THE FATE OF PCDD/PCDF IN DIFFERENT TYPES OF SLUDGE PITS

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Introduction

Burial of dioxin-containing waste as most toxic one requires specially equipped storages. In reality thousands of tons of dioxin-containing sludge and slit have been concentrated in the territories of chlororganic synthesis plants in sludge pits and sludge drying beds where they have been stored in the open air for scores of years and have been exposed to the impact of different environmental factors. Sludge and slit in their turn are a strong source of secondary pollution for the ground water and the air. In this connection a most acute problem is studying the processes going on in sludge pits and risk assessment of their impact on the environment.

Earlier the processes going on in sludge pits of the plant "Ufachimprom" have been studied[1] and it has been found that during long storage the following processes may take place: PCDD/PCDFs migration and microbiological formation of highly chlorinated PCDD/PCDFs and their subsequent dechlorination accompanied by formation of toxic 2,3,7,8-TCDD/TCDF.

The aim of this study is determination of PCDD/PCDFs in the sludge sampled from different depths of the sludge pit at the plant "Caustic" Joint-Stock Company (Sterlitamak, Russia) and assessment of its impact on the environment.

Methods and Materials

The object for study was a sludge pit at the plant "Caustic" that had been functioning from 1980 to 1997. The sludge pit consists of slit sediment produced by biological treatment facilities and besides it is characterized by the fact that acid waste water from a chlororganic waste incinerator containing PCDD/Fs polluted soot was discharged periodically to this sludge pit. The sludge was sampled according to the usual scheme of sampling the soil: from 3 different depths of 0-5cm, 0.5m and 1.2m with the Rozanov sampler. Sludge samples were dried in the open air, ground, partitioned and prepared for analysis. A soot sample was obtained by filtering acid waste water of the incinerator. The samples were analyzed in compliance with recommendations of EPA US Methods 1613 and 8280. Chromato-mass spectrometer INCOS 50 produced by Finnigan MAT with a gas chromatograph Varian 3400 and a silica capillary column (30x0.25mm) with a stationary phase DB-5 MS was used for this work.

Results and Discussion

Results of analyzing the sludge sampled from different depths of the sludge pit are given in the table. Sludge sample equivalent toxicity is from 24.72 to 38.33 ng TEQ/g and equivalent toxicity is maximum on the surface of the sludge pit.

PCDD/PCDF isomer profile of sludge corresponds to that of incinerator waste water both by the number of isomers and by percentage. Figure 1 shows percentage of isomers in fresh scrubber water from the incinerator and in sludge from the sludge pit that has been stored there for a long time, more than 15 years. The figure demonstrates that there is no change in percentage what testifies to the fact that no processes of PCDD/PCDF degradation have taken place in this sludge pit for a long period of

Table 1. Isomer composition and equivalent toxicity of sludge samples from the sludge pit and of soot samples of the incinerator waste water.

Isomers of PCDD/PCDF	Soot sample	Sludge samples		
		0-5cm	0.5m	1.2m
2,3,7,8-TCDD	ND	ND	ND	ND
1,2,3,7,8-PcCDD	43,9	8,3	8,2	7,1
1,2,3,4,7,8-HrCDD	32,7	4,0	4,6	4,2
1,2,3,6,7,8-HrCDD	36,1	6,6	5,0	6,3
1,2,3,7,8,9-HrCDD	34,2	5,8	4,8	4,3
1,2,3,4,6,7,8-HpCDD	615,3	98,5	37,3	40,6
OCDD	3193,7	559,2	226,2	280,3
2,3,7,8-ICDF	161,2	53,1	9,1	12,0
1,2,3,7,8-PeCDF	76,3	30,2	11,4	21,4
2,3,4,7,8-PeCDF	70,2	26,1	15,3	16,7
1,2,3,4,7,8-HrCDF	435,7	70,5	48,8	46,1
1,2,3,6,7,8-HrCDF	306,3	41,9	36,8	38,4
1,2,3,7,8,9-HrCDF	182,5	23,1	20,4	21,2
2,3,4,6,7,8-HrCDF	101,0	13,5	8,7	11,1
1,2,3,4,6,7,8-HpCDF	1583,2	427,3	336,0	351,6
1,2,3,4,7,8,9-HpCDF	1053,8	216,5	65,5	60,1
OCDF	6724,3	1513,5	840,9	880,3
TEQ, ng/g	**255,7**	**38,3**	**24,7**	**25,5**

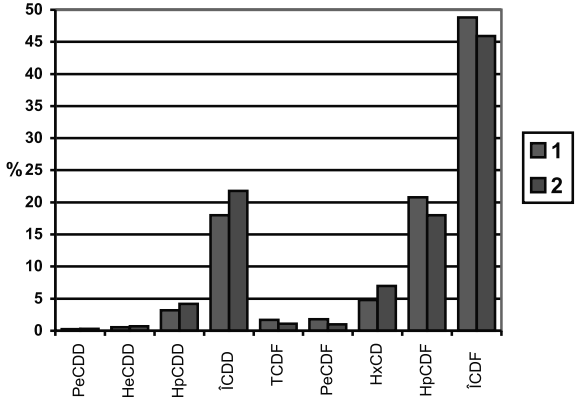

Figure 1. Percentage of PCDD/PCDF isomers in sludge samples (1) and soot of incinerator waste water (2).

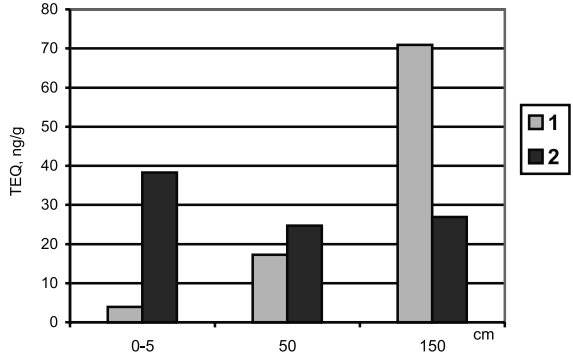

Figure 2. Comparison of change in sludge equivalent toxicity at the plant "Ufachimprom" (1) and at the plant "Caustic" (2) depending on the depth of sludge occurrence.

storage. It also may be noted that no decrease of PCDD/PCDF isomer number takes place as well as no increase of sludge equivalent toxicity occurs (Figure 2) as it was in case of long storage of sludge at the plant "Ufachimprom" [1].

As waste water represents by itself a concentrated solution of hydrochloric acid the surface of the sludge pit polluted area is never overgrown with vegetation, so there is a risk of PCDD/PCDF air pollution by means of the wind spreading soot and sludge particles.

Conclusions

Thus the following conclusions may be made:

- The sludge pit under study is a source of secondary pollution of the environment by PCDD/PCDF, the main impact being the air pollution with soot and sludge particles spreading by the wind from the surface.
- Migration processes do not take place in this sludge pit. This may be accounted for by strong retention of PCDD/PCDF on soot particles.
- Processes of biochemical formation out of precursors of dioxins and biochemical dechlorination also do not take place despite the fact that the main bulk of the sludge pit is excess sludge. A limiting factor in this case is acid medium – to pH = 2 when biochemical processes are impossible.

References

1. Khizbullin F., Muslimova I. Studying the fate of PCDD/PCDFs in sludge pits during long storage // Organohalogen Compounds. - 2001. – V. 52. – P. 451-454.