Current status of microplastics pollution in tianjin coastal waters

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Abstract. Microplastics (MPs) have become a global concern as well as climate change, ozone separation and ocean discrimination. In order to restore the distribution characteristics and influence factors of MPs in Tianjin coastal waters, the distribution of MPs in three sections of Tianjin office area was studied by using surface sampling, density usage separation and alternative microscopies. The size, shape and chemical composition of MPs were further analyzed. Our results show that the extent of MPs in the sea water samples were range from 210 to 1170 particles · m⁻³ with a mean of 612 particles · m⁻³ in the three sections of the offshore area. Three shape types of MPs were present in the seawater samples, including slender fibers, irregular fragments and thin films. Fibers and fragments were predominant forms, which accounted for 52.1% and 46.8%, respectively. The particle size of the detected MPs was consistent with those reported by previous studies. The smaller the particle size, higher the content 55.3% MPs had particle size of less than 0.5mm. According to the microscopy analysis result, most of MPs in surface seawater samples showed a deep color (such as blue, black and red), and a few MPs showed colors of yellow, green and while. The main chemical components of MPs were analyzed by using infrared microscopy components were detected, including PP-PE, ABS, CE, EP, PA, PE, PET, PP, and PVC, with an order of PET > PP-PE > EP > CE > ABS > PE > PA > PVC > PP. The results demonstrated that the MPs pollution in the Tianjin offshore area was affected by the development of marine industries, such as marine fishery, port transportation, etc. In addition, the MPs pollution in the ocean was also affected by land-based sewage discharge due to the fact that Tianjin was an industrialized city with a large population density.

1. Introduction
Marine microplastics were first studied by American researchers Carpenter et al.[1] reported in Science, a large number of polystyrene particles (mean abundance 0.0-2.6 maximum 14 m⁻³) were found in the coastal waters of eastern long island and southern New England. But until 2004, Thompson et al.[2] published articles on microplastics in the journal Science, for the first time ever, i.e. plastic fibers, films and particles less than 5 mm in diameter. At the second United Nations Environment Assembly in 2015, microplastic pollution is listed as the second scientific issue in the field of environmental and ecological science, and become a major global environmental issue alongside global climate change, ozone depletion and ocean acidification.

As plastic waste continues to enter the ocean, the amount of plastic particles is also rising[3]. The study found that microplastics were spread across the oceans, Even in remote polar regions[4], for example, high concentrations of plastic debris were found in the North Pacific circulation[5]. At least 21.290t of floating plastic debris are estimated to accumulate here, based on 24 trans-oceanic surveys.
of five subtropical gyres (2007-2013). About 270,000 tons of plastic floating in the sea, it is estimated that at least 5.25 trillion microplastic particles will be punished. Because humans move more frequently in coastal waters, microplastic contamination is also high, the investigation and research have been carried out at home and abroad. For example, foreign northwest Mediterranean, portuguese coast, west coast of Canada[6], south coast of Korea, etc. A survey of microplastics in China started with the report of East China Normal University on the pollution of floating microplastics in the Changjiang Estuary and its adjacent waters. After the investigation area from north to south includes: Bohai Bay area Dalian and Caofeidian[7], Shandong Peninsula[8], Changjiang Estuary Xin, Guangxi Beibu Gulf, Hainan Island, etc. However, the research on microplastic pollution in Tianjin coastal waters is still blank. Tianjin Binhai New Area[9] as a national development strategy. To promote the regional economic revitalization around the Bohai Sea play an important role, while vigorously developing the marine economy. To maintain the harmonious development of the marine environment. Therefore, through the investigation and research on the pollution of microplastics in Tianjin coastal waters, it not only provides basic data for our country to understand the pollution of marine microplastics, it also reflects the potential ecological risk caused by microplastics in Tianjin coastal waters.

2. Materials and methods

2.1 Research area
Tianjin Binhai New Area including Tanggu, Hangu, Dagang and other three areas, located in the north latitude 38.40 to 39.00',117 East. To 118°00' is east of Tianjin's central district, with a coastline of 153 km. The top of the Bohai Bay, bordering the Bohai Sea. Located at the intersection of the Bohai economic belt and the Beijing-Tianjin-Hebei urban agglomeration, it has many marine industries, and has formed three main marine industrial bases along the Bohai coastline, such as Tanggu, Hangu and Dagang, and human activities are more frequent. The carbon emission of per capita energy consumption has a negative impact.

2.2 Sample collection
Samples were collected from three sections of Hangu(A), Tanggu(B) and Dagang(C) in Tianjin Binhai New Area in September 2018. Three stations per section, a total of 9 sites (Figure 1). Using the sampling method, seawater water samples from cross-section stations were collected from stainless steel containers of fixed volume, after 5 mm, 330pun, 250jim, 125jim of stainless steel screen filtration, collection of sea water. When the filtration is complete, take off the sieve, with as little pure water as possible, transfer to a clean beaker; rinse each screen at least times, ensure that all samples are transferred to the corresponding beaker; the collected samples were filtered by vacuum filter pump to the glass fiber filter membrane. Fold the membrane in half. Tin foil wrap the filter membrane, mark well and refrigerate freeze for preservation. Pure water, instead of seawater, as a blank control group.

2.3 Sample processing
The sample was treated by physical separation and chemical digestion, we're using alkaline digestion, Using strong bases to hydrolyze chemical bonds and denatured proteins to remove biological organic matter[10], but alkaline digestion may cause discoloration and damage to plastics. First, the sample was vacuum filtered through a glass-fiber filter membrane of 2 mm (diameter 50). Filtration of solid matter into 500mL beaker, Add 180mL KOH (10%), and 20mL H2O2(30%) Dissolve the sample by mouth and cover the beaker mouth with aluminum foil to prevent contamination; remove the beaker in 60P oven 24h, shake once every 6h; remove the solution by glass fiber filter membrane (aperture 2 Jim) vacuum filtration, and use 200mL of ultra-pure water to clean the inner wall of the beaker and filter device; put the filter membrane into glass dish, cover with light avoidance, natural air drying.
3. Results and discussion

3.1 Sample processing

Microplastics abundance and particle size distribution in the coastal waters of Tianjin. As shown in Figure 2, the particle size distribution of microplastics in the coastal waters of Tianjin. The particle size is divided according to the range mm more than 1 mm, (0.5-1) mm and less than 0.5 (greater than 1 mm) (0.5-1 mm) according to the proportion of quantity, from large to small. Analysis of particle size distribution in Fig.1, What is different from most studies is the inverse relationship between particle size and content. But less than 0.5 mm of microplastics still dominate, more than half of all microplastics. If the section of Tanggu is less than 0.5 mm, the microplastics even reach more than 70%. The study found that some products, such as skin care products and detergents, contain large amounts of microplastics. Because of its small size and low density, it is not easy to separate and remove from sewage. Thus along with the sewage discharge, into the environment.

The abundance of microplastics is shown in Fig.1, and the abundance of microplastics in 9 stations of surface water in sections of open sea area is at 210 Between 1170, Hangu (790 m⁻³) in order of average abundance > Dagang (560 wide)> Tanggu (486 m⁻³), Average abundance 612 m⁻³.

In the East China Sea, the abundance of microplastics is 0.167±0.138 m⁻³ pills. The abundance of surface microplastics in Xiamen is 103-2017, and that in Changjiang Estuary is 4137.3±2461.5 m⁻³. And the average abundance of microplastics in four baths in Qingdao 10 5.053 -1.25 m⁻³. From the existing data, the pollution of microplastics in the coastal waters of Tianjin is of moderate level. The pollution of microplastics may be affected by the marine industries such as road source discharge, port construction, offshore oil and gas field development, marine transportation, etc.

3.2 Shape and type of microplastics in coastal waters of Tianjin

Of the nine stations in the open sea monitored by the Microplastic Institute in the coastal waters of Tianjin, the shape of sea water sample microplastics can be divided into irregular shape, fine long...
shape, round shape; types include fibers, debris, and films. In the microplastic shape distribution, the most common are slender and irregular shapes, 51.9% and 46.8% respectively, round minimum (1.3%). The types of microplastics shown in Figure 5 are mostly fibers and debris, 52.1% and 46.8% respectively, film minimum (2.6%). The fibrous microplastics are mostly slender, the fragments are irregular. Similar, the order of microplastics in the shape of fibers > fragments > films > particles was obtained from the detection and analysis of bioplastics in Qingdao and Dongying markets. Presumably, this distribution may be related to the discharge of domestic sewage, especially sewage from laundry discharge view. Current classification methods for microplastics are essentially dependent on visual recognition and human judgment. This subjectivity may, to some extent, lead to misclassification, e.g. non-plastic particles and fibers, which may be misclassified as microplastics.

Figure 4. Type distribution map of microplastics in Tianjin coastal waters

3.3 Colour of microplastics in coastal waters of Tianjin
The microplastics observed in the coastal waters of Tianjin can be classified into six categories: yellow, white, black, red, blue and green. As shown in Figure 7. The highest percentage of blue microplastics was 48.5%, followed by black (26.3%), yellow and red (10.2%), less white (3.3%) and green (1.6%), the film is generally transparent or white. The color distribution of three sections, the proportion of microplastics is generally consistent, the main colors are blue and black, studies have shown that During environmental weathering, due to photooxidation, Increased concentration of oxygenated groups on the surface of plastics. This causes the surface of the plastic to yellow and fade and Endo and so on found more discoloration (yellowing) of microplastic particles containing higher PCB concentration can. Most of the microplastics detected in the coastal waters of Tianjin are dark colored. This suggests that these microplastics are mostly released from land sources into the marine environment. And it doesn't last long, daily necessities like facial cleanser, the abrasive particles of toothpaste and bath milk are mostly blue and green. And the experimental observation found that the thin and long fibrous microplastics are mostly blue, black microplastics may come from shipping and chemical materials, etc. Lusher found that black microplastics are the most abundant, 45% Li the opposite is true for light-colored lines (transparent, white, green and yellow) which are significantly more than dark ones (blue, black and red). Therefore, the color of microplastics is related to the local source of microplastics pollution, and the color distribution in different regions is different.

3.4 Influencing factors of microplastics in coastal waters of Tianjin
Bohai Bay is in a semi-closed state and has poor exchange capacity with the outside sea area. As a new economic and technological development area in Tianjin, Binhai New Area is mainly supported by electronic information, automobile and equipment manufacturing, petroleum, marine chemical industry, port transportation, etc. All kinds of plastic wastes, such as industrial raw materials, food packaging bags and daily necessities, are partly disposed of in landfills and sewage treatment plants, and the remaining parts, such as plastic particles of skin care products fibers produced by brewing and washing clothes, are not easily separated due to their small size and low density, and flow into the sea through the sea outlet from land sources. Furthermore, in areas such as the I port salt farms and farms at the entrance of the tourist area, with the activities of human life and production, a large amount of
plastic waste is left on the shore, which has also become the pollution source of land-based microplastics. For marine microplastics, on the one hand, plastic pollution caused by activities such as land-based emissions, ship transportation and offshore operations system; on the other hand, from the global ocean scope, due to the role of wind and ocean currents, marine microplastics migrate and redistribute in the marine environment. However, the greatest contribution of marine microplastics particles is land-based input, and these plastic fragments or microplastics particles entering the marine environment will gradually decompose into smaller particles under light, physical, chemical and biological action.

4. Conclusion
Abundance range of 3 sections of microplastics in Tianjin coastal area is 210-117 m$^{-3}$. The average abundance was 612 one or two pollution levels compared to Hangu > Dagang > Tanggu. PET, PP-PE, EP, are the three types of microplastics with high pollution. This is related to the development of the local marine industry, such as port transportation, marine fisheries, marine petrochemicals, etc. Microplastic types are mainly fibers and debris, PET made of polyester, PA made of cotton fiber, most of the micro-plastic fibers in the ocean come from washing wastewater discharged from the land-source sewage outlet and the loss of marine fishing gear. The color of microplastics is mainly blue, black and red. These microplastics don't exist for long, the effect of external force on it is relatively small. Tianjin industrialization level and local population density are important factors affecting microplastic pollution.

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