Dioxins in Russia. III. Chuvash Republic.

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Introduction

The Chuvash Republic is situated in the middle reaches of the Volga river with the capital in the city of Cheboksary. There is a plant "Khimprom" not far from the city (Novocheboksarsk). Phenoxy herbicides have never been produced by this plant.

In 1996 we carried out determination of PCDD/Fs in sludge pits and in active sludge of biological treatment facilities of this plant. It was found that PCDD/Fs content was within the range of 142-193 ngTEQ/kg of dry weight (in sludge pits) and from 11 to 72 ngTEQ/kg of dry weight in active sludge.

On the basis of this data in 1997 an extended study of the area and the population of Novocheboksarsk and workers of this plant was carried out. The examination was performed at the Environmental Research and Protection Centre by the initiative of the Novocheboksarsk authorities and financed by the municipal Environmental Fund.

Objects and Methods

For the assessment of the impact of "Khimprom" discharge on PCDD/Fs contamination of the plant area and the city territory, and also on the urban population and the plant workers the individual whole blood samples were taken from 5 donors - workers at the age of 27-43, and also a pool blood sample of 5 teenagers at the age of 14 (by 30 ml of whole blood), adipose tissue from belly of two dead workers, 70 and 29 years old, were collected. The cause of death of the elder worker was unknown, the younger died of an accident.

A pool sample of breast milk was taken from 5 women (the average age was 22 years) in a week after the labour, by 50 ml from each woman.

All samples of biological tissue had been frozen at -18°C and kept in this state up to the time of analysis.

Lipids from whole blood were extracted by the mixture of hexane and diethylether, from adipose tissue - by the mixture of methylene chloride and hexane, and from breast milk – by the mixture of acetone and hexane.

Purification of the extracts was carried out with the use of a modified silica gel column, a column with basic alumina and graphitized carbon black (Carbopack-C/Celit 545).

Control of the degree of extraction, of purification level and calibration of the measurement system were performed in compliance with the methods of EPA 1613 (1).

PCDD/Fs extraction from biological samples was 59-98%, MDL – 0.3-1.5 ppt, depending on isomers.

The system of measurement HRGC/HRMS consisted of a chromatograph Carlo Erba 8035, a high resolution spectrometer Autospec-Ultima (10000-12000); column DB-5, J&W, 60 m were used. Data collection was performed by selected ion monitoring (SIM).

Results and Discussion

Table 1. PCDD/Fs concentration in whole blood samples of "Khimprom" workers (Novocheboksarsk) and teenagers, pg/g lipids (ND=1/2 MDL).

PCDD/Fs	w.1, male age-27	w.2, female, age-33	w.3, male, age-39	w.4, female, age-39	w.5, male, age-43	teenagers, n=5, age-14
2378-TCDD	1.84	1.85	ND(1)	2.32	1.67	ND(1)
12378-PnCDD	ND(0.6)	ND(1)	6.25	4.95	4.27	4.25
123478-HxCDD	ND(0.2)	1.5	4.38	4.79	1.71	ND(0.5)
123678-HxCDD	2.48	3.4	8.93	5.36	4.26	7.46
123789-HxCDD	ND(0.2)	1.1	2.79	2.73	1.39	ND(1)
1234678-HpCDD	7.8	9.6	14.25	13.61	7.06	24.03
OCDD	29.2	62.5	67.12	67.47	39.33	76.43
2378-TCDF	ND(1)	0.5	2.96	2.3	1.96	5.67
12378-PnCDF	1.48	2.3	3.95	6.19	1.4	8.88
23478-PnCDF	8.4	9.6	18.19	16.34	10.07	5.21
123478-HxCDF	6	6.05	12.22	15	8.26	12.36
123678-HxCDF	8.36	3.5	7.78	8.35	5.82	8.66
123789-HxCDF	ND(2)	ND(1)	4.27	3.14	1.81	4.18
234678-HxCDF	ND(1.4)	ND(1)	6.3	6.36	3.12	9.93
1234678-HpCDF	7.68	6.55	12.27	13.81	8.07	15.37
1234789-HpCDF	ND(0.4)	ND(0.6)	2.86	3.61	1.79	2.09
OCDF	7.72	3.9	12.68	12.47	16.02	17.09
TEQ, PCDDs	**2.54**	**3.11**	**5.89**	**6.28**	**4.66**	**4.35**
TEQ, PCDFs	**6.23**	**6.03**	**11.72**	**12.19**	**7.34**	**7.31**
TEQ, PCDD/Fs	**8.77**	**9.14**	**17.61**	**18.47**	**12**	**11.66**

Table 2. PCDD/PCDFs in adipose tissue samples of "Khimprom" workers, Novocheboksarsk women breast milk and cow whole milk.

PCDD/PCDFs	Adipose tissue		Breast milk	Cow milk
	male, age-29	male, age-70	N=5, age-22	
2378-TCDD	3.16	14.44	2.07	ND(0.1)
12378-PnCDD	3.7	6.45	1.16	0.52
123478-HxCDD	2.59	4.24	1.18	0.18
123678-HxCDD	3.76	8.82	2.57	0.2
123789-HxCDD	0.86	2.2	0.82	0.13
1234678-HpCDD	5.96	11.41	3.38	0.63
OCDD	35.92	67.7	18.31	1.75
2378-TCDF	2.03	2.15	2.07	ND(0.1)
12378-PnCDF	1.37	2.51	2.06	0.44
23478-PnCDF	7.18	22.81	7.41	0.91
123478-HxCDF	3.6	10.85	3.57	0.59
123678-HxCDF	2.16	7.46	2.08	0.39
123789-HxCDF	0.34	0.64	0.4	ND(0.1)
234678-HxCDF	1.06	3.01	1.18	0.39
1234678-HpCDF	3.08	4.55	2.57	0.54
1234789-HpCDF	0.43	0.44	0.44	0.13
OCDF	1.58	1.54	0.97	0.62
TEQ, PCDDs	**5.89**	**19.37**	**3.16**	**0.42**
TEQ, PCDFs	**4.61**	**13.99**	**4.79**	**0.65**
TEQ, PCDD/Fs	**10.44**	**33.32**	**7.95**	**1.07**

The soil samples taken in the territory of "Khimprom" and near it contained insignificant amount of PCDD/Fs: 0.7-0.8 ngTEQ/kg of dry weight. 2,3,7,8-TCDD was not detected

The sample from newly filled sludge pit contained 87 ngTEQ/kg of dry weight (2,3,7,8-TCDD < 1ng/kg), however, the whole group of furan compounds was represented there (from 85 ng/kg of 2,3,4,7,8-PnCDD to 2840 ng/kg of OCDD).

The sample from the sludge pit filled 15 years ago did not contain PCDD at the detection level and contained PCDD by 10 times lower than the first sample (I-TEQ = 4 ng/kg).

Figure 1 shows the dependence of TEQ PCDD/Fs in blood, human milk and fat samples on the donor age.

We think that the data on research in Novocheboksarsk and the examination of "Khimprom" workers show that there is no specific PCDD/Fs contamination and the levels are close to those of Russia (2).

The content of PCDD/Fs, and, especially, of 2,3,7,8-TCDD in biological tissue is much lower than in other industrial centres of Ural and Povolzhie, such as Ufa, Ekaterinburg, Kirovgrad, Nigny Tagil, Syktyvkar, and others (3).

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References

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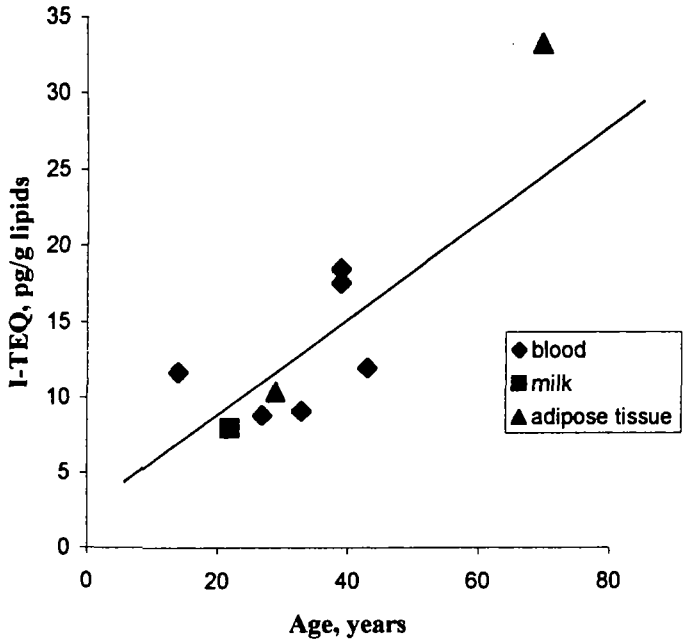

Figure 1. Age depending I-TEQ curve.