Can metals be used as tracers for organic contaminants in potentially e-waste-polluted environmental media?

HEINZ RUEDEL[1], GOLNOUSH ABBASI[2], OLUSEUN E. POPOOLA[3], DIANE PURCHASE[4]

[1] Fraunhofer Institute for Molecular Biology and Applied Ecology (Fraunhofer IME), Business Area Environmental Monitoring, 57392 Schmallenberg, Germany, heinz.ruedel@ime.fraunhofer.de
[2] NILU-Norwegian Institute for Air Research, Hjalmar Johansens gate 14, 9296 Tromsø, Norway
[3] Department of Chemical Science, Yaba College of Technology, PMB 2011, Yaba, Lagos, Nigeria
[4] Department of Natural Sciences, Faculty of Science and Technology, Middlesex University, The Burroughs, London NW4 4BT, UK

Scientific literature reports on contamination of the ambient environment of e-waste dismantling and recycling facilities. Typical compounds emitted during e-waste recycling-related activities are toxic brominated flame retardants (for example polybrominated diphenyl ethers, PBDEs) and metals (including toxic metals like cadmium or lead). PBDEs, for instance, are regulated in Europe as priority substances under the Water Framework Directive. Production of tetra- to octa-BDEs is already banned globally by the Stockholm Convention on Persistent Organic Pollutants - but they are present in many obsolescent products which finally end up as e-waste. PBDEs and metals can be detected, e.g., in the dust emitted from e-waste dismantling and recycling facilities and in soil in the vicinity of such sites.

Crude e-waste recycling facilities are often operated in developing countries where the capabilities for environmental surveillance are limited. An environmental monitoring in order to protect the health of people living in the vicinity of such sites is often not implemented. Since organic (trace) analysis is expensive and sophisticated analytical equipment may not be commonly available in smaller laboratories, the use of tracers for e-waste contaminations as a screening tool would be helpful. Since metals are also found in e-waste it will be discussed in this contribution if one or several metal(s) could serve as tracer(s). As analysis of most of the relevant metals is cheap and relatively easy to perform, environmental samples may be screened and pre-selected by this means. Consequently, only a few suspicious samples (high content of tracer indicating possible e-waste impact) need to be analyzed for a broader spectrum of pollutants to assess the potential risk. All samples should be analyzed in comparison to appropriate reference samples from non-polluted sites of the same region.

The following questions will be considered:

- What typical contaminants are found in e-waste? Are there correlations between levels of organic compounds and certain metals in e-waste fractions?
- Which contaminants were investigated in environmental media (e.g., soil) in the vicinity of e-waste treatment and recycling facilities?
- Is there a co-occurrence of organic compounds and certain metals in environmental media near e-waste facilities and are there any correlations between levels of both groups of contaminants?
- Is there evidence from the gathered literature that metals can be used as tracers for other e-waste contaminants?
- Are the levels of potential tracer metals high enough for easy detection with standard extraction/digestion and analytical approaches?