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LANDFILLS AND MBT AS A POTENTIAL SOURCES OF MICROPLASTICS

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Microplastics are polymer particles less than 5 mm. They are widespread and ubiquitous in our environment. Their occurrence has been reported in marine, fresh water, atmosphere, soil, wastewater, biota and landfill leachate. However, recent studies on microplastic findings are still mainly focused on aquatic systems, while little is known about microplastics in terrestrial ecosystems and their sources. Microplastics, produced in such a small size, for example, as part of face creams, are called primary microplastics. Secondary microplastics form as a result of breakdown of larger particles.

Mechanical biological treatment (MBT) facilities and landfills potentially can be one of the main sources of secondary microplastics (Sundt et al., 2014). Before treatment at MBT, unsorted mixed municipal solid waste (MSW) presumably already have a significant amount of microplastics. Further MSW treatment such as shredding and then screening can lead to the formation of new secondary microplastics from large plastic waste. However, there is none study on how small fragments are generated during this process (Avfall Sverige, 2014). Due to screening, microplastics get into the biological fine fraction, go through bioprocessing and end up in organic stabilizer. Screening of organic stabilizer after maturing can sort out big non-degradable particles, but can’t remove microplastics. Nowadays, content of microplastic items in organic stabilizers is not regulated, and might in practice be an unintended incentive for microplastic production in this waste flow. Mostly, this stabilizer is used for landfill covering, slope formation and sometimes for recultivation of damaged areas, which are subsequently, will not be used for food plant growing.

Thus, microplastics as part of the organic stabilizer can get into landfills. Besides it, landfills are receptacles for cumulative loading of large plastic waste, which for some reason have no other alternative than disposal. In Europe, about 25% of all plastic waste is still landfilled (PlasticEurope, 2019). Under the influence of temperature, pH and the physical compacting process, plastic can be degraded into microplastics more rapidly and to a larger extent in landfills (Sundt et al., 2014). From active landfill, microplastics can enter environmental in two ways: together with the leachate or with air drift from uncovered surface.

The aim of this study was to investigate microplastics occurrence in technical compost from MBT and landfills. In this study, several samples were taken from Kaunas MBT in Lithuania and Torma landfill in Estonia to recognize the type and proportion of microplastic fractions. The percentage of plastic in mixed municipal waste transported to the Kaunas MTB varied from 12% to 31 % (Kauno RATC, 2019). Biological output from Kaunas MBT is technical compost with size less than 15 mm.

There are none standard operating protocols for sampling and detection of microplastics in terrestrial samples (Loder et al., 2015). Therefore, algorithm for microplastic extraction was developed by authors base on literature analysis. As microplastics are particles smaller than 5 mm, samples first was sieved thought sieve with mesh sizes of 5 mm.

Removing non-plastic materials for samples is time-consuming and can be achieved through a series of bench procedures that will always include physical (density-based) and chemical (oxidation/reduction) steps combined (Imhof et al., 2016). The most widely used method for microplastic separation is density separation. It is used to isolate the particles which have lowdensity from higher density particles like sand, mud, and sediments (Mai et al., 2018). Depends on polymer type, microplastics have different density. Some of them such as PE can be separated by water as their density lower then density of water. However, for such plastic like PVC (1.40 g/cm^{-3}) solutions with higher density are needed. The most commonly used solutions are sodium chloride (1.20 g/cm^{-3}) (Bayo et al., 2016), zinc chloride (1.5-1.7 g/cm^{-3}) (Imhof et al., 2012), Calcium chloride (1.30 – 1.35 g/cm^{-3}) and sodium iodine (1.8 g/cm^{-3}) (Nuelle et al., 2016). For our study, potassium iodide solution with density 1.6 g/cm^{-3} was used.

Environmental samples as well as landfilled waste and pretreated fine fraction after MBT contain high proportion of organic matter and other impurities that may embed microplastics. (He et al., 2018). While inorganic materials can be separated from microplastics using density separation, the organic fraction impedes the ability to conduct reliable analyses. Commonly applied techniques for removing organic material from environmental matrices are oxidation using hydrogen peroxide (H_2O_2), Fenton's reagent, alkaline digests or acids. In current study organic was removed by Fenton‘s reagent. After purification, microplastics were washed and concentrated on filter.

Plastic type can be further identified by Fourier transformedinfrared (FTIR) or Raman spectroscopy. Main reason of it is the ability to collect appropriate parameters due to non-destructivity of methods. In both methods the polymers are determined on the basis of the energy absorption of characteristic functional groups (Prata et al., 2016).

Analysis of MBT and landfill samples show that they contain big amount of microplastics and can be secondary sources of microplastics. Microplastic concentration in MBT samples was 11 particles/10 g and 61 particles/10 g in landfill samples. Most of the microplastics from MBT samples were polystyrene. Current study concluded that organic stabilizer can't used for other purpose, except use for landfill covering or slope formation.

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