Promotion of International Harmonization of Analytical Methods for Environmentally Sound Management of Plastic Wastes Containing Newly Listed POPs

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[Abstract]

Key Words: Plastic waste, Simplified method, International interlaboratory study, Brominated flame retardants, Chlorinated paraffins, Microplastics, Resource recovery, Recycling, Environmentally sound disposal

For this study, considering some newly listed persistent organic pollutants (POPs), we developed a rapid simplified method to quantify polybrominated diphenyl ethers (PBDEs) and hexabromocyclododecanes (HBCDs) in plastic waste using gas chromatography coupled with a quadrupole mass spectrometer (GC/MS) or an electron capture detector (GC/ECD). Moreover, we developed a novel analytical method to quantify short-, medium-, and long-chain chlorinated paraffins (SCCPs, MCCPs, and LCCPs) in plastic wastes by liquid chromatography/electrospray ionization-tandem mass spectrometry (LC/ESI-MS). The developed methods can identify plastic wastes containing such chemicals above the low POP content limits proposed by the Parties to the Basel Convention. To evaluate the accuracy of our GC methods, and to disseminate these methods as widely as possible in order to promote the proper management of plastic wastes containing POPs, we conducted two interlaboratory studies with 32 national and international participant institutions. A total of 11 test samples, including standard solutions, plastic waste extracts, and pieces of plastic waste containing PBDEs and HBCDs were distributed among the participants for chemical analysis using two different analytical methods: the usual in-house methods of each laboratory and the simplified methods we developed. The relative standard deviations for both PBDE and HBCD concentrations in the test samples were comparable between the two methods, validating our simplified methods. The occurrence of PBDEs and chlorinated paraffins were assessed in a wide range of samples, such as consumer products, E-waste plastic mixture, automobile shredder dust, and recyclates, to evaluate the current status of their intentional use and unintentional contamination. The results obtained with the novel analytical method for chlorinated paraffins were not significantly different from those measured with conventional ultra-high-resolution instrument, indicating the usefulness of our method. The PBDE contents in crashed cathode ray tube television casing were prominent, suggesting that controlling measures are needed to prevent it from being used as recycling feedstocks. In addition, we conducted a series of onsite surveys at landfills and waste recycling facilities in Japan to elucidate the environmental emission dynamics of microplastics containing PBDEs. At controlled landfills, waterborne emissions of microplastics containing PBDEs were small, and their impact were minor. Airborne emissions of microplastics from waste recycling facilities were also small, but emissions of PBDEs were similar to those from home appliance waste and E-waste recycling plants.

[References]

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