HOME MADE DIOXINS: KNOWN AND LESS KNOWN SOURCES

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Abstract

Dioxins can be emitted as by products of thermal processes. Domestic heating with solid fuel and angle grinding are high temperature processes outside industrial activities that have the potential to emit dioxins. Burning household waste in wood stoves resulted in emissions that were several orders of magnitude higher than that usually found in state of the art waste incineration plants. In contrast we observed relatively low emissions when angle grinding was applied to different materials.

Introduction

Polychlorinated dibenzo-p-dioxins and polychlorinated dibenzofurans (PCDD/F) are some of the most toxic environmental contaminants. They never have been produced intentionally but are emitted in trace quantities as by-products of different industrial and thermal processes [1].
They are ubiquitously present in our environment and accumulate in body due to their highly lipophilic properties. Once there they can cause cancer and have adverse effects on the endocrine, immune and nervous system [2].
Beside well known potential sources of dioxins, like waste incineration and some processes in the chlorine industry, also domestic heating can be a considerable source of dioxins [3,4, 5].
Being dioxins mainly by-products of thermal processes, we identified in angle grinding a high temperature process that can occur in craftsman's daily work. Angle grinding is routinely used to cut also metal containing materials. Depending on which material is cut by angle grinding it should lead to different emissions. That means different exposure to PCDD/F.

Materials and methods

PCDD/PCDF source wood stove:
A conventional wood stove used for room heating was fed with different kinds of fuels: compressed sawdust from chipboard, empty juice/milk cartons and household waste were consecutively used. Waste 1 was normal household waste, waste 2 was apparently rich in plastic waste. Sampling and analysis of the wood stoves was carried according EN 1948 standard, but due to the small stack diameter (10 cm) instead of isokinetic sampling a constant flow sampling was used. Sampling time was reduced to 1 h.
PCDD/PCDF source angle grinding:
A commercial available angle grinder equipped with a metal grinding disk was used.
For sampling of the total emissions (dust and gas phase) of angle grinding a simplified stack gas sampling cartridge consisting of quartz wool and polyurethane foams plugs was coupled to a sampling pump running on 70 l/min. The total emissions (dust and gas phase) during grinding of three different materials were sampled on the cartridges. The materials used (cut) were an iron plate, a current cable (25,4 mm in diameter) and a composite plate made of PVC/Cupper/PVC. The grinding and sampling time was approximately 60 seconds for all materials.
After sampling filter and adsorbents were extracted in a soxhlet extractor with toluene. For PCDD/F samples a sulphuric acid pre-treatment and multi step clean up on an automated sample clean up apparatus (Power Prep, FMS) were used to purify the extract. Determination of PCDD/F and Benzo(a)pyrene (BaP) were performed on a Thermo MAT 95 XP high-resolution gas chromatography and high resolution mass spectrometry (HRGC/HRMS) system using an Agilent DB XLB GC column (60 m, 0,25 µm , 0,25 mm).

Results and Discussion

In table 1 are resumed the results obtained by burning different kinds of fuels.

Dioxins and Benzo(a)pyrene in emission of the wood stove		
Fuel	**Dioxins in ng TEQ/Nm3 (refers to oxygen 11%)**	**BaP in µg/Nm3**
	Results are standardized to 11% oxygen	
Compressed sawdust	**1,5**	**6**
Carton	**3,9**	**26**
Waste 1	**12**	**150**
Waste 2	**82**	**1498**

Table1:

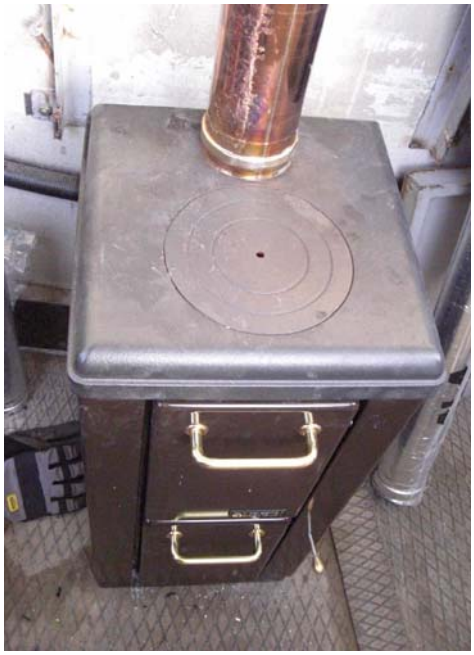

Fig1: wood stove

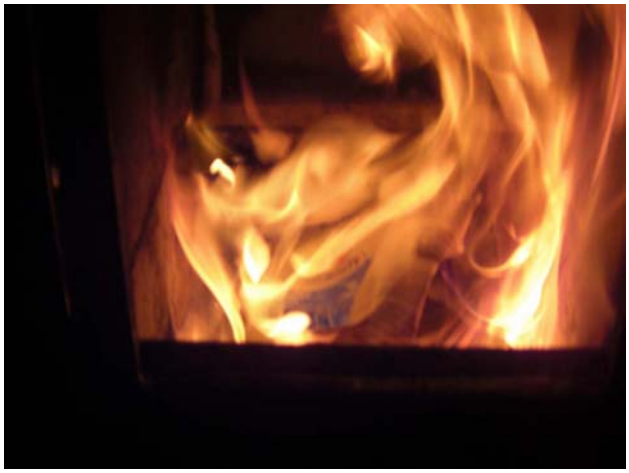

Fig. 2: inside look during combustion

Depending on the material burnt significant differences in the amount of pollutants released by flue gas were observed. When household waste rich in plastics was burnt in the wood stove the emission were several order of magnitudes higher than in a state of the art incineration plant. Using household waste as fuel for wood stoves seems to be extremely dangerous for the environment.

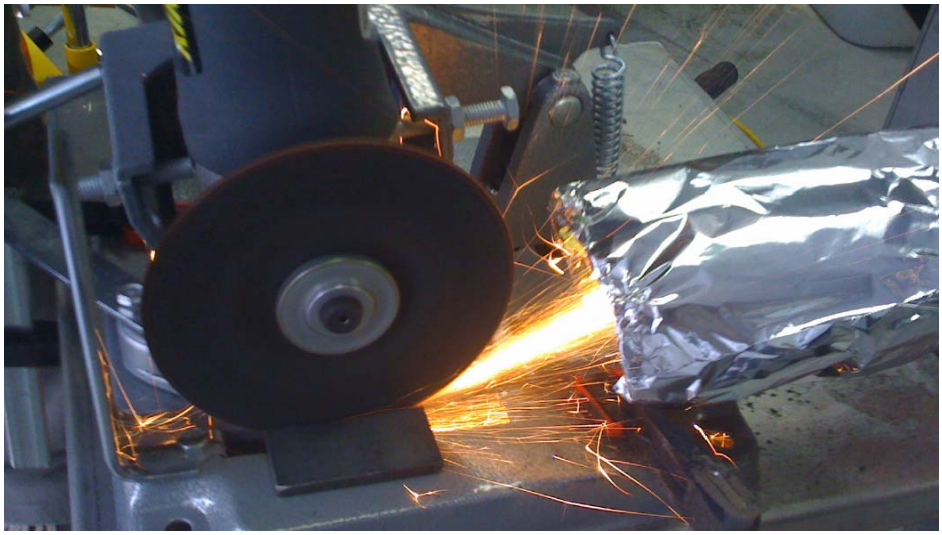

Fig.3: sampling the exhausts of an angle grinder

			all results in pg per grinding (60 seconds)		
	I-TEF		composite plate	current cable	iron plate
2378 TCDD	1		0,4	0,3	0,2
12378 PCDD	0,5		2,4	2,9	1,5
123478 HxCDD	0,1		1,8	1,6	1,0
123678 HxCDD	0,1		3,7	3,7	2,7
123789 HxCDD	0,1		3,2	1,8	2,5
1234678 HpCDD	0,01		25,4	21,7	16,4
OCDD	0,001		54,1	40,4	24,9
2378 TCDF	0,1		7,8	11,2	11,6
12378 PCDF	0,05		5,3	3,1	5,5
23478 PCDF	0,5		16,1	9,7	10,8
123478 HxCDF	0,1		12,7	8,7	8,7
123678 HxCDF	0,1		11,6	7,8	7,4
234678 HxCDF	0,1		15,2	9,8	10,3
123789 HxCDF	0,1		0,5	0,2	0,3
1234678 HpCDF	0,01		49,3	30,3	29,8
1234789 HpCDF	0,01		6,4	3,7	4,9
OCDF	0,001		29,9	16,9	20,3
TEQ in pg			16,4	11,8	11,6

Table 2: PCDD/F emission levels when grinding different materials

In table 2 the results of the angle grinding experiments are resumed. In contrast to the domestic burning of waste in the wood stove we observed relatively lower emissions of PCDD/F. Changing to materials that in combustion processes lead to high PCDD/F emissions (current cable, PVC/cupper composite materials) did not give significant higher emissions. The levels observed are one order of magnitude higher than the ones formed in the smoke of one cigarette.

References:

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