Research Status of Microplastics Pollution in Abiotic Environment in China

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Abstract. With the continuous attention to the microplastics pollution in the world, since 2014, Chinese scholars have rapidly carried out a large number of microplastics pollution investigation and experimental research. This paper summarizes the research results of microplastics pollution in abiotic environment (ocean, land water, soil, atmosphere) in this stage, in order to provide support for the future research.

1. Definition, Classification and Source of Microplastics

The definition of microplastics was first published in Science in 2004, that is, plastic fragments or particles with size less than 5 mm[1], which are new environmental pollutants. With the international in-depth development and attention to the research of microplastic pollution, the second United Nations Environment Conference in 2016 listed microplastic as one of the major global environmental issues[2]. Subsequently, Chinese scholars also carried out a lot of research on the pollution of microplastics[3-16], and held the first National Symposium on environmental microplastics pollution and control in 2018, which promoted the research on the causes and control of microplastics pollution in China.

Microplastics come from a wide range of sources in the environment. All kinds of human production and life activities will make microplastics enter the environment. The classification of microplastics in the environment is mainly based on their size, type, shape and source. According to the classification of the size of microplastics, at present, it is mainly based on the classification and literature report of the EU Maritime Strategic Framework Directive[17], the plastic with the size less than 5 mm is microplastics, while the plastic with the size between 1-100 nm as small as nanometer level is called nanometer level microplastics. According to the type and shape of microplastics, it can be divided into fiber, chip, film, particle and foam type plastic. All kinds of microplastics show irregular shape, lender, triangular and circular[18-19]. According to the classification of microplastics sources, it can be divided into primary microplastics (primary microplastics, primary microplastics) and secondary microplastics (new microplastics, secondary microplastics)[20-21]. The former is mainly the industrial raw materials of plastic/resin particles, industrial products containing microplastics particles or cleaning micro beads, such as drugs, polishing materials, personal care products (cosmetics, facial cleansers, toothpastes and body washes) etc.[22-24], the latter refers to the small plastic fragments formed by the physical (abrasion, water disturbance, wave strike, wind), chemical (UV radiation, freeze-thaw cycle) and biological process (degradation) after the large plastic enters the environment. It can be said that various human production activities (industry, agriculture, aquaculture, fishery, tourism, etc.) break down, decompose or reduce in volume) And living activities
(use of plastic products, washing of clothes, pollution control) lead to many large pieces of plastic into the environment, and generate a large number of this life microplastics through migration and transformation[25-28].

2. Research Status of Microplastic Pollution in Abiotic Environment in China

2.1. Study on the Pollution of Microplastics in the Ocean

The initial international research on microplastics started from the marine environment. Since 2014, Chinese scholars have carried out extensive research on microplastics pollution in China's offshore waters, as shown in Table 1[7,13,15,18,29-43]. Microplastics can migrate and transform in the marine environment. Some studies have shown that the deep sea is the sink of microplastics. However, there are few studies on the pollution of microplastics in the deep sea. Therefore, the pollution of microplastics in the deep sea area needs further study.

| Sea Area         | Research Medium                                                                 | Research Contents                                                                 |
|------------------|---------------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| Bohai Sea        | Sea water, seabed sediment, coastal intertidal zone, tidal flat area, benthos   | The type, particle size, abundance, spatiotemporal distribution and source of microplastics in media were studied. |
| Yellow Sea       | Tidal flat, sediment, surface seawater, oyster                                   | Assess ecological risks.                                                        |
| South China Sea  | Tidal flat, sediment, surface seawater, oyster estuary, seawater, fish          |                                                                                  |
| The East China Sea | Surface water, zooplankton, sediment, beach, sea water and seafood in aquaculture area |                                                                                  |
| Other Pacific waters | Deep sea sediments, benthos and surface seawater                               |                                                                                  |

2.2. Study on Microplastics Pollution in Water of Land Area

China's research on microplastic pollution in land water environment is later than that in marine environment, and the research medium is mainly water layer and sediment in river, lake and wetland environment, as shown in Table 2[3-5,12,14,44-54]. After entering the land water body, microplastics will enter the bottom of the water body under sedimentation, and can also be transmitted to the ocean through river action, even spread over the global marine environment under the action of current, wind, tide and tsunami, in addition, biological feeding in the land water body will also cause physical damage such as intestinal blockage and chemical damage such as additive leaching, thus causing certain damage ecological risk.

| Water Body | Medium                                                                 | Research Content                                                                 |
|------------|------------------------------------------------------------------------|----------------------------------------------------------------------------------|
| River      | Surface water and sediment, river water and sediment, estuarine water, beach and organism of urban river | The abundance, type, particle size distribution, surface characteristics, components, temporal and spatial distribution, sources of microplastics in media and their possible effects on the structure and composition of microbial communities were studied. |
| Lake       | Lake water, lake mouth, surface water, sediment, beach, benthos, tilapia |                                                                                  |
| Reservoir  | Surface water and sediment irrigation area drainage ditch water and sediment, wharf water |                                                                                  |
| Other Water Bodies |                                                                 |                                                                                  |

2.3. Study on Microplastic Pollution in Soil

With the deepening of the research on microplastic pollution, the situation of microplastic pollution in the soil environment has attracted the attention of domestic scholars, and the investigation and Research on microplastic pollution in the main regional soil have been carried out, as shown in Table 3[19,28,55-62]. microplastics can affect the structure and other physical properties of soil, absorb
heavy metals and organic pollutants in soil, affect the composition of soil microbial community and the survival of soil animals[20,63].

| Soil Type       | Research Area                                                                 | Research Contents                                      |
|-----------------|-------------------------------------------------------------------------------|--------------------------------------------------------|
| Farmland soil   | Dianchi Lake Basin area, typical black soil area of Harbin City, upper and middle reaches of Fenhe River, Hetao irrigation area of Inner Mongolia, vegetable field in Shanghai suburb, northeast soft soil. Daliao River Basin, | The abundance, particle size, mass, surface morphology, spatial distribution and main driving mechanism of microplastics were studied. |
| Water bank soil | Zhangpu coastal area of Fujian Province, Yangtze River Bank (Chongqing urban section) |                                                         |

2.4. Study on the Pollution of Microplastics in the Atmosphere

There are few reports on the study of microplastic pollution in the atmosphere. R.Dris[64-65]foreign researchers have found that there are fiber microplastics in the air subsidence of Paris city and suburbs, France. They have observed that there are synthetic fiber, mixed fiber and natural fiber in the air of Paris, France. It is speculated that indoor air microplastics (fiber) pollution may be an important source of microplastics in the atmosphere. China's research on the pollution of microplastics in the atmospheric environment is just in its infancy. K.Liu[66]studied the sources of microplastics in Shanghai's aerosols, conducted potential risk assessment, and also studied the spatial distribution, morphology, appearance and chemical composition of the microplastics in the suspended atmosphere of the western Pacific Ocean, L.J.Cai[67]studied the microplastics in the dust fall of Dongguan's atmospheric environment. The main chemical composition, abundance and surface morphology show that the tested microplastics have undergone different degrees of mechanical wear and chemical weathering. Q.Zhou[46]studied the types, abundances, compositions, fluxes of microplastics in the atmospheric environment of Yantai, a coastal city of China, and the dynamic changes in the four seasons of the year. In addition, The mass concentration, shape and component distribution of indoor and outdoor dust MPs were measured by C.G.Liu[68]. At present, the pollution characteristics and settlement laws of microplastics in the atmospheric environment are not clear enough. The existing research table shows that the surface of microplastics in the atmosphere is subject to different degrees of mechanical wear and obvious weathering characteristics, which can prove that the microplastics in the atmospheric environment come from water and soil. However, these microplastics may enter the water and soil environment through settlement. The mechanism of the formation of "sea land air" microplastics is not clear.

3. Conclusion

Based on the review of the research on microplastics pollution in abiotic environment by Chinese scholars, it is found that there are more researches on microplastics pollution in water environment, more in-depth researches on sediments and seawater in main land waters and coastal waters, but less researches on rivers and groundwater in deep sea and small watershed. In recent two years, the investigation and Research on microplastics pollution in soil environment has increased gradually. However, there are few researches on microplastics pollution in the air environment. In the future, we can focus on the study of microplastics pollution in river water, groundwater, atmospheric environment and special types of soil. At the same time, it is found that the current research focuses on the investigation and traceability of the abundance, type and composition of microplastics pollution in environmental media, and the research on the migration and transformation mechanism of microplastics in environmental media is not deep enough.
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