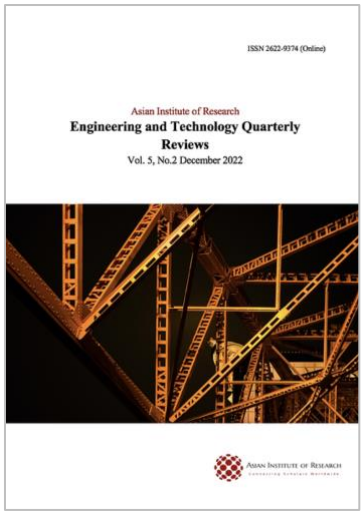

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Microplastics as a Serious Challenge in Marine Environment

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Abstract
Today, the production of plastic materials has multiplied with the growth of the population and the development of industry in the world. Microplastics are released into the sea environment as a result of the decomposition of plastic materials and are carried into the water by wind or waves. Unlike small inorganic particles in seawater, microplastics increase the concentration of organic pollutants by splitting. Microplastics are ingested by marine life and have adverse effects on them. The potential degradation of these substances in the marine ecosystem is still being quantitatively evaluated and modelled. Due to the increasing levels of pollution by plastics in the seas, a better understanding of the effects of microplastics in the ocean food web is of great importance.

Keywords: Degradation, Environment, Industry, Marine ecosystem, Microplastics

1. Introduction

The first reports of plastic dumping in the oceans in the early 1970s attracted little attention from the scientific community in the following decades, by collecting information about the environmental consequences of plastics, this issue became of interest to researchers. During recent years, plastic production has increased all over the planet, currently it has reached about 245 million tons and it is the main part of the garbage and they account for about 95 percent of the accumulated garbage that exists on the beaches, surface and seabed (Mason et al., 2016). Plastic products are suitable for various applications due to their variety, lightness, transparency and strength. In the packaging industry, well-designed plastic has replaced conventional materials such as glass, metal, and wood. Plastic in today's society has many benefits for human health and the environment, for example, plastic packaging prevents food waste or contamination and thus saves resources. Although the industrial benefits of plastic are extensive, this valuable commodity has attracted a significant part of environmental concerns in the public and private sectors, scientists and the general public. Plastics are transformed into micron-sized particles under mechanical, chemical and biological decomposition currently, the National Oceanic and Atmospheric Administration defines microplastics as the smallest plastic particles with a diameter of less than 5 mm. The origin of microplastics can be primary and secondary. Primary microplastics are produced as micron-scale plastic particles in various industries for example, microplastics are used in industrial and household products such as hand and face cleaners, cosmetics, toothpaste and scrubs. But secondary microplastics are the result of

decomposition and crushing of macro plastics in water and land environments. Microplastics, which include small plastic pieces, granules and fibers, have been considered as pollutants since the beginning of the 20th century (Ryan et al., 2009). Plastic residues have been reported in all marine environments from the shallowest to the deepest point of the ocean, from the coastline to the ocean and from the equator to the polar regions in sediments and even in the ice of the polar regions (Obbard et al., 2014). Microplastics are composed of different particles, shape and chemical compositions, which may be related to their toxicity (Paerl et al., 2016). Studies have shown that microplastics can accumulate in aquatic organisms. But the toxic effects of different types of microplastics are largely unknown (Hu et al., 2016). How microplastic affects aquatic organisms, including fish, has caused concern among researchers and citizens (Seltenrich, 2015). Because microplastics are consumed by many marine species, especially fish. Microplastics can remain in the digestive system of aquatic organisms for a long time and prevent the entry of food and block the intestinal tract (Karlsson et al., 2017). Consumption of microplastic affects important biological processes and causes endocrine disorders, which in turn can affect mobility, reproduction, and mutation (Lithner, 2011). The consumption of microplastics by marine organisms has had adverse effects on their health, such as the amount of food consumption, weight, growth, and in general on their population and life. The potential effects of microplastics on the aquatic food web have increased dramatically (Lusher et al., 2017).

2. Degradation of plastics in the marine environment

Degradation is a chemical change that drastically reduces the average molecular weight of a polymer. Because the mechanical integrity of plastics always depends on their high molecular mass,any extensive destruction weakens the material. Severely degraded plastics become so fragile that they are completely pulverized during transportation. Sometimes even these powder components, cannot be seen with the naked eye, they can be further degraded (generally microbial biodegradation) by converting polymeric carbon to CO_2 (and part of the biomass accumulation). When this process is completed and all the carbon in the polymer is converted to CO_2, complete degradation occurs (Andrady,1994). Destruction is generally divided into several categories according to the factor that causes it: 1- Biodegradation: Degradation by living organisms, usually microbes. 2- Photo degradation: Degradation by light, generally sunlight when exposed outdoors. 3- Thermal oxidative degradation: slow oxidative failure at medium temperature. 4-Thermal destruction: destruction at high temperatures. 5- Craft water: reaction with water. For common polymers and nylons that are exposed to the sea environment, The UV-B radiation of sunlight starts the photooxidative destruction. This destruction can proceed in an endothermic manner. This destruction can proceed endothermicly, without the need for more ultraviolet radiation. As a result of degradation, the molecular mass of the polymer decreases and functional groups rich in oxygen appear in the polymer. Other types of degradation processes are slower compared to photo induced oxidation (Al-Oufi et al., 2004). Craft water is usually not an important compatible in the sea. While all biological materials such as plastics are biodegraded in the sea. The speed of this process, even in sediments, is several times lower than the speed of oxidative degradation caused by plastic light. In plastics that are exposed to the air or on the surface of the beach, the destruction started by the ultraviolet radiation of the sun is an effective mechanism. But when the same plastic floats in sea water in the same position and is exposed to sunlight, the degradation process slows down (Meenakumari and Radhalakshmi, 1998). Reducing the destruction of plastics that float in sea water depends on two factors: lowering the air temperature and reducing the concentration of oxygen in the water. Unlike samples that are exposed to air, samples placed in water maintain a minimum ambient temperature that prevents the reaction from progressing. The contrast in the speed of destruction (between buoyancy and air exposure) there is, it is worsened by the effect of mass. The surface of floating plastics is ready to become clogged mass and over time it will be covered by algae biofilms and the formation of invertebrate colonies (Muthukumar et al., 2011).

3. The entry of microplastics into the sea

Plastic is the main component of waste and sometimes accounts for 95% of the accumulated waste that exists on the beaches, sea surface and seabed. Every year, about one trillion tons of plastic bags enter the waste cycle. Although most of these wastes are buried, the final destination of many of these waste bags are the oceans, and sometimes even these wastes do not decompose until 1000 years later and remain in the environment. Plastic bags, fishing equipment, food and beverage containers are among the most common waste materials that pollute more than 80% of beaches and resorts (Mason *et al*., 2016) Plastic particles may be widely distributed in the marine environment through hydrodynamic processes and ocean currents (Claessens *et al*., 2011). Many effects of marine

plastic waste on the marine environment have been reported. A wide range of marine species, including birds, sea turtles and mammals, are known to be affected by these wastes and by consuming these wastes, they are affected by consequences such as impairment and reduced ability to feed, reduced fertility and reproduction, wounds, lacerations and death have become (Gregory, 2009). Also, based on research, at least 180 species of marine animals and birds have been found to have consumed plastic (Teuten et al., 2009). The main sources of microplastics entering the sea are divided into two groups: 1- Those that are directly exposed to water running.2- Macro and mesoplastics that are exposed to decomposition and weathering (Andrady, 2011). Those that enter the environment through municipal and industrial wastewater include scrubbers that.

They are in pharmaceutical, health and cosmetic products (toothpaste, body shampoo, etc.). Microplastics that originate from the breakdown of larger plastic items include fishing net fibers, industrial raw materials, household items, polymer pellets or plastic pieces (Eerkes-Medrano et al., 2015).

The main sources of microplastics in marine environments are second type sources, the highest concentration of microplastic particles and fibers has been observed in coastal areas, ports and near industrial units (Desforges et al., 2014).

4. The effect of microplastics on aquatic organisms

Pollution with plastic waste and microplastic fragments is recognized as a major problem in freshwater and marine systems. Negative effects may be due to organisms being trapped in plastic nets or feeding on these plastics by invertebrates, birds, fish, mammals and turtles **(**Koelmans et al., 2014). The ecotoxicological effects of microplastics on aquatic animals have been investigated by a large number of laboratory studies, using marine and freshwater species. When microplastics are ingested by aquatic organisms, the greatest effect may be due to the accumulation of these particles in the digestive systems of living organisms. Consumable microplastics may accumulate in the digestive system of aquatic animals and even block it, which leads to a reduction in nutrition due to false saturation. As a result, body weight loss, inhibition of growth, disruption of the reproductive system, reduced mobility and even death. Ingestion of microplastics can also induce other negative effects, including physical damage to digestive organs, oxidative stress, changes in enzyme production and metabolism in tissues. In addition, due to the fact that microplastics may be converted into smaller particles, the possibility of these microplastics penetrating into the circulatory system and phagocytic cells of exposed organisms increases, and due to the long-term persistence of microplastics in organisms, it can cause more damage to them. However, the actual effects associated with the consumption of microplastics on aquatic or exposed animals seem to differ from the physicochemical properties of microplastics which shows further research on a wide range of aquatic species and microplastics with different sizes, shapes and compositions (Wang et al., 2019).

5. Toxicity of ingested microplastics

Sea water has a lot of nano and micro particles (approximately 106-107 particles per mL or 10-500 µg/L) most of them are larger than 100 nm (Rosse and Loizeau, 2003). Filter feeders in the oceans range from nano-sized zooplankton to the largest marine animal, the whale. All these organisms communicate with each other without harming each other or transmitting diseas. Just as there is no enzymatic pathway to break down these natural polymers in the cell walls of natural marine particles, there is no way to digest and absorb plastic particles. Ingestion of microplastics by marine micro-organisms creates many different problems. The greatest concern is the potential for transport of persistent organic pollutants. Plastic particles are transported by marine organisms (Bowmer and Kershaw, 2010). In fact, it is persistent organic pollutants that produce toxicity.
In general, the toxicity of plastics includes one of the following:

- Among the monomers left over from the industry (plastic production stage) in plastic or toxic additives used, we can mention the presence of bisphenols in the production of polycarbonate or the toxicity of phthalates in the production of PVC.
- Toxicity caused by the release of some mediators that result from the surface degradation of plastics. For example, burning polystyrene and styrene produces other toxic substances

- Organic pollutants in seawater are slowly absorbed and thus accumulate in microplastics. In fact, this action does not mean cleaning the sea of chemical pollutants by plastic particles, but this action increases the bioavailability of pollutants for marine organisms (Endo et al., 2005).

Recently, a study was conducted on the bioaccumulation of pollutants in microplastics (Voparil et al., 200). Based on these findings, different levels of toxicity in algae (Hund-Rinke and Simon, 2006). Zooplankton (Lovern et al., 2006). Daphnias (Zhu et al., 2007). Fish like carp (Asharani et al., 2008). and trout (Mason et al., 20016). It has been reported.

6. Conclusion

It seems that the indiscriminate production of plastics is uncontrollable and the amount of plastic waste in the environment increases every year**.** The results of the studies show that the presence of this pollutant in the environment has caused them to enter the food chain, so it can affect human health, the environment, and living organisms in aquatic environments. On the other hand, the detection of the amounts of microplastics in drinking water also shows that this pollutant can enter the human body and other organisms directly through drinking water. Despite the importance of the presence of this pollutant in water environments, studies in this regard are insufficient. In Afghanistan, this field has not been done so far and it is necessary to address it. In addition to the studies related to the identification and detection of microplastics, it is suggested to have written training programs in order to use less plastic materials in everyday life along with presenting the correct solutions for the recycling of plastic materials, and also with the help of industries, suitable alternatives to plastic. to be presented.

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