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Atmospheric Total Suspended Particle-bound Organophosphate Esters from an Industrial Area

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Extended Abstract

This study developed a sampling and analysis method for measuring organophosphate esters (OPEs) bound to atmospheric total suspended solids (TSP) from five locations (A1–A5) around an industrial park in Tainan, Taiwan. The sampling of atmospheric TSP was carried out from the 6th to the 8th of October 2021 and followed the US EPA 40 CFR Appendix B to part 50. The filters were extracted using microwave-assisted extraction. Silica column gel and sodium sulfate prewashed with acetone, dichloromethane, and hexane were used to isolate eleven OPEs. Gas chromatography-tandem mass spectrometry (Agilent 7890A and Agilent 7000D) was used for analysis. The column used was DB-17MS 30 m×0.25 mm×0.25 μm, and helium gas at a flow rate of 1.2 mL/min was used as the carrier gas. The oven temperature program was as follows: 45℃ for 3 min; a temperature ramp of 25 ℃/min up to 260 ℃; a temperature ramp of 10 ℃/min up to 310 ℃ Hold 8 min.

The TSP concentrations from the five sampling locations ranged from 39.1–67.4 μg m^{-3}. A5, located within the industrial park, had the highest TSP-bound OPE concentration of 2815 pg m^{-3}, followed by A2 (1317 pg m^{-3}), A1 (1009 pg m^{-3}), A3 (972 pg m^{-3}), and A4 (690 pg m^{-3}). There was no significant correlation between TSP and OPE concentrations. A1 and A2 were downwind to A5, explaining the high concentration. A3 was located upwind of A5 but was the closest to the sampling locations to the industrial park. A4 was the furthest away and was upwind of A5, explaining the lowest concentration. Generally, TCPP had the highest concentration of 459±255 pg m^{-3}, followed by TCP (131±125 pg m^{-3}) and TEHP (125±76.8 pg m^{-3}). TCPP was the main OPE in four of the five locations, except in A5, where TBEP was predominant. TEP was not detected in all the samples. The high variability in the OPE profile of the locations suggests that the source of TSP-bound OPE could be numerous. The results presented in this abstract are preliminary and are part of a particle-bound multi-pollutant sampling and analysis project.

Keywords: Air pollutant, Emerging contaminants, Flame retardants, Particle-bound pollutant