MICROPLASTIC POLLUTION OF THE OCEANS

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Actually, the spread of microplastics in seawater is an urgent topic in the science. An estimated 360 million tons of plastic were produced worldwide in 2018 (Plastics-Europe, 2019). Different types of plastics are produced worldwide. However, the commercial market mainly produces four types of plastics: polyethylene (73 million tons), PET (53 million tons), polypropylene (50 million tons) and PVC (35 million tons) (UNEP, 2016).

Plastic debris annually enters the oceans. Microplastic contamination poses a threat to marine inhabitants. This negatively affects the economic and aesthetic spheres. Up to 10% of the global annual production of plastic goes to the oceans, which corresponds to 5 * 109 - 15 * 109 kg of plastic products [1,3]. For example, in 2014, it was estimated that 2.7 * 108 kg of plastic is in the oceans. Recently, as a result of research, "plastic contamination" has been reported worldwide. Oceans are the main place of plastic pollution, because of oceanic currents. In the cycles of streams, “garbage islands” are formed - two in the Atlantic and Pacific oceans, one in the Indian. The Arctic Ocean is considered to be less polluted. However, the prevalence of microplastics, as a consequence of secondary pollution, is an environmental disaster. Microorganisms, plankton, jellyfish, crabs, fish, all turn out to be consumers of plastic. The trend towards increased pollution can lead to irreversible consequences for all life on Earth.

Microplastic is particles of plastic that are less than 5mm [9]. Micropalastic is classified according to the genetic type into 2 groups: primary and secondary plastic. Primary microplastic is marine debris, the sources of which are wastewater. They spread plastic particles into the marine environment that are found in various cosmetic scrubs and synthetic abrasives [2]. Secondary microplastic is formed during weathering of the plastic. Most man-made waste (bags, disposable tableware, bottles) gradually disintegrate into small particles. These particles retain their molecular structure [4,11]. It is widely known as a potential source of microplastic contamination - these are fibers that are formed as a result of washing textiles.

There are several variations of the methods of collecting plastic, data processing, and laboratory research on microplastics. For example, a method for analyzing suspended plastic particles in water samples collected by a net [8] (Fig.). The method consists in filtering solid particles collected from the sea surface. Typically, research scientists use a net to collect samples called the Manta Troll. The net has a diameter of through filtration cells of about 5-6 mm. After sampling, the sieved material is dried until it is possible to determine the mass of solids in the sample. Then, the solid is subjected to peroxidation in the presence of a Fe (II) catalyst to break down the labile organic matter, while the microplastic particles remain unchanged. Next, the microplastic particles are tested by visual inspection under a Raman microscope at a power of 40X.

Fig. Neuston net

The method of sampling plastic in coastal areas can be used to analyze plastic debris in beach sand collected by a shovel. Microplastic debris collected from coastal areas is determined by a similar method, as samples are taken by the net. Samples of plastic debris in bottom sediments are collected using a core or sampler (e.g. Ponar sampler). The method involves the initial disaggregation of dried sediments. Disaggregated deposits are sieved using sieves. Microplastic, which turned out to be concentrated on a sieve, is also subjected to wet peroxidation. Further, the algorithm for processing the material and its analysis is similar to the method of sampling microplastics from the surface of the water and coastal areas.

In scientific works [6], the application of a technique based on fluorescence using Nile red pigment for the detection and quantification of microplastics in environmental samples has been presented. This method is characterized by low cost, ease of use and accessibility of equipment, and can also be automated for high-performance analysis of samples. The method includes the following steps: sample purification, fluorescence microscopy and free image analysis software.

Most marine inhabitants are susceptible to plastic contamination, and a more comprehensive assessment of the environmental risk of these materials has become the main research idea [2]. Microplastics ranging in size from 1 μm to 5 mm correspond to different food elements for marine organisms, so this means that plastic particles is a direct interaction of animals with plastic pollution [7]. According to studies [5], the ingestion of microplastics affects the physiology and health of marine zooplankton, for example, a decrease in feeding speed and fertility.

To date, the ecotoxicological effect of swallowed microplastics on marine organisms is not well studied. However, some experimental studies on fish and invertebrate animals show complex physiological and biochemical reactions to microplastic ingestion, including impaired synthesis of endogenous hormones, suppression of DNA processing, the onset of oxidative stress, and inflammation reactions [10].

Thus, it should be understood that microplastic pollution poses a significant threat to the marine environment, and therefore, to the entire oceans. In the process of plastic formation in the marine environment, plastic particles accumulate in the organisms of marine objects, which lead to disruption of the food chain and a direct negative impact on human health. Obviously, the problem of microplastics requires a detailed study.

Work is supported by State program RF «Science». Project FSWW-0022-2020.

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