PCDD/PCDF BALANCE OF DIFFERENT MUNICIPAL WASTE MANAGEMENT METHODS
IV. RECYCLING

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Introduction

The Federal Waste Law gives a priority list for waste management methods in order to minimize waste amounts: avoidance > recycling > removal. Especially recycling has won great importance in the last few years. Recycling consists of physical, thermal and chemical treatment of wastes, and there seem to be no remarkable differences between waste or primary stuff treatment in regard to pollutants (1). The authors examined not only composting (see III) as one form of recycling, but waste recycling within industrial processes, especially of non-ferrous metals, too.

Experimental

The authors examined 70 soil samples from the area and in the vicinity of a cable pyrolysis plant. The soil samples in the neighbourhood of the plant were selected in regard to the main direction of the wind. Soil samples were taken mainly down to 5 cm depth, in case of profiles in 0 - 20 cm, 20 - 40 cm and 40 - 60 cm. Samples included (2):

* 4 samples (2 soil, 1 dust, 1 sand-heap) from the area of the plant
* 36 soil samples from gardens in the north of the plant
* 2 samples from vegetables beds enriched with compost produced in the corresponding gardens
* 6 soil samples from a camping site in the west of the plant
* 3 soil samples from a building-material stock
* 19 soil samples from different places in the vicinity of the plant.

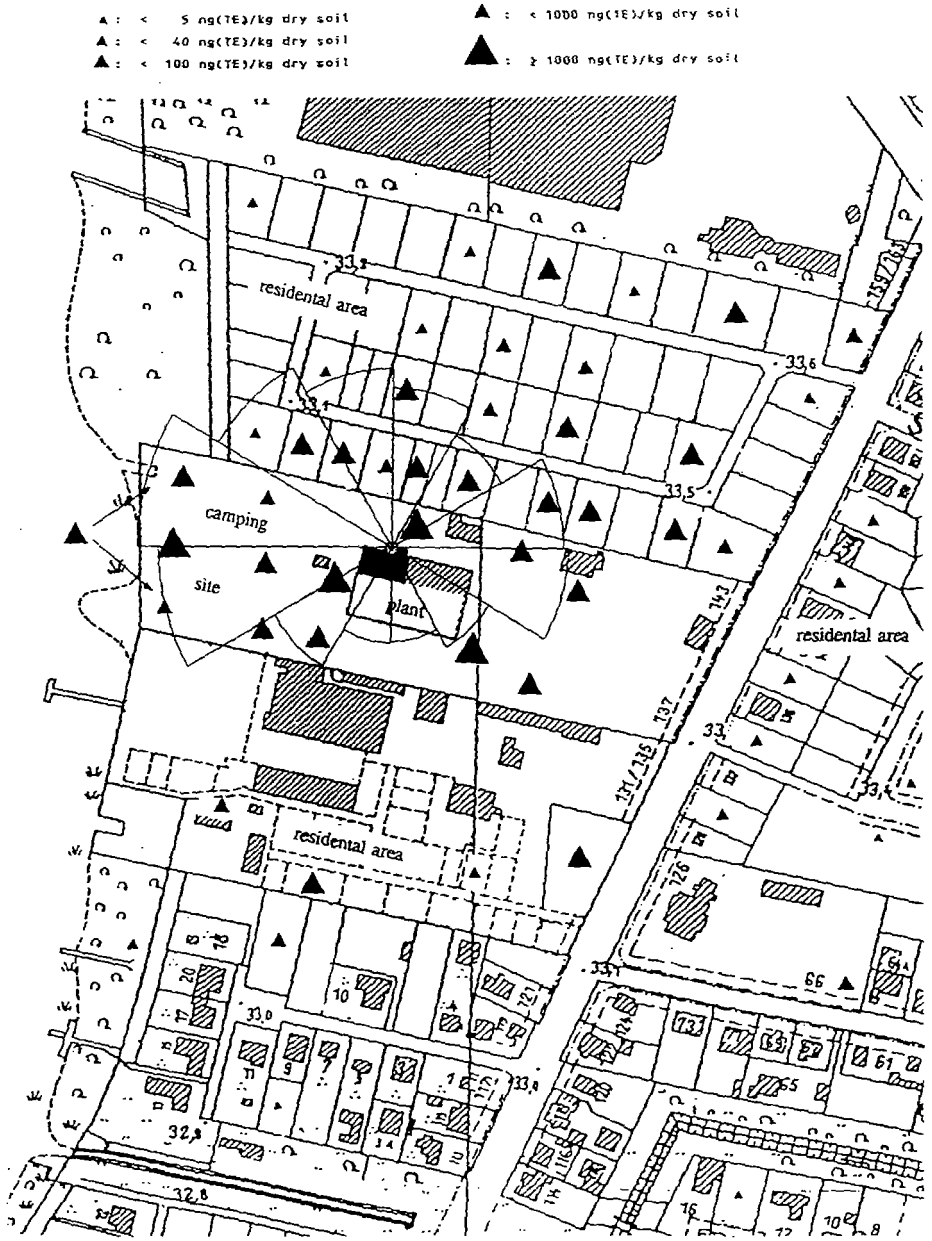
Results

The highest amounts of PCDD/PCDF were found in the samples from the area of the plant, as expected. The highest burden of 4958 ng/kg PCDD/PCDF (TE) was found in the dust sample from the plant. The other samples derived directly from the plant area, amounted to 1646 ng/kg (sand-heap), 948 ng/kg and 405 ng/kg (soil) PCDD/PCDF (TE). Up to a distance of 150 m, the area in the vicinity of the plant is highly contaminated with PCDD/PCDF with amounts up to 100 ng/kg (TE) and much higher. Especially soils at the camping place and the residential area show contaminations above 40 ng/kg, the limit for growing vegetables. Having 89 resp. 30 ng/kg (TE), both compost enriched soils lie clearly under the untreated soils in the same site (203 resp. 89 ng/kg (TE)), but on the other hand above the limit for unrestricted agricultural use (5 ng/kg (TE)). As can be expected, PCDD/PCDF - burdens

Tab. 1: Samples from the area and vicinity of a cable pyrolysis plant

	dust [ng/kg]	sand-heap [ng/kg]	soil [ng/kg]	soil [ng/kg]	camping site [ng/kg]	camping site [ng/kg]	resident. area [ng/kg]	resident. area [ng/kg]
2378-TetraCDD	69	22	11	5,9	23	9,5	9	1,7
12378-PentaCDD	261	148	30	31	117	28	30	17
123789-HexaCDD	1466	621	166	89	344	142	167	79
123678-HexaCDD	1255	602	180	87	354	106	136	44
123478-HexaCDD	474	432	55	36	204	25	59	37
1234678-HeptaCDD	13958	3521	2604	679	3820	807	1420	522
2378-TetraCDF	1079	380	272	98	464	119	216	101
12378+12348-PentaCDF	2056	1182	913	366	1101	442	891	500
23478-PentaCDF	2891	901	568	331	1086	248	584	218
123478+123479-HexaCDF	10994	3693	2151	1025	5101	1253	2343	946
123678-HexaCDF	6149	2011	1672	549	2236	719	1453	620
123789-HexaCDF	723	127	109	4,7	84	42	143	35
234678-HexaCDF	6997	2042	795	446	2097	533	908	365
1234678-HeptaCDF	48423	11009	5026	2672	13207	2872	7059	2443
1234789-HeptaCDF	3098	1132	1057	447	2070	336	1434	423
Sum TetraCDD	2526	835	319	130	1527	230	344	143
Sum PentaCDD	6299	2709	767	256	2844	599	744	405
Sum HexaCDD	13080	5073	1512	913	5036	1111	1462	622
Sum HeptaCDD	26987	6401	4419	1257	7224	1543	2368	991
OctaCDD	44694	15591	10304	2908	10850	1895	4387	1505
Sum PCDD	93585	30609	17321	5464	27481	5378	9303	3666
Sum TetraCDF	10375	4287	2299	1009	5989	1430	2190	1014
Sum PentaCDF	25001	8245	7436	1959	13731	3194	5995	2672
Sum HexaCDF	46264	12788	8440	3367	18443	4328	9358	3217
Sum HeptaCDF	69355	16437	8839	4060	20639	4230	11664	3959
OctaCDF	33449	13605	5901	4487	16353	3240	13247	3772
Sum PCDF	184443	55362	32915	14872	75155	16423	42454	14633
Sum PCDD+PCDF	278029	85971	50237	20336	102636	21802	51758	18300
tox.Equivalents (BGA)	4958	1646	948	405	1912	495	955	390

Fig. 1: Survey of the examination area around a cable pyrolysis plant



become smaller with increasing distance to this plant. The soil profiles show the contamination to be reduced 10-fold each step. Figure 1 gives a survey of the investigation area. The sample collection points with high burdens are marked. Table 1 shows the results of the highest contaminated samples. Additional to the map of the investigated area a 'compass card' is included, which illustrates the frequency of distinct directions of the wind.

Discussion

Dioxin emissions for the outlet to Air Pollution Control (APC) of secondary copper plants are cited in literature (1) with

* 27 - 1421 ng/dscm (dry standard cubic meter) 7 % O_2 (scrap insulated copper and aluminium wire, reclamation with afterburner for APC)
* 7610 - 12100 ng/dscm 7 % O_2 (copper and other metals, recovery from scrap, telephone and circuit boards, with afterburner and baghouse for APC).

The sources for PCDD/PCDF - production are suspected mainly to be PVC, which is present in large amounts in the cable covering. Copper recycling by cable pyrolysis seems to offer optimal conditions for PCDD/PCDF - generation. Other recycling processes which gather PVC or other organics (plastics etc.) and chlorine (e.g. hydrogene chloride) under high temperature (secondary aluminium smelters, scrap recycling within steel and iron processing) are probably dioxin - producers, too.

References

(1) Visalli R.: The similarity of environmental impacts from all methods of managing solid wastes. Presented at the Municipal Solid Waste Technology Conference, San Diego, California, 30.1.-1.2.1989

(2) Bericht über Bodenuntersuchungen auf polychlorierte Dibenzodioxine (PCDD) und Dibenzofurane (PCDF) in der Umgebung der Kabelverschwelungsanlage in B. ITU - Forschung, Bericht Nr. 90/10 30.3.1990