

# Identification of novel organophosphate flame retardants and plasticizers released from a plastic recycling industrial park using target and nontarget analysis

YIMING YAO

Nankai University

Presenting Author: yimingyao@nankai.edu.cn

The global production of organophosphate ester (OPE) flame retardants and plasticizers has been increasing from 300 kt to 1000 kt over the past several decades, due to the restriction and phaseout of legacy brominated flame retardants (FRs). China is a main market for manufacturers and consumers for OPEs for taking 55% of the global share and had a production of 360 kt in 2020. Plastic recycling and reprocessing activities can be a potential source of organophosphate ester (OPEs) flame retardants and plasticizers to the environment around. However, the contamination profiles and impacts have not been well clarified for this point source.

Therefore, we investigated 28 target OPEs and their metabolites (mOPEs) in agricultural soils and runoff water during a rainfall event around one of the largest plastic recycling industrial parks in North China, and revealed novel organophosphorus compounds (NOPs) using high-resolution-mass-spectrometry-based nontarget analysis.

Twenty and twenty-seven target OPEs were detected in runoff water and soil samples within 5 km from the park with total concentrations of 86.0-2491 ng/L and 2.53-199 ng/g dw, respectively. A total of thirteen organophosphorus contaminants were identified in runoff water samples and soil samples, including four novel OPEs, two novel oligomeric OPEs, three novel OPE metabolites, two novel organophosphite antioxidants, and two phosphine oxides. Among them, seven NOPs were detected in environmental matrix for the first time and the two phosphine oxides, triphenylphosphine oxide (TPPO) and diphenylphosphinic acid (DPPA), had high detection frequency and concentrations.

Principal component analysis and correlation analysis indicate strongly the source impact of industrial release and potential transformation thereafter. The decreasing concentrations of the OPEs and NOPs in runoff with the downwind distance from the park suggested the atmospheric emission and subsequent precipitation is a significant source to adjacent environment, which spreads potential ecological and human exposure risk.

