

## PCDD/F AND HEAVY METAL CONTAMINATION ON FOOTPATHS HAVING RECEIVED INCINERATOR ASH AND OF SOIL IN THE VICINITY OF AN INCINERATOR

Tanja Pless-Mulloli<sup>1</sup>, Bernd Schilling<sup>2</sup>, Olaf Pöpke<sup>2</sup>, Richard Edwards<sup>1</sup>

<sup>1</sup>Department of Epidemiology and Public Health, University of Newcastle upon Tyne, Framlington Place, NE2 4HH, UK,

<sup>2</sup>Ergo Forschungsgesellschaft mbH (ergo Research Laboratory), Geierstr 1, D-22305 Hamburg, Germany

**Introduction** - In response to local concern about the practice of using ash from a local incinerator and about plans to extend its operations, 44 sites were identified across the city of Newcastle upon Tyne as having received between 10 and 150 tones of ash between 1994 and 1999. 27 sites were footpaths in allotment gardens, 16 were footpath in other mainly recreational sites. The aims of this preliminary investigation were:

1. To assess contamination with PCDD/F in selected areas where ash from the incinerator had been used
  2. To assess soil and footpath contamination with PCDD/F in allotments near the incinerator ,
- A further aim was to advice local authorities on potential risks to the public health from past and current operations of the incinerator/heat station. Alongside the measurement of PCDD/F heavy metals were also measured.

**Methods and Materials** - Following consideration of possible exposure pathways 3 criteria were used to identify 16 sites for the sampling of ash:

1. One sample from each site, which received ash only from one delivery during the years 1994 to 1999. This allowed an evaluation of variation in contamination over time
2. If more than one site was available using criterium 1 allotment sites were given preference over other sites, and those having received a higher quantity were given preference over those having received a smaller quantity of ash
3. All sites having received more than 100 tones were sampled.

Additionally one site labeled as a school was included in the sampling, because of the potentially vulnerable nature of the users of the site. However, later inspection of this site revealed that it was a footpath near the school rather than the school itself, which had received ash. In order to give an indication of possible contamination near the incinerator 4 soil samples were taken from an allotment in the direct vicinity (50-200m) of the incinerator.

In total there were 6 samples for the years 1994 to 1999, and 6 samples from sites, which had received over 100 tones of ash. There were 3 allotments in the vicinity of the incinerator (distance less than 400m), of which two also had received ash from the incinerator, the other one has received ash from a coal fired power station in the past. Footpath samples were taken from the first two of these and two disturbed and undisturbed soil samples each from the latter. If fugitive emissions and/or deposition had occurred these would be the locations most likely to show contamination. Additionally two samples were taken from allotment paths, which had not received ash from the incinerator (controls). Each of the 23 samples analysed was a composite sample of between 2 and 8 individual samples of 2 to 25 cm depth collected in February 2000. Samples were collected in line with HMIP guidance [HMIP, 1989 #92]. The analysis of samples

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was carried out in accordance with directive VDI 3499. All measurements were performed using High resolution gas chromatography/High resolution mass spectroscopy (HRGC/HRMS).

The PCDD/PCDF concentrations were compared with guideline levels for soil as described by Basler in 1995 [Basler, 1995 #89], for heavy metals the Dutch list of trigger levels for further risk assessment was used [Hein, 1999 #88; Hein, 1999 #95; Niederlaednisches Ministerium fuer Wohnungswesen, 1988 #96].

**Results and Discussion** - In the following table results are summarised for ash on footpaths across Newcastle, which had received ash, for footpaths near the incinerator, which had received ash, for four soil samples from bear the incinerator and for 2 control samples. The amount of ash received and the years of their delivery are shown. For heavy metals the pattern of contamination is shown . PCDD/PCDF levels are shown as ng/kg I-TEQ.

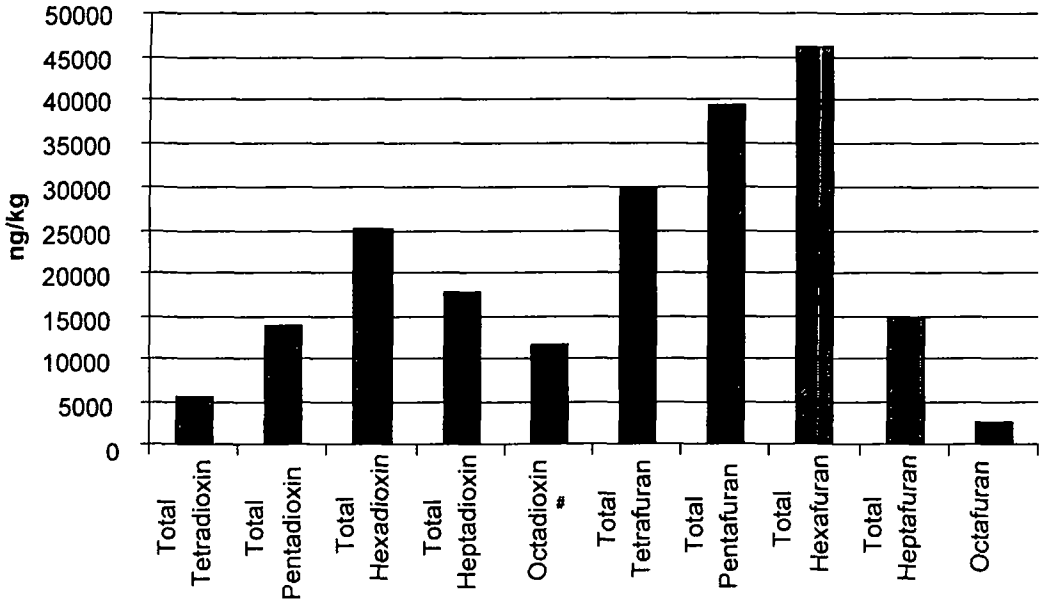
**Table 1** Sampling locations, amount of ash, heavy metal pattern, I-TEQ in ng/kg<sup>1</sup> and PCDD/F pattern

No	Name	Ash in tons	Years	Pattern of heavy metal	PCDD/F I-TEQ in ng/kg	Pattern <sup>3</sup>
<b>ASH ON FOOTPATHS ACROSS NEWCASTLE</b>						
1	A Coxlodge	40	94	Cu,Pb,Zn	4224	N
2	F Lightwood Avenue	40	95	Cu	2015	N
3	A Walkergate Hospital B	10	96	Cu,Pb,Zn	35	B
	A Walkergate Hospital A	Power station ash		Pb	16	O
4	A Ridgewood Crescent	40	97	Zn	88	N
5	A Keebeldale Pigeons	10	98	Cu,Pb,Zn	440	N
6	A Brunswick	20	99 <sup>2</sup>	Pb,Zn	373	N
7	A Christen Rd	100	97	Cu,Pb,Zn	3535	N
8	A Denton Dene	110	94,95,96,97,99	Cu,Pb,Zn	1636	N
9	A Fenham Nursery	150	94,95,96, 97, 99	Cu,Pb,Zn	2521	N
10	A Walkergate 3b	100	94,96,97,99	Cu,Pb,Zn	976	N
11	A Westmacott Str	100	94,95,96,97	Cu,Pb,Zn	2123	N
12	B Three Hills	140	95	Cu,Pb,Zn	415	N
13	B near Feversham School	80	96	Zn	11	O
16	A Walkergate 3A	70	95,96,97,99	Cu,Pb,Zn	1932	N
<b>ASH FROM NEAR INCINERATOR</b>						
14	A St Michael A	20	94	Cu,Pb,Zn	783	O
15	A St Michael B	20	94	Cu,Pb,Zn	860	N
<b>SOIL FROM NEAR INCINERATOR</b>						
17	A Walker Road	undisturbed		Pb,Zn	26	O
18	A Walker Road	undisturbed		Pb,Zn	34	O
19	A Walker Road	disturbed		Cu,Pb,Zn	36	O
20	A Walker Road	disturbed		Cu,Pb,Zn	88	O
<b>CONTROL</b>						
22	A Highbury	no ash		Pb,Zn	13	O
23	A Oxnam Crescent	no incinerator ash		Pb,Zn	16	O

A: Allotment, B: Bridle Path, F: footpath, <sup>1</sup> sample numbers are those used in the report, please note that there was no sample no 21, <sup>2</sup> incinerator burning coal, <sup>3</sup> Pattern specific for Newcastle incinerator = N, other = O, <sup>4</sup> Walkergate 3a and 3b were included because they were thought to be twin sites, later inspection revealed that this was not the case and two separate samples were taken.

**Figure 1**

**Typical pattern of PCDD/F contamination found in majority of footpath samples (Sample No 1 Coxlodge, I-TEQ 4224 ng/kg)**



There was a substantial contamination with dioxins/furans in a large majority of ash samples from footpaths. The median of 16 ash samples was 918 I-TEQ, values ranged between 11 and 4224 ng/kg. Contamination with PCDD/F was highest in those samples with high copper content. A characteristic zigzag shaped pattern of the sums of dioxins and furans was found in 14/16 ash samples. Given the knowledge that all these footpaths had received ash from the incinerator we believe that the pattern is indicative of ash from the incinerator (see figure 1). This pattern was not found in soil samples from the vicinity of the plant, or in the ash from the coal-fired power station.

It is known since 1977 that fly ash from municipal waste incinerators contains PCDD/PCDF [Olie, 1977 #97]. Since then a number of studies have reported correlations between particle size and PCDD/PCDF concentration and between heavy metal concentration and PCDD/PCDF concentration [Olie, 1977 #97; Hinton, 1992 #98; Hinton, 1991 #99; Chang, 1998 #48; Fiedler, 1998 #23; Fiedler, 1999 #112]. The levels found in this study are well in line with those previously reported from fly ash of municipal waste incinerators [Olie, 1977 #97; Hinton, 1992 #98; Hinton, 1991 #99; Chang, 1998 #48; Fiedler, 1998 #23; Fiedler, 1999 #112; Buekens, 1998 #6]. Buekens and Huang reported a PCDD/PCDF content of filter ash of 4000 ng/kg I-TEQ; boiler ash 200 ng/kg I-TEQ, bottom ash 30 ng/kg I-TEQ and municipal solid waste 90 ng/kg I-TEQ.

The distribution of PCDD/PCDF around municipal waste incinerators has been measured at a number of locations. While the number of samples in the current study was very small (n=4, I-TEQ sample no 17: 26 ng/kg, 18: 34 ng/kg, 19: 36 ng/kg, 20: 88 ng/kg) the comparison with

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previously reported levels provides an indication of the order of magnitude that can be expected by deposition and fugitive emissions from waste incinerators. At this early stage of the investigation chimney height, topography and wind direction were not yet included in the consideration. Deister and Pommer reported for municipal waste incinerator in a rural location in Germany PCDD/PCDF levels of between 0.2 and 4.4 ng/kg I-TEQ in 15 samples at distances between 350 and 750 m from the plant [Deister, 1991 #32]. Schumacher et al. reported in 1997 on PCDD/PCDF concentrations near a Spanish waste incinerator. They found 44 ng/kg I-TEQ at a distance of 750m [Schumacher, 1998 #20].

While analysis in this study has not taken into account a separation by particle size, the observations on particle size noted at the time of the sample collection supported the view that the material used on footpaths in Newcastle was a combination of slag and fly ash. This is consistent with the description of the process of waste incineration, which indicted that fly ash and bottom ash/slag had been combined.

Another consideration was UK background levels of soil. In 1989 Creaser et al reported on 78 samples taken from a 50-km grid across England, Scotland and Wales [HMIP, 1989 #92], which were analysed for PCDD/PCDF. While the sample from Highbury in Jesmond was largely below the average background levels, the levels in the samples from Walker Road were mainly well above levels expected in urban areas. The levels in the sample from Oxnam Crescent (control) indicated contamination even though no ash from Byker was delivered there.

**Conclusions:** The contamination found in footpath samples was consistent with the use of a mixture of slag and fly ash. On the basis of this preliminary investigation contamination of soil, animal produce, and vegetables by ash from footpaths could not be ruled out. Contamination of soil in four samples from near the incinerator was such that a systemic uptake by consumption of vegetables or animal produce could not be ruled out. Further measurements are necessary to ascertain the potential for risk to the public health. We recommended further investigations of footpaths and soil as well as the sampling of eggs and vegetables. In the absence of detailed information about soil contamination we also made recommendations about the use of the allotments prior to further investigations based on a precautionary principal:

13 egg samples (11 from contaminated allotments some of which used ash within the chicken pen and 2 control samples ) have been collected which are currently being analysed. A sampling strategy for soil and vegetable samples is currently under consultation. Newcastle City Works has agreed to remove all ash from footpaths, which have received material from the incinerator. This work is currently under way.

### Acknowledgments

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### References

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