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Identification of organic contaminants resulting from the manufacture and recycling of electronic equipment

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Abstract: This study investigated the scope of organic contaminants arising from the electrical and electronic equipment industry sector in several countries. The GC/MS identification of organic compounds was performed on environmental samples affected by a) manufacture of electronic equipment (China, Thailand, Philippines and Mexico) [1]; b) processing of electronic wastes (China and India) [2,3]. Samples of several wastewaters and solid wastes were also subject to analysis. Most of the identified compounds could be attributed to anthropogenic input e.g. use as plasticizers, flame retardants, photoinitiators, insulators, solvents, antioxidants, surfactants or as additives to transformer oils or capacitors. Some chemicals were found in wastestreams from more than one manufacturing sector investigated, including some toxic, environmentally persistent groups such as polybrominated diphenyl ethers (PBDEs), phthalates esters and certain chlorinated solvents. PBDEs and polychlorinated biphenyls (PCBs) were particularly in evidence in the samples from the sites of electronic waste reprocessing. Several samples collected in association with acid processing facilities contained a number of so-far unidentified compounds showing fragmentation patterns characteristic of polyhalogenated organic compounds. Further research would be required to identify these.

Instrumentation and GC/MS conditions

Semi-volatile compounds analysis

GC: Agilent 6890 with 7673 Liquid Autosampler

MS: Agilent 5973N inert operated in SCAN or SIM mode

Column: Rtx-5MS 30m x 0.25mm ID x 0.25µm

Carrier Gas: Helium, 1ml/min constant mode

Oven: 35°C (hold for 5 min), raised to 260°C at 10°C/min, and then to 325°C at 50°C/min (hold 4min)

Volatile compounds analysis

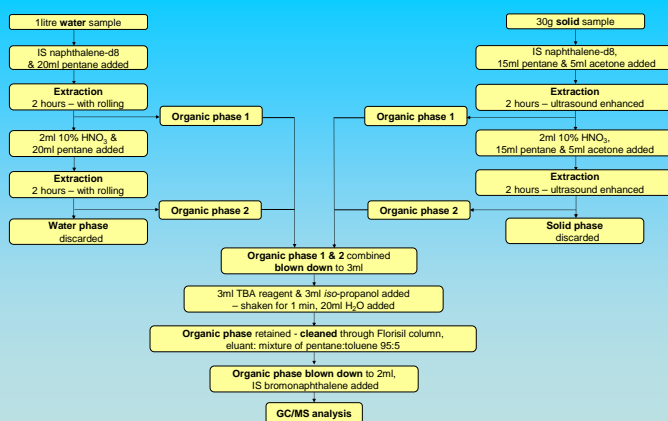
GC: Agilent 6890 with 7694 Headspace Sampler

MS: Agilent 5973N operated in SCAN or SIM mode

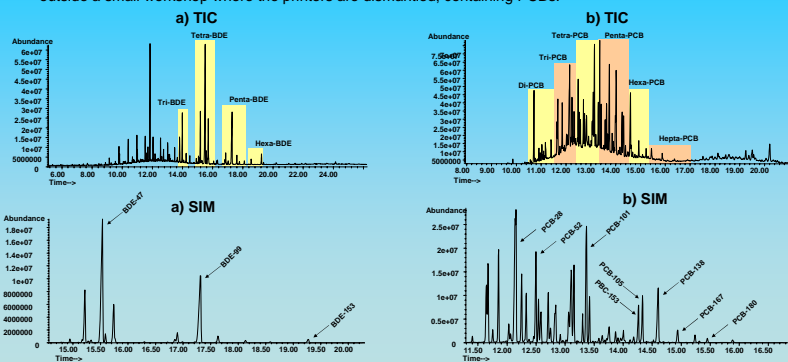
Column: Rtx-624 30m x 0.25mm ID x 1.4µm

Carrier Gas: Helium, 1ml/min constant mode

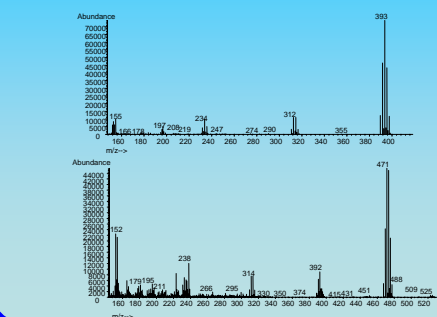
Oven: 35°C (hold for 4 min), raised to 55°C at 5°C/min, and then to 210°C at 15°C/min



Chromatograms of two samples collected in Shan Tou City, Guang Dong Province, China: a) sediment from a wastewater discharge gully by open-air workshop where circuit boards are shredded & components separated; found to be contaminated with a range of PBDEs; b) sediment from a small pool in a yard used to store printers, outside a small workshop where the printers are dismantled; containing PCBs.



Mass-spectra of two unidentified compounds, which showed GC/MS fragmentation characteristic for polyhalogenated organic compounds. These compounds were isolated from the sediment sample collected from the wastewater discharge channel of waste shredding and separating facility, Shan Tou City, Guang Dong Province, China. The sample also contained a range of chlorinated benzenes, polychlorinated naphthalenes and polybrominated diphenyl ethers.



References

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2. Brigden, K., Santillo, D., Labunska, I. & Johnston, P. (2006) The toxic legacy: e-waste recycling in China and India. Public Service Review: International Development 1: 84-86
3. Brigden, K., Labunska, I., Santillo, D. & Allsopp, M. (2005) Recycling of electronic wastes in China and India: workplace and environmental contamination. Greenpeace Research Laboratories Technical Note 09/2005, Publ. Greenpeace International, August 2005: 56 pp. (+ 47 pp. appendices)

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