

ENVIRONMENTAL PICTURE OF PCDD/FS POLLUTION OF RECEIVING ENVIRONMENTS AND REPRESENTATIVES OF NATURAL ECOSYSTEMS IN IMPACT, BUFFER AND BACKGROUND AREAS

Zarema Amirova*, Natalia Kuramshina**, Edvard Kruglov*

*Environmental Research Centre of the Republic of Bashkortostan, 147, October Av., 450075, Ufa, Russia

**Research Institute of Secure Life Activity, 12/1, 8 marta St., 450005, Ufa, Russia

Introduction

Production of phenoxyherbicides results in persistent PCDD/Fs pollution of the manufacturing plant territory and buffer areas. In the city of Ufa (Bashkortostan) 2,4,5-T (1965-1967) and TCP (1964-1987) were produced out of 1,2,3,4-tetrachlorbenzen. Due to this fact the level of soil and sludge pollution in old sludge pits is now from 0.6 to 15 ppb (TEQ). [1].

Industrial waste of 2,4,5-T and TCP production was buried close to the plant and now it remains a permanent source of dioxin pollution of the environment. PCDD/Fs concentration in soil, mud and sludge reaches 200 ppb (TEQ). The soil and sludge contain large amount of decomposition products (phenols, chlorphenols, phenoxyherbicide decomposition products).

The impact zone of the plant has some peculiarities: extremely high level of PCDD/Fs pollution, limited area. Inevitable decay of biological organisms in the plant territory occurs due to a complex impact, and primarily to the impact of chlororganic compounds. A study of PCDD/Fs biological accumulation by representatives of different systematic groups of animals was carried out to evaluate accumulation of PCDD/Fs isomers.

This research studies the level of pollution and PCDD/Fs biological accumulation by representatives of different systematic groups of animals in industrial production places, in adjacent and distant areas.

Objects and Methods

PCDD/Fs accumulation was studied on *Lumbricus terrestris*, *Porcellio porcellio*, *Rana ridibunda*, *Mus musculus* in background, buffer and impact areas.

PCDD/Fs determination was carried out by the methods of HRGC/HRMS, HRGC/LRMS in compliance with EPA 1613, 8290 (Autospec-Ultima, TRIO-1000). Samples preparation was performed according to the methods described in [3, 2]. The MDL was 1 ppt for biosamples, 0.1 ppt for soil and 1 ppq for water.

I-TEQ PCDD/Fs was calculated for soil and bottom sediment in conversion for dry weight, for biological tissue – lipid component. Biological accumulation coefficient (index) was determined by relation of PCDD/Fs concentration and TEQ of the sample to PCDD/Fs concentration in the environment.

Results and Discussion

The state of biota in the impact zone is adequate to the level of chemical load. Table 1 presents the results of PCDD/Fs content in biological tissue, soil and bottom sediment in the chemical plant territory and in the industrial landfill site.

PCDD/Fs accumulation in the impact and buffer zone have been studied. Biological accumulation coefficients (K_b), mean values (by TEQ) for isomers have been calculated: 6.7 (*Mus musculus*), 5.0 (*Rana ridibunda*), and 5.5 (*Lumbricus terrestris*).

Regularities of PCDD/Fs isomer bioaccumulation in populations of soil organisms living for a long time under conditions of strong pollution have been stated. Bioaccumulation is isomer specific. Maximum value of K_b has been found for low chlorinated isomers of dioxins and furans. The content of hexa-isomers in *Mus musculus* has been increased. In the impact zone (landfill site for toxic waste >200 TEQ ng/g) the maximum level in living organisms has been 15-25 ng/g.

Bioaccumulation in the buffer zone corresponds to the found regularities with TEQ increase in biota samples by 3-5 times as compared to the ambient soil. K_b for tetra- and penta-chlorinated isomers is on the average by 10-20 times higher than for octa-isomers. No selective concentration has been found for *Porcellio porcellio* living in the impact zone where K_b is 0.6-1.2 as compared to the soil.

References

1. Amirova Z, Kruglov E; Situation with dioxins in the Republic of Bashkortostan (Dioxins in the environment, impact on humans and immunology aspects of dioxin impact at the background level and in cohort groups). Ufa, 1998, 115 p.p. (in Russian)
2. Amirova Z, Kruglov E, Loshkina E, Chalilov R; Organohal. Compounds, 1997, 32, 107
3. Loshkina E, Amirova Z, Chalilov R, Zhukova R; Organohal. Compounds, 1998, 35, 25

Figure 1. Relation of PCDD/Fs concentration in soil and sludge (C_s , pg/g of dry weight) and biota (C_b , pg/g of dry weight); I – background level, II – buffer zone, III – impact zone, IV – extreme pollution

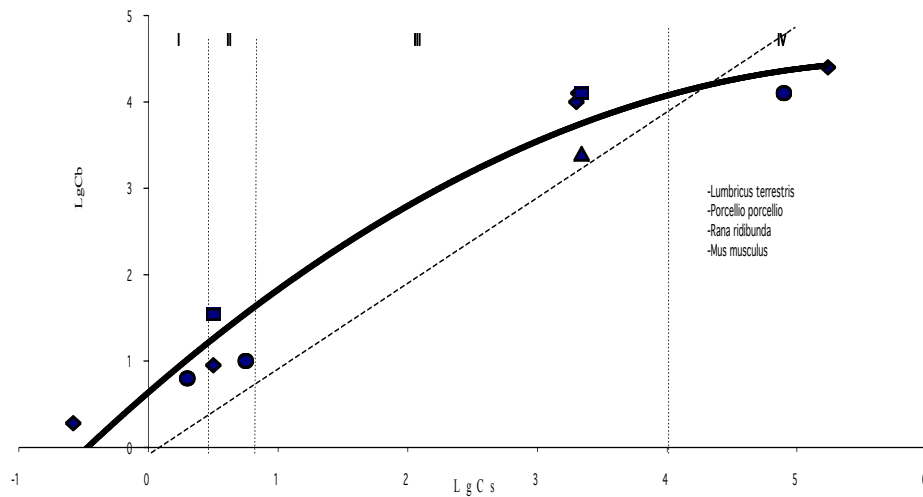


Figure 2. Coefficients of PCDD/F isomers bioaccumulation in living organisms at the background and mean pollution levels, $K_b = C_b$ (pg/g of dry weight)/ C_s (pg/g of dry weight).

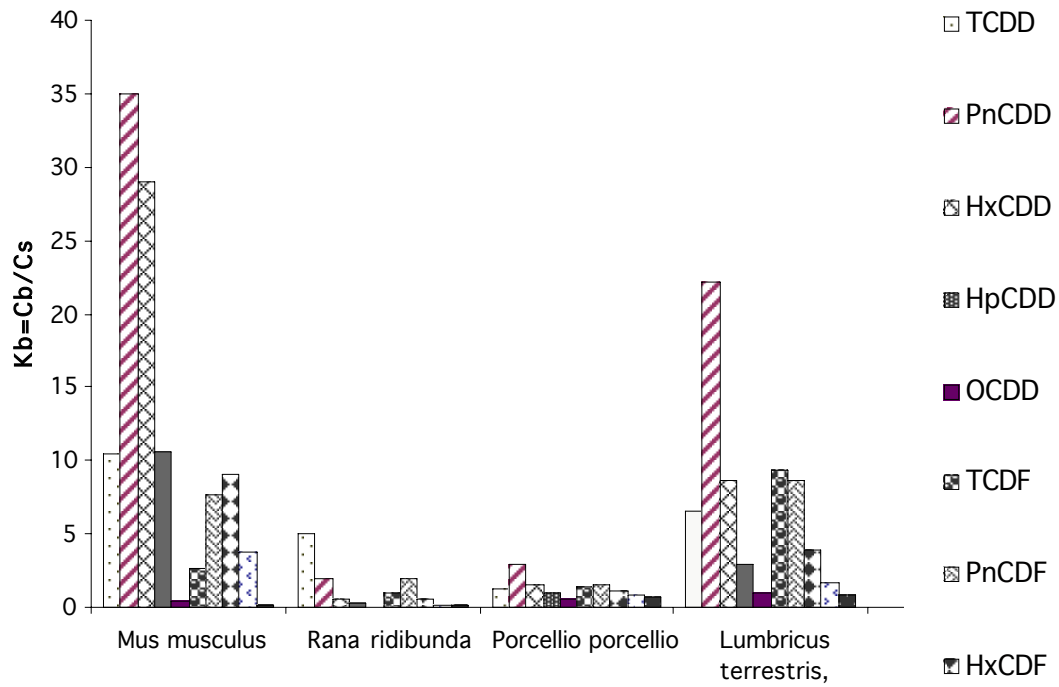


Table 1. PCDD/Fs content in animal organisms and environmental objects within the area of strong and extreme pollution.

PCDD/Fs	Soil, ng/kg d.w.	Lumbricus terrestris, pg/g lipids	Mus musculus, pg/g lipids	Sludge, ng/kg d.w.	Lumbricus terrestris, pg/g lipids	Bottom sediment, ng/kg d.w.	Lumbricus terrestris, pg/g lipids	Rana ridibunda, pg/g lipids
2378-TCDD	993.6	7446.1	695.6	2705.4	11308.8	130000	20607	10933
12378-PnCD D	283.5	2475.7	9912.4	13945.5	2347.9	30172	10000	654
123478 - HxCDD	139.9	910.8	1417.3	292.2	250.1	5124	512	44
123678 - HxCDD	254.8	585.5	7139.2	5935.8	827.5	14432	1515	116
123789 - HxCDD	136.6	280.1	6692.1	2561.9	258	8071	2157	36
123467 8- HpCDD	1476.3	1511.9	15677.5	8383.8	962	34852	2988	116
OCDD	64000	33333.3	24636.1	40819.3	7351.3	1050000	92190	736
2378-TCDF	536.4	4107.6	248.1	ND (2.5)	ND (15)	10000	5000	230
12378-PnCDF	352.8	1868.7	88.1	329	605.7	12400	6717	101
23478-PnCDF	362.2	1098.7	5538.5	336.2	572	27030	3283	627
123478 - HxCDF	2616	5124	9080.5	831.1	613.5	34450	2828	172
123678 - HxCDF	357.4	166.1	11198.2	836	365.7	21030	1475	98
123789 - HxCDF	217.9	143.5	243.7	114.6	97.2	8450	308	ND (6)
234678	252.6	426.6	8111.1	780.4	261.8	110000	5389	133

- HxCDF								
123478 9- HpCDF	1845.4	1354.3	2047.2	190.9	148.8	28620	22777	42
OCDF	58000	30515	7297.1	16190.3	9799.2	1300000	184382	1278
TEQ, pg/g lipids	1983	10637	13327.8	11179.6	13120.3	207000	23680	11714

