Introduction

Every year a new set of waste (e-waste) problems is being created due to the disposal, recycling and part-salvaging of millions of discarded electronic devices such as computers, printers, televisions and toys. It has been estimated that between 50-80 % of the e-waste from industrial countries such as the U.S. ends up in recycle plants in Asian countries such as China, Pakistan and India. Without the benefit of modern and safe technology for recycling and disposal of e-waste, many Asian countries employ primitive and unsafe techniques. Removing electronic components from a circuit board by heating it over a grill, stripping of metals in open pit acid baths, chipping and melting plastics without proper ventilation, and recovering metals by burning cables and plastics are common unsafe practices. Unmanageable materials are disposed of either by dumping in the fields and rivers or by burning in open air. These processes expose workers to toxic chemicals and can lead to environmental damage.

In this paper we report the level of PCDD/PCDFs and PBDEs in samples from the town of Guiyu in Guangdong Province near Hong Kong. Most of the e-waste activities in Guiyu take place at the banks of Lianjiang River. While it is difficult to estimate the total tonnage of e-waste handled in Guiyu, the Chinese press estimates that it is large enough to employ tens of thousands of laborers.

Sample Description

1. **Sediment Samples**

All sediment samples were collected near the Lianjiang River in the Chaoyang region of Guangdong Province. Sediment Nos. 1, 2, and 3 were collected in Guiyu near the site where the recycling e-waste takes place. Sediment Nos. 4, 5, 6 and 7 were collected at river towns located about 20 to 50 kilometers downstream from Guiyu.

2. **Electronic Component Waste (ECW) Sample**

The sample was collected from a waste container. It is a blackened waste consisting of ash, dirt and a very large percentage of tiny metallic parts from electronic devices.

3. **Ash Samples**

Three ash samples were collected near the site. Ash Sample No. 1 mainly contained larger pieces of charred plastic parts. Ash Sample Nos. 2 and 3 were wet mixtures of black ash, mud and sand taken from an area where the ash is covered and mixed with soil.

4. **Hair Samples**

The hair samples were collected from two barber shops in Guiyu near the shops and huts where the salvaging took place.

Analytical Methods

PCDD/PCDFs were analyzed according to U.S. EPA Method 1613 (Revision B, dated Sept., 1997). Polybrominated Diphenylethers were analyzed using Analta Analytical Procedure AP3F rev. 0. The hair samples were repeatedly washed with water to remove dust, then digested with NaOH prior to extraction.

Results and Discussion

The results are presented in Table 1. The sampling locations were selected mainly because of accessibility rather than based on representation of the sites. The sediment samples from Guiyu are much higher than those from locations downstream from the site. Because of the low flow rate of the river in this area translocation of the contaminants is not extensive. The concentrations among the three Guiyu sediments differ greatly from each other. Sediment No. 1 was sampled at a part of the riverbank where ash had been dumped. Sediments No. 2 and No. 3 were from residential areas adjacent to the site. Water from the river is frequently used to wash clothes and cooking utensils.

The three ash samples were collected from sites where plastic was melted and burned. Ash No. 1, which contained mainly larger pieces of charred plastic, has much lower concentrations than the other two samples, which contained soil and finer ash particles.

The Electronic Component Waste (ECOW) is from a large container of blackened material, and has many recognizable small metallic parts in it. This material is for disposal.

Limited data are available on PBDE in environmental samples. Levels are highest in sediments taken at near the recycling operation.

Few human hair studies are available for data comparison. However, the two hair samples have concentrations that are much higher than the less than 1 pg/g (TEQ) reported by Tietz and co-workers (1). The 25.6 and 16.4 pg/g (TEQ) values are near the lower values of the two hair samples 12 and 120 pg/g (TEQ) collected near a very contaminated pentachlorophenol site as reported by us in an earlier paper (2).

Although the samples collected for this study are not comprehensive, higher values are indicative of contamination in the town Guiyu. Similar contamination may occur in other locations where the recycling of electronic devices is being conducted. Besides concerns of disuse/forus in sediment and scattered ash, the quality of the air at or near these e-waste processing sites is a matter of concern. Further studies will focus on sites of the same or similar extent of contamination in the area and assessing ambient air levels. Further work on PBDE levels in workers at the recycling operation and wildlife in the area need to be initiated.

References