Recent research trends in airborne microplastics (AMPs)

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1. Introduction

The total production of plastics is estimated to reach 2 million tons per year in 1950, 300 million tons in 2012, and 40 billion tons in 2050 (Zalasiewicz, et al., 2016). As a result, a large amount of marine plastic waste is generated through rivers. Microplastics (MPs), which are plastic debris with a diameter of 5 mm or less, are mistakenly eaten as food by marine organisms to cause physical obstacles. In addition, MPs include various additives and the adsorbed harmful organic compounds, which probably affect the living body.

2. Current status of airborne microplastics (AMPs)

In recent years, MPs have been detected in rivers, tap water, plastic bottled water, road dust, and indoor air. According to estimates from the United States, MPs are taken up into the body as food and inhalation with about 60,000 particles per year, respectively (Cox et al., 2019). In addition, 90,000 MPs are intaken from bottled water each year. However, reports on airborne microplastics (AMPs) are limited and the current status of AMPs is poorly understood. Previous studies on AMPs have been conducted in the suburban of Paris, France (Dris et al., 2016, 2017) and in Guangdong, China (Cai et al., 2017). However, most research focused on AMPs not in atmospheric aerosols but in fallout. The shape of AMPs in urban areas is mostly fibrous, with few films, fragments, and foams. The identified materials are mainly polypropylene, polyethylene and polyethylene terephthalate (Dris et al., 2016, 2017; Cai et al., 2017, Liu et al., 2019). Although only a few research on AMPs in atmospheric aerosol have been reported, in Paris (France), indoor air contains 1to 60 fibers/m^3, 66% of which were natural fibers such as cellulose (Dris et al., 2017). On the other hand, the number concentration in the outdoor air was 0.3 to 1.5 fibers/m^3 (50 to 1650 μm). The majority of AMPs in urban air in Assaluyeh on the southern coast of Iran were fibers with 0.3 to 1.1 fibers/m^3 (2 to 100 μm), but it is unknown whether they were natural or synthetic fibers (plastics) (Abbasi et al., 2019). In the urban air in Shanghai (China), the number concentration of AMPs was 0 to 4.18 particles/m^3 (23 to 9555 μm), and 67% of them were fibrous (Liu et al., 2019a). At the same point, it was also reported to be 0.05 to 0.07 particles/m^3 (12 to 2191 μm), 43% of which were fibrous (Liu et al., 2019b).

Most of the AMPs studies were performed in urban areas. However, it has been recently reported that deposition fluxes of AMPs were estimated to be 365 particles/m^2/day (> 65 μm) in the French Pyrenees (Allen et al., 2019), which were almost the same levels in urban areas. This suggests that contamination of microplastics through the atmosphere may occur over a wide area. The shapes of AMPs in mountainous areas were very different from those in urban areas, with many fragments and films and low fibrous. These findings were broadcast by NHK last April, and AMPs have also attracted attention from atmospheric chemists in Japan. AMPs have also been detected in snowfall in the Swiss Alps and from ice floes in Fram Strait (Bergmann et al., 2019).

3. Issues in research on airborne microplastics (AMPs)

Up to now, researchers reported their results of AMPs in their unique method, making it difficult to simply compare them, and a unified method is needed for AMPs. In my presentation, I will give the findings on sampling, pretreatments, and identification of AMPs. Based on the standard method we propose, I would like to introduce some of the results, i.e. the aerodynamic particle size distribution, number concentration, shapes, and materials of AMPs in urban and free tropospheric atmospheres.

Keywords: μFTIR, ATR imaging, purification to remove organics, density separation, aerodynamic particle size distribution, number concentration

