmental contamination. Hence, we have to aware about the dangerous effect of plastic in oceanic climate to protect marine world. Another way of protecting our globe from plastic contamination is to follow 5R principle and more emphasis is given to develop a proper alternative biodegradable material. Proper rule must have to be imposed in govt. level for the use of single use plastic products in our day to day life and more importance has to give for the reuse and recycling of the waste plastic materials.

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