

MICROPLASTICS IN A SOLID WASTE LANDFILL IN JAPAN : THEIR CONCENTRATION IN LANDFILLED WASTE, COVERSOIL, RAINWATER AND LEACHATE

Hirofumi Nakayama¹, Atsuki Fukuda² and Takayuki Shimaoka¹

¹ Faculty of Engineering, Kyushu University

744, Motooka, Nishi-ku, Fukuoka, 819-0395 Japan

² Graduate School of Engineering, Kyushu University

744, Motooka, Nishi-ku, Fukuoka, 819-0395 Japan

Abstract

In this study, focusing on the material flow of MPs at a landfill site in Japan, a survey with the aim of understanding the material flow of MPs at a municipal solid waste landfill site in Fukuoka city has been investigated. MPs were found in the samples collected from different places in the landfill site such as landfilled waste, intermediate cover soil, final cover soil, sediment in rainwater reservoir pond, although MPs were not found from the samples collected from the discharged water after leachate treatment. In the landfill site MPs were confirmed to be removed during the leachate treatment process.

1. INTRODUCTION

Among landfilled waste in municipal solid waste landfill sites in Japan, there are wastes containing Microplastics (MPs), such as recycling residues from crushing and sorting facility. The non-woven fabric used as a light-shielding protective mat on geomembrane liners at the slope of the landfill site is made of chemical fiber and there is a possibility that part of the chemical fibers are detached and becomes MPs. It is thought that the MPs carried into the landfill site and the MPs generated within the site move together with the rainwater discharged laterally and reach the rainwater reservoir pond. Also, part of it may have moved to the leachate treatment facility together. However, research on material flow in landfill sites is insufficient. The purpose of this study is to understand the material flow of MPs in a municipal solid waste landfill site in Fukuoka city, Japan.

2. Survey of MPs in a municipal solid waste landfill site

In this study, landfilled waste, cover soil, rainwater, and leachate were collected from a municipal solid waste landfill site in Fukuoka city. MPs density was measured by counting the number of MPs in the collected samples. We also tried to identify the components of MPs by FTIR.

2.1 Sampling methods

About 2 kg of recycling residue generated at a crushing and sorting facility was collected. About 3 kg of cover soil was collected at a section under landfilling and a section where the landfilling has been completed. About 10 kg of sediment was collected from a drain at slope of the site. In rainwater reservoir basins and ponds, submersible pump were used to suck up surface water, and after 1,000 L of water was passed through a plankton net with a mesh size of 100 μm , the remaining residue in the net was collected. The bottom sediment in the rainwater reservoir basin and pond were collected with an Ekman barge mud sampler, then the sample. 1,000 L of raw leachate flowing through the leachate collection pipe was passed through a plankton net with a mesh size of 100 μm , and the remaining residue in the net was collected. At the leachate treatment facility, about 40L of coagulated sedimentation sludge was passed through a plankton net, and the sample remaining in the net was collected. About 100L of discharged water after leachate treatment was passed through a plankton net, and the remaining residue in the net was collected.

2.2 Method for MPs extraction

In this study, MPs were extracted and analyzed according to the procedure shown in Fig. 1, referring to the method of Alfonso et al(2021).

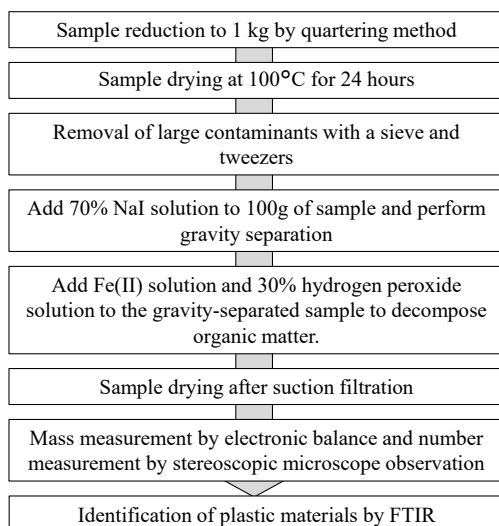


Fig.1 MPs extraction and analysis method



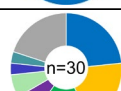
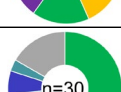
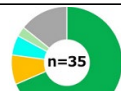
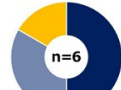
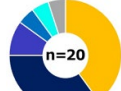
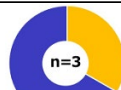
2.3 Analysis results

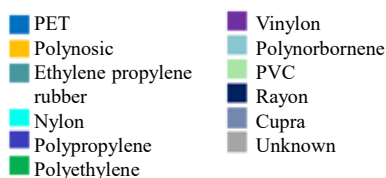
Table 1 shows the MPs density in the samples collected at each location and the composition of plastic materials identified by FTIR. 920 MPs/kg-dry were found in the residue from a crushing and sorting facility which is sent to the landfill site. The main components were PET, polynosic, and ethylene propylene rubber. PET, polynosic, and polyethylene were also main components of MPs in the intermediate covering soil. MPs in the deposits in the slope drain were PET. Since the material of the light-shielding protective mat installed on the slope was also PET, it was thought that the detached MPs accumulated in the deposits. Only 6 MPs/m³ were found in the surface water of rainwater reservoir pond, but 201 MPs/kg-dry were found in bottom sediments. Since no MPs were found in the treated leachate, it was confirmed that MPs were removed during the leachate treatment process.

3. CONCLUSION

In the landfill site investigated in this study, MPs were found in the samples collected from different places such as landfilled waste, intermediate cover soil, final cover soil, sediment in rainwater reservoir pond, though MPs were not found from the samples collected from the discharged water after leachate treatment. In the landfill site MPs were confirmed to be removed during the leachate treatment process.

Table 1 MPs density and composition in samples taken at different places in a landfill site

Place of samling	Sample	MPs density	Composition
Crushing and sorting facility	Residue after crushing and sorting	920 pieces/kg-dry	
Slope of landfill site	Sediment in drain	18 g/kg-dry	
Section under landfilling	Intermediate cover soil	120 pieces/kg-dry	
Section landfilling has been completed	Final coversoil	47 pieces/kg-dry	
Rainwater reservoir basin	Surface water	0 piece/m3	-
	Sediment	249 pieces/kg-dry	
Rainwater reservoir pond	Surface water	6 pieces/m3	
	Sediment	201 pieces/kg-dry	
Leachate treatment facility	Raw leachate	3 pieces/m3	
Leachate treatment facility	Coagulation sedimentation sludge	0 piece/kg-dry	-
Leachate treatment facility	Discharged water after treatment	0 piece/m3	-



REFERENCES

- 1) Alfonso, M. B., K. Takashima, S. Yamaguchi, M. Tanaka, and A. Isobe: Microplastics on plankton samples: multiple digestion techniques assessment based on weight, size, and FTIR spectroscopy analyzes, Marine Pollution Bulletin, Vol.173, pp.1-10, 2021.