Abstract

With the development of civilization and the chemical industry, a whole range of new anthropogenic substances is being introduced into the environment. Some of these substances are produced primarily - targeted for a specific purpose (e.g. pesticides and pharmaceuticals) and others are created as a by-product of chemical synthesis or they are degradation products of primary substances. Whether they are low-molecular substances or macromolecules, in addition to their positive effect on mankind, these substances can also retroactively threaten the environment, including humans. The present work deals with interactions between two groups of xenobiotics, which appear to be a huge global problem. As part of this work, the sorption of a wide group of substances belonging to pharmaceuticals and personal care products (PPCPs) on man-made microplastics from three types of polymers (PVC, HDPE, and PET) in real wastewater was studied. Two different locations were chosen for this experiment - effluents from wastewater treatment plants. Several sampling devices containing different types of microplastics were installed at these sites, including artificially aged alternatives that better reflect the behavior of microplastics found in real conditions.

The results of these experiments showed the ability of microplastic particles to sorb substances from the PPCPs group on their surface. While on the surface of sand particles of the same size, the sum of the averages of all analytes was 1.5 ng/g and 2.5 ng/g depending on the studied location, in the case of microplastics these concentrations were in the range of 46.5 - 336.7 ng/g depending on the plastic used and the location studied. Furthermore, different sorption behavior of xenobiotics was observed depending on whether the microplastics were subjected to artificial aging. In the case of the strongly hydrophobic antihypertensive drug telmisartan (log KOW = 7.7), a reduction in the concentration of substances trapped on the microplastics was observed when aged microplastics were used. In the case of less hydrophobic substances, on the other hand, there was an increase in the absorbed concentration of aged substances. In the case of both studied locations, the sum of the determined substances on the same types of sorbents was of a similar order, which may indicate that all the sorbents used have saturated their sorption capacity. This is the first study to monitor the sorption of pharmaceuticals and personal care products onto the surface of microplastic particles placed under real conditions in nature.

Key words: Microplastics, micropollutants, pharmaceuticals, sorption