Microplastic pollution control strategy

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Abstract. As a new pollutant, microplastics have attracted more and more attention. This paper discusses the primary and secondary sources of microplastics and the ecological impact, and reveals the urgency of microplastics pollution control in the current environmental pollution. In order to deal with the deteriorating environmental problems caused by microplastics, it is proposed to strengthen policy support from the perspective of legislation, clarify relevant responsibilities, improve technical standards, and scientifically divide the types of microplastics. This study proposes to improve the ability to integrate the industrial chain from a technical perspective, and to control the production of microplastics from the source to solve the environmental pollution problems caused by microplastics.

1. Introduction

In order to protect the marine ecological environment, at the 63rd UN General Assembly, June 8 of each year is designated as "World Ocean Day", which aims to call on people to protect the marine ecology. In fact, the ocean, which accounts for 71% of the earth’s area and plays an irreplaceable role in the entire earth’s material circulation and energy flow, is slowly being covered by the unprocessed garbage around us.

As the country with the longest coastline, my country's oceans are threatened by domestic waste, especially plastics and microplastics. According to the results of the marine garbage monitoring conducted by the government in 57 regions in 2018, the amount of plastic garbage accounts for three-quarters of the total marine garbage [13]. Among them, the areas with a higher density of marine garbage are mainly tourism and recreation areas, port shipping and land adjacent to the sea. In addition to the plastic garbage seen by the naked eye, the monitoring report also shows that there are some invisible plastic "pm5.0" particles in the ocean. This is because of the improper handling of plastic waste, which causes them to break up and break down into plastic particles in the marine environment. The current deterioration of the marine environment has increased microplastic pollution.
2. Source of microplastics

Microplastics, as a new kind of impurity, have been widely used in today's ecosystem. Plastic pollution of the past, people think of it as the grass and water, stuffed with animals’ stomachs, flying plastic bags. So now the academic research on plastic pollution has shifted the focus to invisible microplastics. Two sources of microplastics: primary and secondary.

Primary microplastics mainly refer to all kinds of plastic microbeads. At first, plastic microbeads are used for polishing industrial products. Later, with the increasing demand for daily necessities, plastic microbeads are gradually applied to a large number of daily chemical products, which can better exfoliate [1]. As a result, natural materials such as pumice and walnut peel have been gradually driven out of the market and replaced by micropearl-containing body wash, facial cleanser and other products. People use products containing microbeads in their daily life, resulting in thousands of sewage wrapped in the sewage which cannot be removed from the microplastics, and finally flowing into the natural environment, causing the aggravation of the microplastics pollution in the water.

Secondary microplastics refer to small pieces of plastic that form in the natural environment after entering rivers, lakes and the sea. It comes from a wide range of sources, including the increase of plastic products in human life; the rise of Marine tourism, where plastic is discarded on beaches and in the ocean by tourists everywhere; as well as the development of the Marine economy, the replacement of plastics by passing ships in the direction of the sea has led to the increase of Marine plastic pollution. Accordingly, the rapid development of the aquaculture industry leads to the extensive use of foamed polystyrene floating devices, and the aging of the floating devices or the damage and rupture in the use process will lead these plastic products directly into the sea and become an important source of plastic floating garbage [2]. Improper use of a large number of feed garbage bags produced by aquaculture also increases the amount of plastic in the Marine environment and its potential pollution hazards [5]. More and more fishing vessels use plastic fishing nets to catch fish, and the replacement of fishing gear will lead to a large number of old plastic fishing nets, which has also indirectly evolved into marine microplastics.
3. Microplastics pollution and ecological environment status

The plastic garbage patch in the ocean is the natural enemy of all living things. The floating, deposition and winding of plastic bags or their shiny shape attract animals to the garbage bag, which affects their normal breathing and predation and further damages the living space of animals [7].

Under the action of multiple external environmental factors such as ultraviolet light, water flow and wind, large plastics will gradually break or degrade. When the size drops below 5 mm, they become microplastics [6]. Plastic, first observed in the ocean in the 1970s, has long been stable in the Marine environment thanks to its high molecular weight, complex three-dimensional structure and hydrophobicity. More than 94 percent of them are mixed with plankton. Some of the microplastics are swallowed by filter-feeding shrimp and crab shells, which then invade entire communities of Marine life along the food chain, causing toxicity in various forms. When microplastics enter living organisms, like purple mussels and herbivorous crabs will be scratched by microplastics in the intestines, which can be transferred and enriched in tissues and organs and enter the immune system of the body, triggering the inflammatory response of the immune system [3, 9]. The blocking and reflection of the sun's rays by the floating microplastics on the sea surface will hinder the absorption of sunlight by algae. Moreover, microplastics with smaller particle sizes can cross the cell membrane and inhibit the expression of genes related to growth of chlamydomonas [2]. When reduced to nanometers in size, microplastics can pass through the medaka's blood-brain barrier and enter its brain, liver and testicles, exacerbating its demise [4]. Rossi et al. evaluated the effect of nano-sized polystyrene on the properties of biofilms by using molecular simulation experiment method, and the results showed that nanoparticles could easily be inserted into cross membranes, change the structure of membranes, reduce the activity of membrane proteins, and thus change the function of cells [8].

Table 1. Number of marine organisms affected by marine debris.

| Number of known species (unit: PCS) | Number of species with entangled records | Number of species with entangled records |
|-------------------------------------|-----------------------------------------|----------------------------------------|
|                                     | SCBD, 2012 | SCBD, 2016 | SCBD, 2012 | SCBD, 2016 |
| Mammal (115)                        | 52         | 53         | 30         | 46         |
| Fish (16754)                        | 66         | 129        | 41         | 62         |
| Seabird (312)                       | 67         | 80         | 119        | 131        |
4. Source control countermeasures
According to the report released by the Secretariat of the Convention on Biological Diversity of the United Nations in 2016, since 2012, the number of marine species affected by marine garbage has increased from 663 to 817. Of those, 519 species were found to be affected by wrapping or inhaling plastic, and about 40 percent of cetaceans and about 40 percent of cetaceans had microplastics in their bodies[13]. A study by the University of California, Davis, found microplastics in the guts of a quarter of fish sold in California. In China, a survey conducted by the Yantai Coastal Zone Research Institute of the Chinese Academy of Sciences showed that microplastics were found in 90% of the samples of more than 20 common fish with high economic value [14]. In the face of the increasingly serious problem of marine microplastic pollution, it is urgent to control from the source.

4.1 Improve the legislation of plastic pollution control
At present, European and American countries have introduced legislation to ban the addition of plastic microbeads in personal care products, and China's Academy of Sciences has also issued a review to accelerate the enactment of legislation on plastic pollution. Improving legislation is an important basis for strengthening the control of plastic pollution. In view of the existing problems in the current legislation, more specific implementation rules should be formulated on the basis of existing laws and regulations. Specifically, it includes: (1) the responsibilities of all government departments should be clearly defined. In the production, use, recycling and treatment of plastics, there should be clear responsibility departments to avoid confusion and problems that lead to the failure of all departments to effectively fulfill their duties. (2) Specify detailed rules for the punishment of illegal enterprises and individuals, and clearly stipulate the illegal acts and corresponding economic and administrative punishment measures in the legislation. (3) Improve the role of tax and other economic means, and fully reflect the role of economic means in the reduction and recycling of plastic waste in accordance with the principle of pollution and the polluter pays.

4.2 Improve relevant standards for plastic pollution control
To strengthen the management of perfect plastic and plastic-related standards, we suggest that countries as soon as possible for the relevant standard production and recycling of plastic products specifications, recent standards considering the following aspects: about the standards of agricultural production in the plastic film, plastic bags and other plastic packing, plastic enterprise wastewater and air emission standards, as well as about the standards of biodegradable plastics. At the same time strengthen the formulation of microplastics monitoring standards and timely release of urban and industrial wastewater treatment plants tail water microplastics monitoring discharge standards.

4.3 Improve plastic waste management policies
At present, the average plastic recycling rate in Europe is over 45%, and even reaches 60% in Germany. By 2030, the EU plans to recycle all plastic packaging. According to the data published in The Annual Report on The Comprehensive Utilization of Resources in China (2014) released by the National Development and Reform Commission in 2014, the utilization rate of waste plastics in China from 2009 to 2013 was 23%-29% [11], which was significantly different from that of developed countries, indicating that China's waste plastics recycling potential is huge.

The recycling of plastic and microplastic waste should strictly implement the "extended producer responsibility" system [15] and adopt the principle of "whoever polluters pays" to improve the recycling efficiency. We will establish a subsidy mechanism for recycling waste plastic bags and other renewable resources, encourage manufacturers to make innovations in green products, and increase the proportion of recycled materials in their products. We will explore ways to establish an environmental tax mechanism for plastic bags and other disposable plastic products (such as plastic straws), collect environmental taxes from producers or consumers, establish a special fund, and use the tax revenue for the recycling of plastic waste and other environmental protection activities. At the same time, it clarifies the responsibilities of tax authorities and regulatory authorities and gives the regulated objects
reasonable rights and obligations. In addition, the secondary pollution control of plastic recycling enterprises should be strengthened to avoid the re-pollution of the environment caused by plastic recycling.

In general, the most urgent and operable measures are still to strengthen the recycling and utilization of plastic waste, including making full use of waste plastic to produce new plastics and producing oil from pyrolysis. At the same time, the efficient combustion system should be improved to make full use of waste plastic heat while avoiding pollution caused by volatile organic compounds (VOCs) and dioxins [12]. For example, with PET PET no. 1 and HIGH density polyethylene no. 2, recycling plants can better scatter and rebuild. For enterprises, fully recycle plastics, greatly reduce white pollution, reduce carbon emissions, and at the same time drive a lot of employment. It is the spirit of the times of the 21st century that has this vision of overall development. As a result, more and more industries are using recycled plastics in car seats, computer casings, toys, stationery and even buildings.

5. Summarizes
Microplastic pollution, global climate change, ozone depletion and ocean acidification are four major environmental problems in the world today. Coping with environmental problems caused by microplastics, source control, technology upgrading, product recycling, upgrading industrial structure, each link is related to the sustainable development of the environment. In addition to strengthening national legislation and improving industrial standards, the most important thing is that enterprises should increase the innovative research and development of recycled plastics to drive the upgrading and transformation of the entire industrial structure, which is an indispensable part of microplastic pollution control. Microplastic pollution is closely related to human activities, what we can do is to start from their own, reduce the random discard of plastic products, proper disposal of plastic products, for the human living environment to contribute their own strengths.

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