Detection of Microplastics in Incineration Bottom Ash

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INTRODUCTION

Microplastics (MPs, with size < 5 mm along their longest dimension) are now ubiquitous around the world, and have drawn increasing global attention for their potential toxicity. To reduce pollution by MPs, two principles are generally followed. One is to reduce plastic consumption and plastic waste generation at the source, and the other is to increase the recycling and treatment of plastic waste. The first principle seems difficult to implement in the short term for the economic development (Borrelle et al., 2020). As for the second principle, it is generally believed that managed waste treatment systems such as sanitary landfilling, biological treatment and incineration, can stock or eliminate the environmental risks of MPs. However, recent research has found that the sanitary landfills and composting may also produce MPs releasing into the environment (He et al., 2019, Weithmann et al., 2018). Moreover, the unburned material from the bottom ash contained synthetic fibers (Chimenos et al., 1999), which implies that plastics and MPs may still exist after waste incineration. Therefore, we investigated the abundance, polymer type and morphology of MPs in bottom ash from 17 sites in eight Chinese cities and estimated the global quantities of MPs that may be released into the environment from waste incineration systems.

MATERIALS AND METHODS

Sampling sites and MPs exaction

The disposal center only disposed bottom ash produced from incineration plant M10, so samples from the center were produced from the same furnaces as M10 in different seasons. Of the 16 MSW incineration plants, 12 sites were equipped with mass burn furnaces and the other four sites were using fluidized bed furnaces. The service area of seven sites have implemented waste source separation while ten sites have not. The method for extracting MPs from bottom ash was referred to Maniet et al. (Mani et al., 2019) with slight modifications and the suspected particles were identified by Micro Fourier Transform Infrared Spectrometer (μFT-IR).

RESULTS AND DISCUSSION

Occurrence of MPs in bottom ash from different sites

MPs were identified in all 13 sites with mass burn furnaces with an abundance of 125 ± 180 n/kg and in two of four sites with fluidized bed furnaces with an abundance of 84 ± 167 n/kg. Nine types of plastics were identified, of which polypropylene and polystyrene were the predominant types. MPs sized between 50 μm and 1 mm accounted for 74%. Granules, fragments, film, and fibers accounted for 43%, 34%, 18%, and 5% of the MPs, respectively. The abundance of microplastics differed significantly with whether the local waste was

source-separated, the local gross domestic product per capita, and the types of furnace ($p<0.05$).

Estimation of quantities of MPs in the bottom ash

Considering that there are 2–565 MP particles per kilogram of bottom ash, each ton of input-furnace waste will produce 360 to 102,000 MP particles in the bottom ash. Globally, MPs quantities vary from 107 billion to 30 trillion per year in bottom ash, which is in the same order of magnitude as the quantities in compost, which range from 336 billion to 22 trillion per year.

CONCLUSION

The quantities of MPs exacted from MSW incinerator bottom ash were determined. The abundance of MPs from sites with waste source separation was significantly lower than that from sites without waste source separation ($p<0.05$), suggesting the positive impact of waste source separation for MPs management. The negative correlation between abundance of MPs and GDP per capita indicated that MPs abundance were closely related to the composition of waste ($p<0.05$). The research highlights the necessity to revise the MPs emission from managed waste.

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