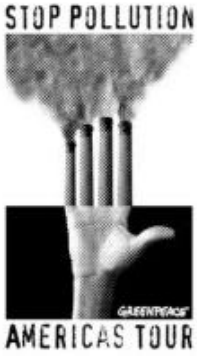

REPORT

Identification of organic pollutants and heavy metal contaminants in samples collected from the Trieco hazardous and medical waste incinerator, Buenos Aires Province, Argentina 2000

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EXECUTIVE SUMMARY

The Trieco incinerator is located in the Doc Sud area of the Buenos Aires Province, Argentina. This incinerator is licensed to incinerate both hazardous chemical wastes and medical wastes. The permitted wastes include compounds of heavy metals and a wide range of organic compounds.

Ashes from the incinerator are stored in barrels within the Trieco incinerator grounds. Many of these barrels are in a very poor condition, and are not sealed to prevent the spread of ashes to the environment.

Greenpeace visited the Trieco incinerator facility in July 2000 and collected samples of incinerator ashes and sediment to determine the potential impacts on the environment from the activities at this facility. The analysis of these samples for organic contaminants and heavy metals demonstrated the following:

- The ashes produced at the Trieco incinerator facility contain a wide range of toxic pollutants, especially concentrated levels of heavy metals.

- The improper storage of these ashes is resulting in the release of pollutants to the local environment. This is clearly demonstrated by the high levels of many heavy metals in sediment close to this facility.

- A sample of sediment collected from a water runoff channel coming from the Trieco facility contained a number of toxic heavy metals at significantly elevated levels, with certain metals at even higher concentrations than those found in the ashes themselves. This suggests either accumulation of metals leached from the ashes into the sediment, or selective carry over of the fine fractions of the ash, which may contain higher concentrations of these metals than the ashes as a whole.

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

1 INTRODUCTION

The Trieco incinerator is located in the Doc Sud area of the Buenos Aires Province, Argentina. This incinerator is licensed to incinerate both hazardous chemical wastes and medical wastes. The permitted wastes include compounds of heavy metals such as chromium, copper, zinc, cadmium, mercury and lead, as well as a wide range of organic compounds. The allowable organic compounds include chlorinated organic compounds and other halogenated organic compounds, with the exception of polychlorinated dibenzo-furans and polychlorinated dibenzoparadioxins (Secretaria de Politica Ambiental de la Province de la Province de Buenos Aires 2000).

Ashes from the incinerator are stored in barrels within the Trieco incinerator grounds. Many of these barrels are in a very poor condition, and are not sealed to prevent the spread of ashes to the environment.

2 SAMPLING PROGRAM

In July 2000, Greenpeace visited the Trieco incinerator plant and collected two samples of incinerator ash, and one sample of sediment from a water runoff channel from the plant.

2.1 General Sampling Procedures

All samples were collected and stored in pre-cleaned 100ml glass bottles that had been rinsed thoroughly with nitric acid and analytical grade pentane in order to remove all heavy metals and organic residues. All samples were immediately sealed and cooled upon collection. The samples were returned to the Greenpeace Research Laboratories for analysis. Detailed description of sample preparation and analytical procedures are presented in Appendix 1.

2.2 Sample Descriptions

The two samples of ash were collected from barrels within the incinerator plant, close to the incinerator chimneys, in the north-east corner of the plant. The barrels from which these samples were collected were not sealed in any way to prevent the spreading of ashes to the environment, and spilt ashes from these barrels could be clearly seen on the ground in this area. The ashes contained in the barrels are believed to be bottom ash or a mixture of bottom and fly ashes. A large number of barrels in a similar condition are stored in other areas of this plant, some of which may also contain incinerator ashes.

The sample of sediment was collected from a water runoff channel coming from the plant in the area where the ash samples were collected. Flowing water in this channel has been observed to carry spilt ashes from the barrel storage area that was sampled. This channel was not flowing at the time that the sediment sample was collected.

Sample Number	Sample Description	Sample Location
AM0033	Incinerator ash	Storage barrel within the incinerator grounds. Ashes contained no visible hospital wastes
AM0034	Incinerator ash	Storage barrel within the incinerator grounds. Ashes contained visible hospital wastes
AM0036	Sediment	Runoff channel from the incinerator plant, which flows to an adjacent marsh area.

Table 1. Description of samples collected from the Trieco incinerator in the Doc Sud area of the Buenos Aires Province, Argentina 2000.

The ash sample AM0034 contained partially burnt material that appeared to be medical wastes, including glass vials.

3 RESULTS AND DISCUSSION

The results of the organic screen analysis and heavy metals analysis are presented in Table 2, including a breakdown of the groups of organic compounds reliably identified in the samples. For more information on the environmental behavior and toxicological outlines for key pollutants detected during this study see Appendix 2.

3.1.1 Incinerator ashes

The two incinerator ash samples (AM0033 and AM0034) contained a number of toxic and potentially toxic heavy metals. The concentrations of heavy metals in these incinerator ashes are very high compared to background levels in the environment (see Table 3). The levels were considerably higher in sample AM0033 for all metals other than cadmium and zinc.

Heavy metals are not destroyed by incineration but are simply concentrated in the remaining ashes, or released to the environment via stack emissions. The concentrations of heavy metals in the ashes are highly dependent on the amounts of these metals in the wastes being incinerated. This is clearly demonstrated by the variation in the concentrations of metals between the two ash samples AM0033 and AM0034.

Heavy metals can remain in their original form during incineration or may react to form new compounds such as metal oxides, chlorides or fluorides (Dempsey and Oppelt 1993). These changes are dependant on the composition of the wastes to be incinerated, and the forms that the metals are in. However, for the incineration of municipal wastes, the process of incineration has been shown to greatly enhances the mobility and bioavailability of toxic metals compared with the raw waste (Schumacher et al. 1998).

Sample number	AM0033	AM0034	AM0036
Description	Incinerator ash	Incinerator ash	Sediment
Location	Storage barrel within the plant (no visible medical waste)	Storage barrel within the plant (with visible medical waste)	Runoff channel from the Trieco plant
Metals	**mg/kg**	**mg/kg**	**mg/kg**
Cadmium (Cd)	3	7	22
Chromium (Cr)	6732	361	355
Cobalt (Co)	484	20	387
Copper (Cu)	2090	1080	922
Lead (Pb)	234	2301	1107
Manganese (Mn)	1820	335	565
Mercury (Hg)	2.88	0.79	22.1
Nickel (Ni)	905	170	313
Zinc (Zn)	1342	2365	3772
No. of organic compounds isolated	20	221	121
No. of organic compounds reliably identified	3(15%)	53(24%)	50(41%)
POLYAROMATIC HYDROCARBONS			
Naphthalene and/or its derivatives		✓(7)	✓(11)
Anthracene and/or its derivatives		✓	✓
Acenaphthylene		✓	
Phenanthrene and/or its derivatives		✓	✓
9H-Fluorene and/or its derivatives		✓	✓
Fluoranthene		✓	
OTHER AROMATIC COMPOUNDS			
Alkylated benzenes	✓	✓(5)	✓
Biphenyl and/or its derivatives		✓	✓(3)
ALIPHATIC HYDROCARBONS			
Linear	✓(2)	✓(31)	✓(21)
Cyclic		✓(4)	✓

Table 2. Organic chemicals and heavy metals identified in samples collected from the Trieco incinerator, Doc Sud, Buenos Aires Province, Argentina 2000. For the groups of organic compounds reliably; ✓(#) signifies compounds identified using 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 for solid samples.

Heavy metals exert a broad range of toxic effects to humans, terrestrial and aquatic life and plants. A number of these metals also have the potential to bioaccumulate, including cadmium, chromium, lead and mercury and zinc (USPHS 1997, Kimbrough *et al.* 1999, MINDEC 1995). In addition, certain forms of cadmium and chromium have carginogenic properties (USPHS 1998). For more information on the environmental behavior and toxicity of these heavy metals see Appendices 2.

The two ash samples also contained a range of organic compounds. A considerably larger number of compounds were isolated from sample AM0034, and the majority of these were

present at significantly higher levels than those isolated from sample AM0033. For both samples, it was only possible to identify a small number of these compounds.

Of the compounds identified from both samples, the majority were hydrocarbons. Other compounds identified were polyaromatic hydrocarbons (PAHs) and alkyl benzenes. PAHs are commonly found as product of incomplete combustion of organic substances (Jones 1991, Overton 1994). Hydrocarbons, alkyl benzenes and PAHs are also components of crude oils or petroleum products, and are therefore very widespread environmental pollutants (Mackay 1988, Wang & Fingas 1995). As the incinerator ashes are not isolated from the environment, external sources such as vehicle emissions may be contributing to the presence of these compounds in the samples collected. Additional information on the sources, environmental behavior and toxicological outlines of PAHs is given in Appendix 2.

3.1.2 Water runoff channel

The sediment collected from the water runoff channel contained a large number of toxic heavy metals at high concentrations. Typical background concentrations of these metals in soil, and the elevation above these levels found the sediment sample AM0036 are given in Table 3.

Metal	Background Concentrations in soil (mg/kg)	Elevation above background concentrations in sample AM0036	Reference
Cadmium (Cd)	0.01-2.0	11-2200	USPHS 1997, Alloway 1990
Chromium (Cr)	<1-100	4-355	Alloway 1990
Cobalt (Co)	1-40	10-387	Alloway 1990
Copper (Cu)	20 –30mg/kg	31-46	Alloway 1990
Lead (Pb)	10-30	37-111	Alloway 1990
Manganese (Mn)	80-7000	<1-7	Alloway, B.J. 1990, p202
Mercury (Hg)	0.02-0.625	35-1105	Alloway 1990, WHO 1989
Nickel (Ni)	5-500 (50 average)	<1-63 (6 average)	USPHS 1997
Zinc (Zn)	10-300 (50 average)	13-377 (75 average)	Alloway 1990

Table 3. Typical background concentrations of metals found in soil, and the elevation above these levels in the sediment sample AM0036.

In light of the high levels of these metals in the ash samples collected from this area (AM0033 and AM0034), and the observed washing of ashes from the storage area to the runoff channel, incinerator ashes are clearly a major contributor to the contamination of this area with heavy metals. The levels of cadmium, mercury and zinc in the sediment sample (AM0036) were significantly higher than those found in either of the two ash samples collected (AM0033 and AM0034), indicating the possible accumulation of these

metals in the soil. The leaching of these toxic and potentially toxic heavy metals from the Trieco incinerator ashes could have a considerable impact on the local environment.

In addition to the high concentrations of many heavy metals, the sediment sample AM0036 also contained a similar range of organic pollutants to those found in the incinerator ash samples. This indicates that the spreading of ashes, and the leaching of compounds from these ashes, is resulting in the spreading of organic pollutants to the environment. Other sources of the organic pollutants in this sediment cannot, however, be ruled out.

Fallout of material from the incinerator chimneys may also be contributing to the contamination of this area.

3.1.3 Emissions to Air

The analysis of the samples from the Trieco incinerator shows the levels of pollutants in ashes formed as a result of the incineration of wastes at this facility. In addition to these ash outputs, a range of pollutants will also be released to air via the incinerator chimneys. It is highly likely that these will including particulates, heavy metals, and organic compounds including PAHs (EC 1998, Yasuda and Takahashi 1998, Magagni et al. 1991).

Certain metals, including cadmium, lead and mercury, are emitted from incinerator stacks in flue gases and as tiny particles (EEA 2000). The European Environment Agency (EEA 2000) note that the separation of mercury is a special problem in incineration. Almost 100% of elemental mercury present in waste is emitted to stack gases because it does not bind well to filter dust or ashes. Elemental mercury constitutes about 20-50% of the total mercury emissions. The remainder is in the form of divalent mercury, which may be predominantly mercury chloride ($HgCl_2$). After emission to the atmosphere, divalent mercury, which is water soluble, may be deposited close to the incinerator. On the other hand, elemental mercury may be transported for long distances on air currents before it is eventually converted to the divalent form and can become deposited once more on the ground (Carpi 1997).

The quantity of PAHs emitted is determined by waste composition, temperature and excess air during incineration. High emissions of PAHs have been shown to occur during start-up of incinerators (see Yasuda and Takahashi et al. 1998).

4 CONCLUSIONS

The ashes produced at the Trieco incinerator facility contain a wide range of toxic pollutants, especially concentrated levels of heavy metals. The improper storage of these ashes is resulting in the spreading of ashes, and the leaching of pollutants to the local environment, as demonstrated by the high levels of many heavy metals in sediment close to this facility.

A sample of sediment collected from close to the Trieco facility contained certain metals at concentrations higher levels than those found in the ashes themselves. This suggests either accumulation of metals leached from the ashes into the sediment, or selective carry over of the fine fractions of the ash which may contain higher concentrations of these metals than the ashes as a whole.

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

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