Identification of organic pollutants and heavy metal contaminants in filter ash collected from the Siderca primary and secondary steel smelter, Campana, Argentina 2000

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1 INTRODUCTION

The Siderca primary and secondary steel smelter is located in the district of Campana, Argentina.

2 SAMPLING PROGRAM

In June 2000, Greenpeace obtained a sample of filter ash from the Siderca steel smelter. The sample was collected and stored in a pre-cleaned glass bottle that had been rinsed with nitric acid and analytical grade pentane in order to remove all heavy metals and organic residues. The sample was sealed upon collection, cooled and returned to the Greenpeace Research Laboratories for analysis. In addition, quantitative dioxin/furan analyses were conducted on the sample by EUS Laboratories, Southampton (UK), according to UKAS accreditation standards. Further details on the analytical methods employed can be provided on request.

3 RESULTS AND DISCUSSION

The results of the organic screen analysis and heavy metals analysis of the sample are presented in Table 1, including a breakdown of the groups of organic compounds reliably identified in the samples.

Metals	mg/kg (dry weight)
Cadmium (Cd)	87
Chromium (Cr)	1304
Cobalt (Co)	9
Copper (Cu)	1249
Iron (Fe)	316534
Lead (Pb)	10679
Manganese (Mn)	18858
Mercury (Hg)	2.63
Nickel (Ni)	66
Zinc (Zn)	73954

Organic Compounds	
No. of organic compounds isolated	25
No. of organic compounds reliably identified	11(44%)
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs)	
Fluoranthene	✓
Phenanthrene	✓
Pyrene	✓
OTHER AROMATIC COMPOUNDS	
Benzaldehyde	✓
ALIPHATIC HYDROCARBONS	
Linear	✓(6)
Cyclic	✓

Table 1. Organic chemicals and heavy metals identified in the sample of filter ash from the Siderca primary and secondary steel smelter. For the groups of organic compounds reliably identified; ✓(#) signifies compounds identified using a general GC/MS screening method, with the number of compound given in parentheses for groups with more than one compound. Metal concentrations are given in mg/kg dry weight.

The sample contained a number of toxic and potentially toxic heavy metals at high concentration, particularly for lead and zinc. The concentrations of many of these metals are significantly elevated above background levels in the environment (see Table 2). The sample also contained very high levels of iron. Zinc and iron are commonly found at very high concentrations in steel industry dusts. They may reach concentrations where the dusts are either landfilled as wastes or sent to repressors for zinc recovery (EC 1999).

Heavy metals exert a broad range of toxic effects on humans, terrestrial and aquatic life and plants. A number of these metals also have the potential to bioaccumulate, including cadmium, chromium, lead, mercury and zinc (USPHS 1997, Kimbrough et *al.* 1999, MINDEC 1995). In addition, certain forms of cadmium and chromium have carcinogenic properties (USPHS 1998).

Metal	Background concentrations in soil (mg/kg dry weight)	Factor by which the sample exceeds the highest background soil concentration	Reference
Cadmium (Cd)	0.01-2.0	44	USPHS 1997, Alloway 1990
Chromium (Cr)	<1-100	13	Alloway 1990
Cobalt (Co)	1-40	<1	Alloway 1990
Copper (Cu)	20 –30	42	Alloway 1990
Lead (Pb)	10-30	356	Alloway 1990
Manganese (Mn)	80-7000	2.7	Alloway 1990
Mercury (Hg)	0.02-0.625	4.2	Alloway 1990, WHO 1989
Nickel (Ni)	5-500 (50 average)	0.1 (1.3 average)	USPHS 1997
Zinc (Zn)	10-300 (50 average)	247 (1479 average)	Alloway 1990

Table 2. Typical background concentrations of metals found in soil, and the elevation above these levels in the filter ash sample.

The filter ash sample also contained a range of organic compounds, the majority of which were hydrocarbons and polycyclic aromatic hydrocarbons (PAHs). PAHs are commonly found as product of incomplete combustion of organic substances (Jones 1991, Overton 1994).

The filter dust collected from Siderca was found to contain 0.208 ng/g ITEQ (ppb) dioxins. This confirms that the Siderca plant is a source of dioxins. Steel smelters are known to be amongst the largest sources of dioxins to the atmosphere in Europe (Lexén *et al.* 1993, HMIP 1995, EC 1999). The chlorine required to generate dioxins can enter the process from a number of sources. For example, scrap is used in most types of furnace, and this can be contaminated with PVC, or with chlorinated cutting oils such as the chlorinated paraffins. Different technologies within the steel industry may produce varying amounts of dioxins; the sintering process whereby mixtures of materials such as ores, filter dusts and mill scale are fused together to make a suitable feedstock for blast furnaces is thought to emit the largest quantities. Scrap preheating can also increase the quantities of toxic organochlorines including PCDD/Fs that are released (EC 1999). Elimination of chlorinated substances from the feedstock of Siderca would be an important step in eliminating dioxin emissions from the plant.

4 CONCLUSIONS

The filter ash produced at the Siderca steel smelter contains a wide range of toxic pollutants, especially concentrated levels of heavy metals. Analysis of the sample confirmed the presence of dioxins in the filter dust from this smelter.

In addition to the detrimental effect placed on the environment by the release of filter dusts, it is highly likely that a wide range of pollutants are also being released to the environment via emissions to air from this facility.

5 REFERENCES

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