

Z. Amirova

PCDD/Fs pollution in Russian regions (Urals, Volga region, Far East and Siberia)

Review of research made by Environmental Research & Protection Center, Ufa, Russia

Background document for the 2nd Technical Workshop of UNEP/GEF Project Regional
Based Assessment of Persistent Toxic Substances - Region III - Europe

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Research works that are reviewed in the given report have been carried out by the Environmental Research&Protection Center (BREC) in 1996-2002 in compliance with the republican program "Dioxin", some stages of the federal program of the Russian Federation "Protection of the environment and population against dioxins and dioxin-related toxicants for 1996-1997", the program of international cooperation (CEC International Partners "North American-Russia Workshop on Joint Actions to Reduce Dioxin and Dioxin-Related Compounds", USEPA grant #82769701a, according to the task set by sanitary and epidemiological inspection of Republic of Komi, Chuvashia, Udmurtia, Sverdlovsk, Irkutsk, Perm, Ulyanovsk regions, Primorskyi kray and the same enterprises (Nizhny Novgorod, Volgograd), by the order of the Ministry of Emergencies and Green Peace of Russia.

1. Republic of Bashkortostan.

The area of Republic of Bashkiria is 143.6 thousand sq. km, about half of the area are agricultural, 4.8 million hectares of arable lands and 6.2 million hectares of forests. The area is of a complicated landscape, great variety of climatic conditions, vegetation and soil covering. There are 1120 rivers with total extension of 20 thousand km, 2720 lakes and 25.5 million cubic m of surface water is formed. Natural water intake is 1210 million cubic m, 1143 million cubic m are used for economic needs. Surface waters are polluted with oil products, phenol, ammonia and nitrite nitrogen, copper, manganese, and mercury. Natural water pollution with manganese is of natural character; the background concentration in surface water is 0.16 mg/l. The volume of the wastewater in the region is 718 million cubic m including 565 million cubic m of polluted wastewater.

There are 20 cities in the region, 40 urban-type villages, 54 agricultural districts; the population is over 4 million people. Ufa is a capital of Bashkiria (more than 1 mln people). The industry (oil-refining, petrochemical, metallurgical, chemical fertilisers) has a considerable impact on the environmental pollution. Emissions into the air are 1478 thousand tons including 120 thousand tons of hydrocarbons, 120 tons per year of chlororganic substances, 0.5 tons per year of chlorine.

Risk zones of dioxin pollution in the Republic of Bashkortostan are, first of all, the territories near the oil-chemical plants situated in the north part of the city of Ufa, a part of which (Khimprom) is located in close vicinity with the residential area. Among the examined cities there are industrial centres with plants of oil chemistry, basic organic synthesis (Ufa, Sterlitamak, Salavat), metallurgy (Kumertau, Beloretsk) and small towns with no industrial load.

As a result of polychlorinated phenols and phenoxyherbicides production during 1960-1980s a zone of high pollution with PCDD/Fs appeared, PCDD/Fs concentration reaching 200 ng/g in soil and sludge/ PCDD/Fs are spreading with suspended particles of emissions, dust, wastewater and ground water

over the adjoining areas forming a trace of spreading (up to 10000 m), they have their impact on the urban area creating a higher background in environmental objects, biota and human tissues by 3-5- times exceeding the background level of the region.

Objects and number of PCDD/Fs sampling in the Republic of Bashkortostan (1996-2000)

Objects	Background level	Buffer level	Impact zone
Drinking water	20 samples from 7 districts	250 samples from 9 sites	10 samples
Ground water	16 samples from lakes and rivers	17 samples from lakes and rivers	15 samples sewage
Soil	70 samples from 8 districts	32 samples from 5 cities	40 samples
Sediments	4 samples from lakes and rivers	3 samples from rivers	14 samples
Snow	12 samples	37 samples from 5 cities	18 samples
Vegetation	15 samples (12 pool)	10 pool samples	3 pool samples
Biota	12 pool samples	5 pool samples	5 pool samples
Meat of animals	20 samples from 14 districts	3 samples	-
Cow milk	18 samples from 18 districts	-	-
Food	10 samples (5 tips)	76 samples (20 tips)	-
Blood	15 samples from 153 donors from 11 districts	71 samples from 265 donors from 11 cities	75 individual samples
Adipose tissue	-	8	-
Breast milk	12 samples from 24 donors from 12 districts	26 samples from 44 donors	-
total– 937	219	538	180

PCDD/Fs in the Environment of Bashkortostan.

Drinking and ground water. During 1994-1999 more than 350 drinking water samples were collected in Ufa and other regions of the region. TEQ in none of measurements does not exceed 1 ppq. The tap water samples from rural regions beyond the Urals may be considered as being background, here only the OCDD is detected on the 0.3-0.5 pg/l. In river water samples the PCDD/Fs content is higher and achieves the value of 5 ppq. (Amirova et.al. Organohal. Comp. v. 32, 1997, p.107-110)

Calculated daily intake from drinking water is 1,3 pg/day (< 1% from total exposure).

Bashkiria is a region with stable snow coat during 5 month. Snow as a matrix can be applied in determination the contamination by way of PCDD/Fs precipitation with dust and aerosol particles from the atmosphere.

PCDD/Fs in snow, pg/l

PCDD/Fs	45 km from Ufa, 1996, n=2	Urban area, 1996, n=5	Roads, 1997, n=6	200 m from Khimprom, *	
				1996, n=7	1998, n=5
2378-TCDD	ND(0,2)	0,44±0,19	42,6±55,6	6,1±2,6	4,9±1,9
12378-PnCDD	ND(0,1)	0,35±0,2	79,2±145,2	15,5±8,1	4,9±2,7
123478-HxCDD	ND(0,3)	0,75±0,07	115,2±226,8	5,0±1,7	1,5±0,7
123678-HxCDD	0,61	0,65±0,07	14,5±21,6	11,9±5,6	3,0±1,9
123789-HxCDD	ND(0,3)	0,75±0,21	44,6±60,9	9,2±4,0	2,3±2,1
1234678-HpCDD	0,96	1,92±0,1	147,2±174,9	47,8±24,0	13,6±8,9
OCDD	2,13	9,52±0,1	944,4±1443,7	210,4±108,4	145,0±156,2
2378-TCDF	ND (0,1)	1,72±0,17	47,4±47,3	8,0±2,0	9,7±6,9
12378-PnCDF	0,93	1,58±0,37	26,3±32,7	7,4±2,9	7,2±6,1
23478-PnCDF	1,28	1,83±0,15	62,3±77,3	9±2,6	9,8±6,3
123478-HxCDF	1,73	1,68±0,1	106,8±117,0	14,3±3,8	10,9±5,6
123678-HxCDF	1,09	0,65±0,07	56,4±6,73	7,9±1,6	4,1±2,5
123789-HxCDF	0,67	0,88±0,4	34,5±43,5	4,5±0,8	3,9±1,8
234789-HxCDF	1,0	1,09±0,01	51,0±64,9	9,3±2,4	3,8±1,8
1234678-HpCDF	2,4	3,7±1,8	471,6±634,6	69,1±31,9	16,7±9,3
1234789-HpCDF	0,7	0,88±0,17	57,1±74,7	6,5±2,2	3,2±1,7
OCDF	1,73	4,3±0,4	831,6±178,88	172,7±92,5	54,7±64,9
I-TEQ, PCDD, pg/l	0,38	0,86±0,05	99,3±150,8	17,4±8,2	6,4±4,1
I-TEQ, PCDF, pg/l	0,9	1,69±0,09	68,3±82,2	8,3±2,4	5,8±3,2
I-TEQ, PCDD/Fs, pg/l	1,28	2,54±0,04	167,6±182,3	25,4±7,9	15,9±8,2
TEQ, pg/m2	30	70	9000	800	300
TEQ, pg/m2/day	0,08	0,19	25	2,2	0,83

*- Khimprom territory; 1995.; n=5; 2,3,7,8-TCDF = 241,3±145,2 pg/l.

PCDD/Fs intake by inhalation in region is - 1,8 pg/day (rural), 4,5 pg/day (urban) or 1,5-2,5% from totals daily intake.

PCDD/Fs in soil (ng/kg)

PCDD/Fs	Game reserve, national parks, n=5	Rural area, n=67	Urban area, n=32	200 m from Khimprom, n=4
2378-TCDD	ND(0,05)	ND(0,06)	0,87	109,0
12378-PnCDD	ND(0,01)	ND(0,01)	0,16	60,0
123478-HxCDD	ND(0,03)	ND(0,02)	0,74	37,2
123678-HxCDD	0,12	0,19	ND(0,06)	36,4
123789-HxCDD	0,07	0,37*	0,19	22,5
1234678-HpCDD	0,27	0,41*	14,1	128,1
OCDD	0,62	2,3**	81,1	2997,6
2378-TCDF	0,03	ND(0,01)	3,52	37,7
12378-PnCDF	ND(0,02)	ND(0,03)	1,3	55,3
23478-PnCDF	ND(0,05)	ND(0,09)	1,48	55,2
123478-HxCDF	0,12	0,14	2,07	73,34
123678-HxCDF	0,15	0,22	ND(0,08)	32,26
123789-HxCDF	ND(0,1)	0,21	1,4	37,7
234789-HxCDF	ND(0,03)	0,15	1,42	44,0
1234678-HpCDF	0,09	0,47**	15,72	227,7
1234789-HpCDF	ND(0,1)	0,25**	2,24	21,7
OCDF	0,31	1,91**	8,6	2294,5
I-TEQ, PCDD	0,09	0,13*	1,33	152,9
I-TEQ, PCDF	0,06	0,22**	1,91	54,28
I-TEQ, PCDD/Fs	0,15±0,1	0,25±0,15	3,24±0,73**	207,2±10,7**

* (p<0,05), ** (p<0,01)

The contamination of impact zone.

The main source of dioxin contamination in Ufa is the plant Khimprom.

For 55 years of the plant operation several chlororganic products have been manufactured at large scale – 2,4-D, 2,4,5-trichlorphenol and trichlorphenolate of copper, orthochlorphenol. In 1964-1967 production of butyl ether of 2,4,5- trichlorphenoxyacetic acid was organised. Industrial buildings where these chemicals were produced still exist and they remain hazardous in terms of dioxin pollution.

2,4,5-trichlorphenol and 2,4,5-trichlorphenolate of copper were produced in 1962-1987, 100-120 tons and 35 tons per year respectively. 2,4,5-TCP was produce by saponification of 1,2,4,5-tetrachlorbenzol with methanol solution of alkali. Samples of technical 2,4,5-TCP contained up to 0.65 mg/kg of 2,3,7,8-TCDD. Dioxin affection of 15 workers of TCP shop was registered.

Butyl ether of 2,4,5-trichlorphenoxyacetic acid (50-60 tons per month) was produced in 1965-1967. 2,4,5-T production cycle included alkali hydrolysis of 1,2,4,5-tetrachlorbenzol, condensation with metachloracetic acid in butanol, extraction of 2,4,5-T out of sodium salt and etherification in the presence

of sulphuric acid. In the process of production some stages were modified. Thus to speed up alkali hydrolysis and to increase the output of the final product the saponification was carried out at 300⁰C and raised pressure what should inevitably result in PCDD/Fs formation. Putting the plant into operation and mastering the production cycle was accompanied by numerous accidents that resulted in mass occupational decease of workers (128 cases of chloracne).

For many years PCDD/Fs have been spreading from the plant territory together with products, waste and storm water, emissions of ineffective incinerators for chlororganic waste burning, dust. PCDD/Fs are also in sludge pits. A case is known when about 8 tons of reaction mixture was washed out into the sewerage. Industrial waste and hardened reaction mass was removed to a landfill site nearby the plant.

In order to obtain systematic data on PCDD/Fs levels and content in 1997 a detailed examination of the territory, production buildings and finished products was carried out. Places of sampling, their characteristics and the results of PCDD/Fs determination are given in table.

The highest PCDD/Fs concentrations (from 1.5 to 7.7 ppb) were found in the samples of plaster in former 2,4,5-T production shop. Plaster in former 2,4,5-TCP production shops still contains from 0.4 to 1.6 ppb TEQ PCDD/Fs, and half-ruined concrete bases of pressure filters – more than 6.6 mkg TEQ/kg.

Such a long period of producing dioxin hazardous products resulted in pollution of the Khimprom plant territory. Soil samples from the plant territory contain dioxin from 0.4 to 10 ppb including the soil at the depth of several meters. The highest pollution was found in the samples taken near a chlororganic waste incinerator that had been a source of dioxin emission for a long time. Pollution of the area within the radius of 200 meters beyond the plant territory exceeds 0.2 ppb. PCDD/Fs for many years have been accumulated in sludge pits where 11.3 ppb TEQ PCDD/Fs were found and in mud sediment where BOS 3.8 mkg/kg were determined. 1,2,3,7,8-PnCDD makes maximum contribution to the total toxicity coefficient of sludge samples. Its concentration by 2-7 times exceeds that of 2,3,7,8-TCDD. The total toxicity of hexa-isomers of dioxins and furans also exceeds the contribution of 2,3,7,8-TCDD. In plaster samples the main components are 2,3,7,8-TCDD and 1,2,3,7,8-PnCDD, the content of penta- and hexa-furans is also high.

The territory of the industrial waste landfill site is an area of extreme pollution. Thus in bottom sediment of the pond formed by ground waters from the plant and landfill site territory the concentration of 200 ppb was found. In wastewater of the Khimprom plant high PCDD/Fs concentrations (to 2 ng/l) are registered from time to time due to transfer of polluted soil and mud particles from the plant territory.

PCDD/F content in samples of soil, wall plaster and sludge of Khimprom, Ufa, ppb

PCDD/Fs	Soil			Wall plaster scrapes			Sludge
	Shop TCP	Shop 2,4,5-T	Incinerator	Shop TCP (1962/75)	Shop TCP (1975/87)	Shop 2,4,5-T	Sludge pit
2378-TCDD	6.11	0.51	4.49	0.48	6.0	1.0	2.71
12378-PeCDD	0.93	0.13	5.97	0.84	0.84	0.18	13.95
123478-HxCDD	0.15	0.13	2.74	0.21	0.12	ND (1)	0.29
123678-HxCDD	0.60	0.05	7.08	0.87	0.48	0.18	5.94
123789-HxCDD	0.22	0.08	4.15	0.45	0.18	0.13	2.56
1234678-HpCDD	0.67	0.55	22.14	2.92	0.52	0.68	8.38
OCDD	4.32	0.71	42.31	50.0	4.83	10.0	40.82
2378-TCDF	0.23	0.11	0.44	ND (8)	0.21	ND (5)	ND (2.5)
12378-PeCDF	0.07	0.09	0.86	0.36	0.06	0.12	0.33
23478-PeCDF	0.08	0.20	1.60	0.59	0.07	0.16	0.34
123478-HxCDF	0.16	1.84	1.65	1.21	0.13	2.21	0.83
123678-HxCDF	0.05	0.15	ND (2)	0.49	37.4	0.18	0.84
123789-HxCDF	0.03	0.16	ND (2)	0.37	0.03	0.15	0.11
234678-HxCDF	0.05	0.12	ND (2)	0.58	0.05	0.11	0.78
1234678-HpCDF	0.76	1.94	5.47	10.0	0.55	1.54	3.87
1234789-HpCDF	0.05	0.92	1.17	0.65	0.04	1.15	0.19
OCDF	5.61	8.98	30.58	130.0	4.39	23.0	16.19
I-TEQ, PCDD/Fs	6.76	0.99	10.04	1.69	6.60	1.54	11.18

Production of phenoxyherbicides results in persistent PCDD/Fs pollution of the manufacturing plant territory and buffer areas. The level of soil and sludge pollution in old sludge pits is now from 0.6 to 15 ppb (TEQ).

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

**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-PnCDD	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	7 139.2	5935.8	827.5	14432	1515	116
123789-HxCDD	136.6	280.1	6692.1	2561.9	258	8071	2157	36
1234678-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-HxCDF	252.6	426.6	8111.1	780.4	261.8	110000	5389	133
1234789-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

Coefficients of PCDD/F isomers bioaccumulation in biota

PCDD/Fs	<i>Mus musculus</i>	<i>Rana ridibunda</i>	<i>Leuciscus idus</i>	<i>Porcellio scaber</i>	<i>Lumbricus terrestris</i>	Poultry	Cow	Pig
TCDD	7,7	5,1	5,6	1,2	6,5	4,7	1,4	1,6
PnCDD	35	8,3	20,2	2,9	22,1	8,3	11,0	21
Σ HxCDD	29	0,5	7,5	1,5	8,6	2,3	1,0	2,0
Σ HpCDD	10,6	0,3	2,9	1,0	2,9	1,1	0,8	1,6
OCDD	0,4	0,05	0,9	0,6	1,0	4,4	0,6	4,2
TCDF	0,5	1	5,0	1,45	9,4	16,8	4,3	9,7
Σ PnCDF	7,7	2	1,6	1,5	8,6	15,6	2,5	10,7
Σ HxCDF	9,0	0,5	2,1	1,1	3,9	3,5	1,6	2,8
Σ HpCDF	3,8	0,2	3,0	0,8	1,7	3,0	1,2	3,0
OCDF	0,1	0,1	2,3	0,7	0,8	1,7	0,8	1,6
I-TEQ, pg/g lip.	6,7	5,0	3,6	1,2	5,7	5,0	3,2	4,2
% lipids	3,5	1,9	3,5	0,3	6,11	11,2	5,7	7,2
I-TEQ, pg/g w.w.	0,2	0,1	0,1	0,004	0,4	0,5	0,2	0,3

Daily food PCDD/Fs intake

Food	Intake, g/day	PCDD/Fs		Intake	
		pg/g fat	pg/g w.w.	pg/day	%
Beef	100	1,7	0,30	32,0	23,0
Pork	30	2,2	0,63	18,9	13,6
Lamb	10	-	0,12	1,2	0,8
Poultry	30	1,54	0,35	10,5	7,5
Animal fat	19	0,56		10,6	7,6
Sausage	25	1,21	0,44	11,3	8,1
Vegetable oil	19	0,18		3,6	2,6
Butter	12	0,43		5,5	4,0
Eggs	22	-	0,03	0,6	0,4
Fish	15,2	9,2	0,26	3,95	2,3
Pocketed milk	140	3,32	0,11	29,4	21,2
Cream	7	1,14	0,17	2,0	1,5
Sour cream	7	1,33	0,29	0,6	0,4
Milk products	27	2,22	0,10	2,7	1,9
Mayonnaise	7	-	0,10	0,7	0,6
Cheese	7	1,13	0,32	2,2	1,6
Total				139	100

PCDD/Fs intake and levels in human

Region	Daily intake, pg/kg body burden/day	PCDD/Fs, pg/g lipids	
		In blood	In adipose tissue
Urban area of Bashkiria	2,5-3,5	17-23	23-26
Rural area of Bashkiria	1-2	5-13	-

PCDD/Fs in human (whole blood and breast milk)

Isomer composition of breast milk samples of donors and mean values for cities and villages of the region are given in Tables. As Tables shows the most polluted breast milk samples are from Ufa and from neighbouring (about 100 km) Blagoveshchensk (25.9-27.1 pg TEQ/g). This is most probably due to transfer of pollution from chemical plants to the city. Meteorological conditions and lay out of freight transportation roads also contribute to pollution. Increased PCDD/Fs level in milk samples from Iglinsky and Sterlitamaksky (21.9 and 26.7 pg TEQ/g) districts are accounted for by their location in the vicinity of industrial centres. Breast milk sample from Salavat contained 8.7 pg/g of lipids what is lower than the value earlier reported. Perhaps individual differences were of importance or some peculiarities of sampling. Probably pollution of population is being reduced (in our opinion data on time trend of PCDD/Fs in breast milk are so far insufficient).

Results of blood samples analyses mainly correspond to the data on PCDD/F contents in breast milk from the same districts. Pollution level in industrial centres is by 10-15% higher than that in rural areas due to technologies load. However only samples from Ufa and Blagoveshchensk have an increased 2,3,7,8-TCDD level as a result of pollution by the chemical plant producing 2,4,5-T. Samples from small towns do not carry any information on technologies pollution. It is obvious that individual qualities or diet peculiarities acquire more importance.

Mean level of pollution does not exceed similar levels for other regions of the world. Analysis of PCDD/Fs accumulation in individual samples from donors of different age permits to estimate accumulation in biological human tissues at the level of 0.8 pg per year for cities and 0.5 pg per year for rural areas).

PCDD/Fs in breast milk, pg/g lipids

PCDD/Fs	Mean of cities, n=8	Mean of rural areas, n=9	Mean, region
2,3,7,8-TCDD	7.0±6.5	4.6±4.9	5.7±7.2
TEQ	15.91±11.2	12.8±11.9	14.4±12.2
Number of donors	43	23	66

PCDD/Fs in whole blood, pg/g lipids

PCDD/Fs	Industrial centres, n=4	Small towns, n=7	Rural areas, n=12	Region
2,3,7,8-TCDD	14.3±7.5	5.9±4.9	5.5±4.9	8.6±4.1
TEQ	39.8±10.2	25.0±15.3	24.8±7.5	29.9±13.9
Number of donors	124	138	102	264

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PCDD/F contents in breast milk of citizens, Bashkortostan

PCDD/Fs	Cities									Rural areas										Mean (region)
	Ufa	Blagoveshensk	Davlecanovo	Ishimbay	Kumertau	Neftecamsk	Salavat	Yanaul	Mean of cities	Baimaksky	Beloretcky	Iglinsky	Mechetlinsky	Mishkinsky	Salavatsky	Sterlitamaksky	Checmagushevsky	Ishimbaysky	Mean by areas	
2378-TCDD	13.5	13.6	3.5	9.4	3.8	5.3	2.9	3.6	7.0	1.6	2.4	9.3	2.0	3.9	3.1	10.6	4.8	4.0	4.6	5.7
12378-PnCDD	11.1	14.1	4.1	0.2	3.8	5.0	2.8	3.6	5.6	1.9	1.6	11.0	2.9	3.4	3.3	10.9	5.2	5.2	5.0	5.3
123478-HxCDD	2.8	2.2	1.8	1.2	1.0	1.6	0.7	1.1	1.5	0.4	0.5	1.9	0.7	1.2	0.8	1.0	1.3	0.9	1.0	1.3
123678-HxCDD	6.7	3.6	1.9	1.6	2.4	3.2	3.0	2.7	3.1	1.1	0.8	4.1	1.0	2.1	2.3	4.3	2.8	2.6	2.4	2.8
123789-HxCDD	2.1	0.6	0.4	0.3	0.8	0.7	2.1	0.9	1.0	0.3	0.6	0.9	0.4	0.7	1.7	3.7	0.4	0.5	0.9	0.9
1234678-HpCDD	10.7	3.6	2.6	3.1	3.1	5.4	6.7	3.5	4.8	2.1	2.7	4.1	3.2	3.2	1.9	8.0	4.8	4.0	3.8	4.3
OCDD	46.9	14.1	8.0	12.3	14.2	20.7	15.0	12.9	18.0	6.9	41.0	18.4	15.2	12.5	8.0	26.9	15.5	17.9	18.0	18.0
2378-TCDF	2.6	2.6	1.7	1.8	1.5	2.0	1.5	2.7	2.1	1.4	1.6	2.4	1.6	2.5	1.6	10.5	2.2	2.2	2.9	2.5
12378-PnCDF	1.3	2.2	1.3	4.8	10.3	1.6	0.5	1.5	2.9	2.5	1.6	2.2	3.3	1.3	1.9	6.6	4.2	1.7	3.0	2.9
23478-PnCDF	7.7	8.8	6.4	18.1	5.3	9.8	5.9	9.4	8.9	3.9	2.7	10.0	5.9	6.9	6.3	15.7	7.8	6.5	7.3	8.1
123478-HxCDF	6.3	5.7	3.4	3.2	1.0	5.3	2.9	2.8	3.8	2.7	2.2	5.2	4.6	3.6	5.5	2.4	3.3	3.9	3.7	3.8
123678-HxCDF	3.5	2.6	1.6	1.7	1.7	0.4	1.8	2.0	1.9	1.6	1.5	3.3	2.6	2.2	2.1	1.1	1.7	2.0	2.0	2.0
123789-HxCDF	0.6	0.5	0.2	0.3	0.4	0.2	0.3	0.1	0.3	0.3	0.7	0.4	0.4	0.5	0.9	5.3	0.1	0.3	1.0	0.7
234678-HxCDF	1.7	1.2	1.0	1.1	1.1	1.4	1.1	1.0	1.2	1.0	1.8	1.3	1.5	1.3	1.0	1.2	1.0	1.2	1.3	1.2
1234678-HpCDF	6.0	2.1	1.5	1.4	2.9	1.9	2.4	1.6	2.5	1.8	0.1	2.5	3.7	2.0	1.4	5.2	1.9	1.8	2.3	2.4
1234789-HpCDF	1.0	0.3	0.4	0.3	0.4	0.3	0.3	0.2	0.4	0.3	1.3	0.5	0.5	0.3	0.7	1.1	0.4	0.7	0.6	0.5
OCDF	3.5	0.6	0.4	0.7	9.7	0.5	0.6	0.7	2.1	0.7	89.8	0.6	1.3	0.8	1.0	2.1	0.3	0.6	10.8	5.8
TEQ, pg/g lip.	25.9	27.1	10.1	19.9	9.8	14.3	8.7	11.6	15.9	5.7	9.0	21.9	7.8	10.6	9.5	26.7	12.9	11.2	12.8	14.4
Number of donors	17	5	1	1	1	10	5	3	43	2	1	9	1	3	3	2	2	2	23	66
Mean age	23.5	23.2	20	24	23	23.4	20.6	20	22.2	19	25	30.4	25	26	22.8	22	22	24	25.4	23.8

PCDD/F contents in whole blood samples from cities and rural areas of Bashkortostan

PCDD/Fs	Salavat	Sterlitamak	Blagoveshchensk	Baymak	Beloretsk	Ishimbay	Kumertau	Uchaly	Yanaul	Beloretsky	Davlekanovsky	Iglinsky	Mechetlinsky	Sterlitamasky	Alsheyevsky	Uchalinsky
2378-TCDD	6.1	10.2	19.0	4.8	4.1	3.2	4.7	4.9	11.5	3.7	3.0	2.6	4.8	3.0	9.6	4.0
12378-PnCDD	1.8	9.8	19.0	3.9	2.0	6.3	2.0	7.8	15.1	1.9	7.9	6.8	18.3	6.3	10.2	3.5
123478-HxCDD	5.2	5.7	10.0	3.7	1.2	1.7	2.9	2.9	4.4	4.1	2.6	7.6	4.1	3.3	3.2	2.3
123678-HxCDD	8.2	9.1	5.5	2.2	4.3	2.9	6.0	6.3	8.3	6.4	5.1	15.3	8.4	1.5	6.7	12.6
123789-HxCDD	3.9	5.5	6.7	1.5	2.1	1.4	2.9	1.9	3.5	2.0	2.2	10.7	3.7	4.5	2.6	7.1
1234678-HpCDD	25.1	26.9	24.0	30.3	9.1	20.9	17.8	16.6	17.7	14.4	12.0	28.4	18.3	21.2	9.3	28.6
OCDD	93.2	175	189	188	50.8	105	96.4	76.5	101	89.3	72.9	613	312	89.0	77.1	166
2378-TCDF	10.4	25.8	19.2	10.0	8.8	7.5	7.3	10.6	22.2	18.1	8.2	23.2	5.4	6.5	4.6	5.7
12378-PnCDF	6.4	7.4	3.4	5.0	4.6	2.2	4.1	5.9	18.3	7.8	2.8	13.8	10.9	7.4	9.5	3.9
23478-PnCDF	21.6	34.3	24.2	26.4	11.6	21.3	14.2	17.2	24.7	17.7	13.1	29.9	2.2	5.0	13.5	4.0
123478-HxCDF	10.0	27.3	21.3	19.6	8.1	3.4	16.9	15.1	10.9	12.3	9.0	15.0	16.7	5.0	17.5	20.6
123678-HxCDF	7.0	9.7	5.4	7.9	5.4	3.3	11.5	8.8	10.0	7.6	5.7	12.3	10.1	5.0	6.3	13.0
123789-HxCDF	3.6	8.1	9.5	1.5	2.6	2.9	5.8	4.6	11.5	5.2	2.7	8.8	4.3	5.0	7.3	6.0
234678-HxCDF	6.7	9.2	8.6	3.4	4.2	1.4	9.3	7.1	11.0	7.4	5.1	12.5	4.0	5.0	4.9	10.6
1234678-HpCDF	25.2	28.7	19.5	19.6	8.8	17.8	20.1	16.5	16.7	16.3	13.7	96.7	44.7	20.3	7.0	35.3
1234789-HpCDF	4.4	4.0	7.2	2.9	1.9	3.7	3.3	3.6	2.9	3.0	2.9	10.5	7.6	5.7	3.9	3.4
OCDF	12.3	13.4	25.4	14.2	6.1	20.4	17.6	13.3	14.7	14.6	8.7	10.5	3.0	17.7	6.9	25.1
TEQ, pg/g lip.	24.6	41.0	50.1	25.9	15.0	20.0	19.8	23.8	40.5	20.6	18.0	35.2	22.3	13.4	27.5	16.6
Number of donors	40	25	15	15	43	16	18	22	20.	24	9	3	11	13	3	7.0
Mean age	42	39.5	24	27.5	23.5	36	36	37.5	32.5	35.7	31	25	25	41	42	43

PCDD/Fs in blood samples of exposed workers.

PCDD/Fs determination in blood samples of 75 former workers of different Khimprom shops was made in 1996-1998, 20-30 years after the maximum exposure.

Group	N	Age	2,3,7,8-TCDD	TEQ of the sample
			pg/g of blood lipids	
Men workers, 2,4,5-T	32	57.1	97.2±64.4	156.8±88.6
Women workers, 2,4,5-T	9	56.0	127.3±94.7	163.9±111.1
Workers, 2,4,5-TCP, TCP-Cu	4	55.0	318±242.6	490.3±290
Workers, 2,4-D production	24	52.0	98.1±104.2	243.3±172.5
Workers, chlorbenzene, MCPA	6	54.1	53.9±28.7	128.2±79.5
Unexposed donors (control)	44	54.7.	21.9±13.1	43.5±22.8

When analysing chloracne cases of the Khimprom workers no dependence was found between the fact of disease in 1965/67 and the residual level of PCDD/Fs content in blood in 1997.

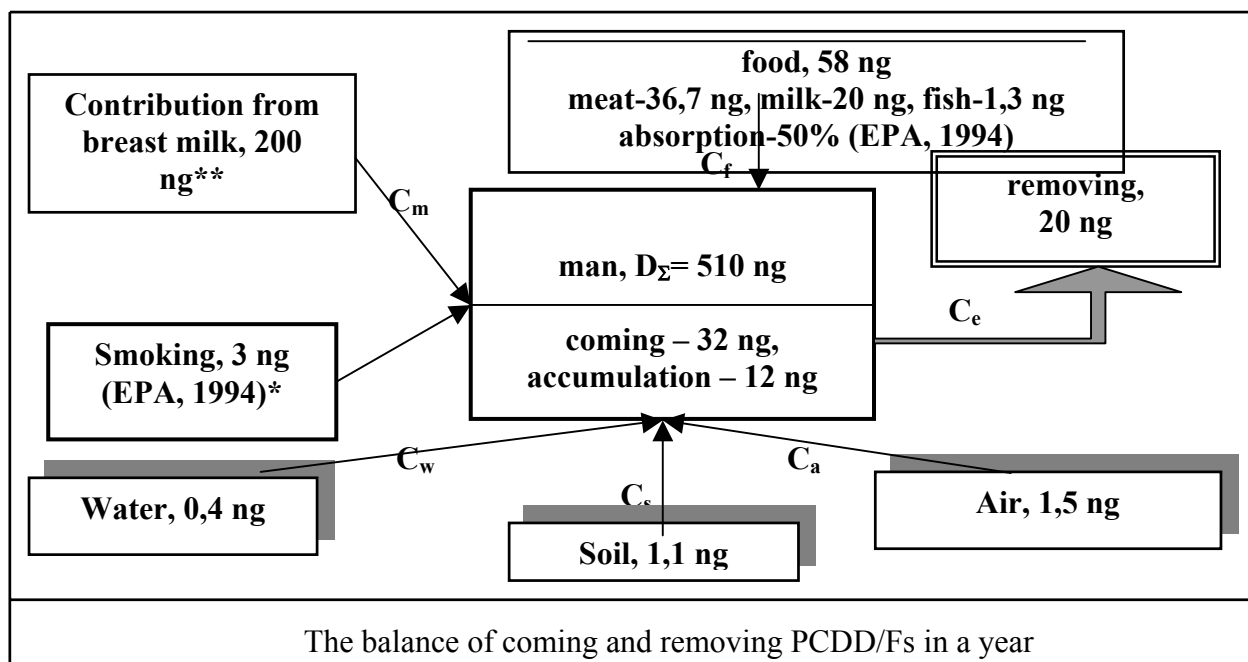
Chloracne cases (1966/67) and the mean level of PCDD/Fs content in blood of Ufa united cohort representatives (pg/g lipids)

Chloracne	n	2,3,7,8-TCDD				TEQ			
		min	max	med.	mean	min	max	med.	mean
Yes	32	30.7	361.4	101.1	113.3±75.8	74.6	439.1	140.5	165.8±92.1
No	31	11.9	560.7	65.5	108.5±80.7	16.5	845.3	141.1	220.0±192.3

As a result of studying remote consequences of PCDD/Fs exposure an increased mortality rate exceeding that of the city and the region population for the workers of Khimprom plant as a whole, for the workers of chlororganic production (the united cohort) and for the subcohort of highly exposed workers 20-30 years ago involved in 2,4,5-T and 2,4,5-TCP production was stated.

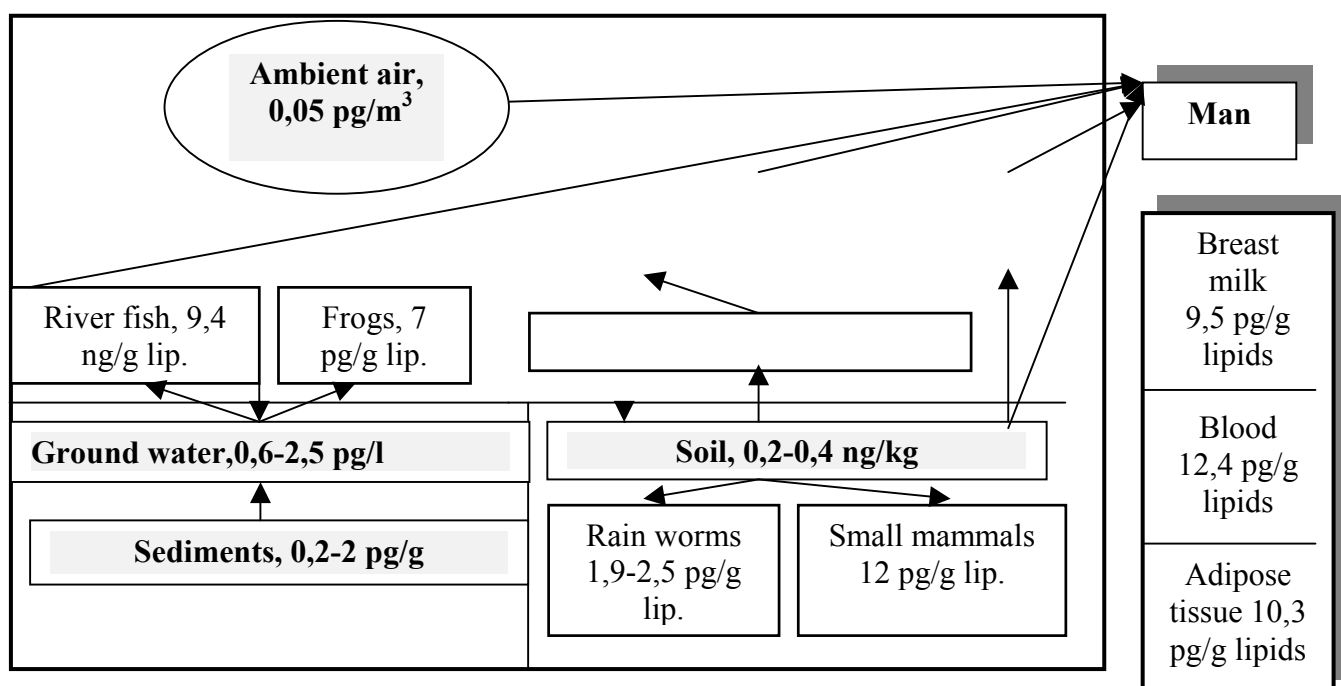
The cohort in Ufa has a sufficiently high level of experimentally confirmed exposure (about 2/3 of the whole group), the mean current level of contamination (1997) is about 200 pg TEQ/g lipids what by 4.5 times exceeds the background level of the corresponding age group of the city population.

The calculation was carried out for the region citizen (50 age, weight 70 kg, fat content-25%).

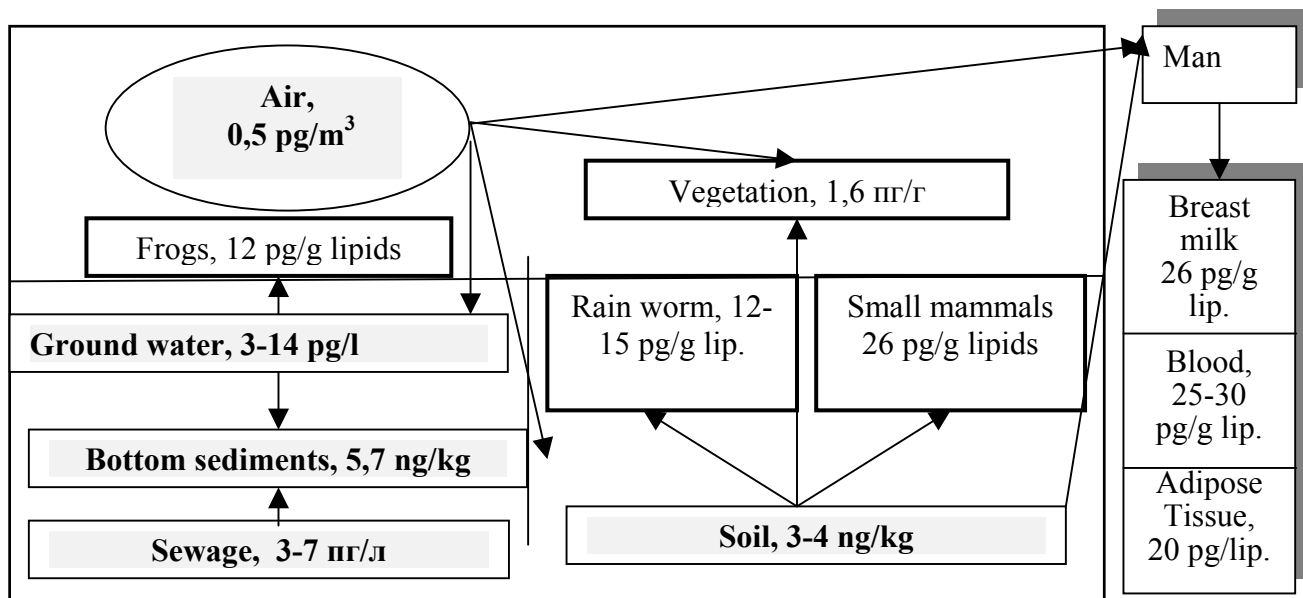


($C_m = 1,07$ pg/kg b.b./day, $C_f = 2,0$ pg/kg b.b./day, $C_w = 0,01$ pg/kg/day, $C_s = 0,03$ pg/kg/day, $C_a = 0,05$ pg/kg/day, $C_e = 0,8$ pg/kg b.b./day, *- data did not used, **-initial doze).

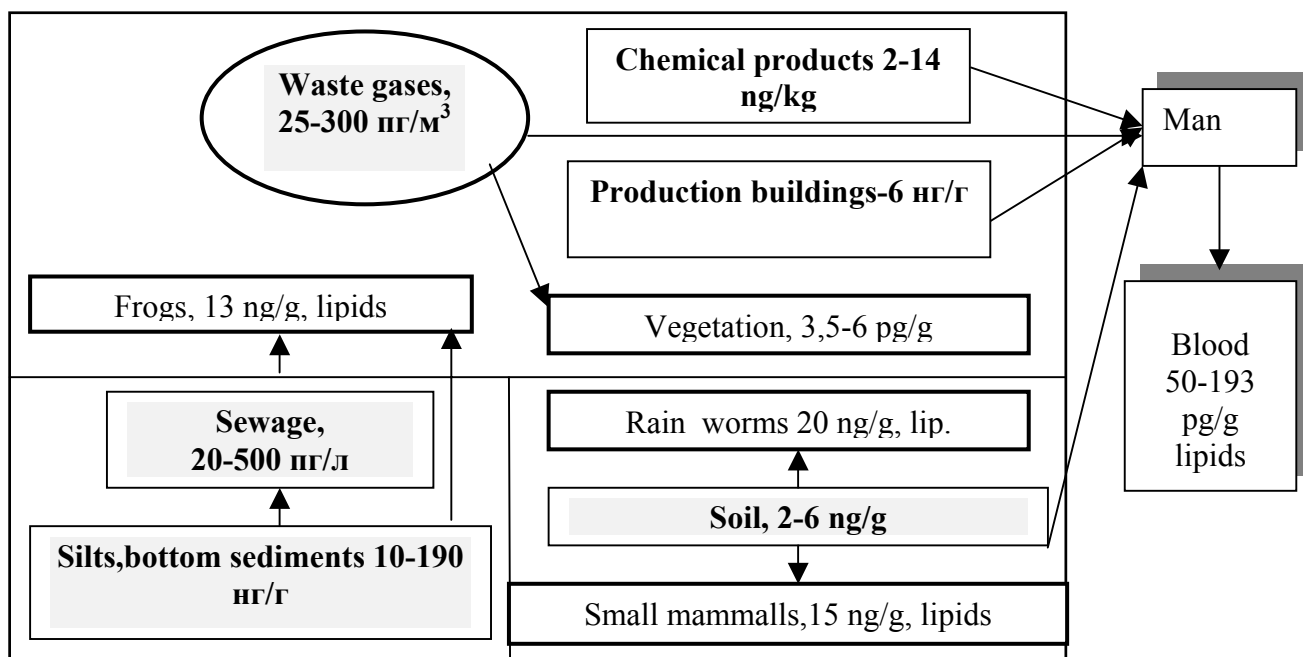
Scenario of PCDD/Fs contamination in urban, rural and industrial zones



Scenario I. Background contamination of rural areas of Bashkortostan region, Russia

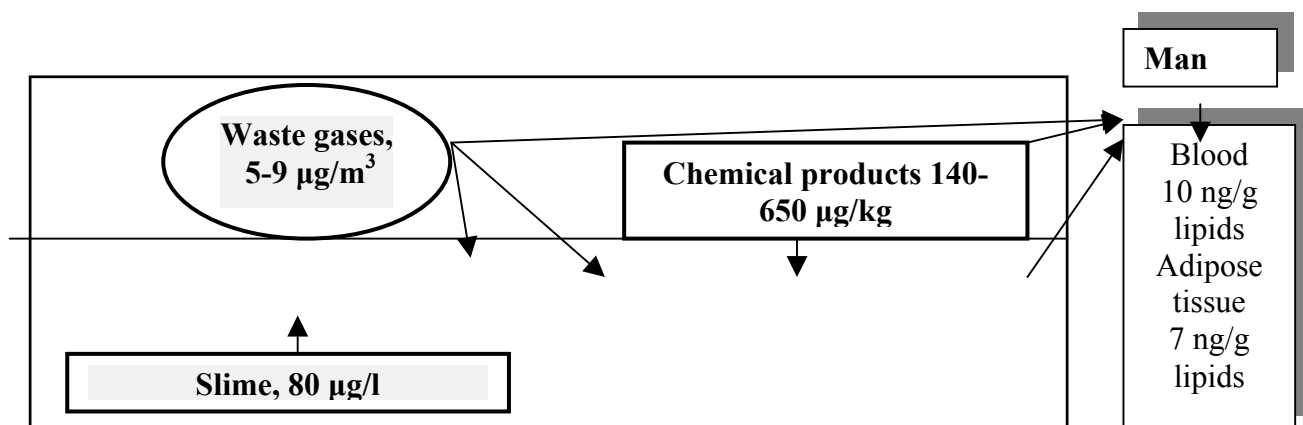


Scenario II. Urban areas of the Republic of Bashkortostan



Scenario III. Industrial pollution.

Scenario IV was calculated by extrapolation the data to the period of 245-T production (60-70). Half-life PCDD/Fs in soil (10 years), bottom and sediments (15 y), human (7,4 year) were used.



Scenario IV. Extreme contaminated zone (retrospective, calculation).

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PCDD/Fs Monitoring in Environmental Objects and Biological Samples from the Republic of Komi, Russia.

In 1997, 1999 and 2001 PCDD/PCDF pollution of the Komi Republic area was investigated and over 50 samples were analysed.

The Republic of Komi (with the city of Syktyvkar as the capital) is situated in the North - East of the European part of Russia. There is wood industry, sawmill industry, woodworking industry and materials of construction industry. Near Syktyvkar there is a large woodworking complex (SWC). The reason for investigation was the existence in the region of a large pulp and paper mill production paper with the use of chlorine bleaching (SLPK).

In 1997 the Vichegda River pollution was studied. The river was the source of drinking water for the city of Syktyvkar. Wastewater of the pulp mill, the ground around the saw – mill, river fish, donor blood, breast milk, fat tissue of workers, butter samples were also analysed.

Considerable pollution of the Vichegda River by pulp mill wastewater was found at a distance of 5 km up to 14pg/l. Wastewater contained PCDD/Fs at a level of 380 pg/l, fish caught in the river – 173 pg/g lipids TEQ-WHO.

Water system is the main PCDD/Fs spreader in the region. In blood of the pulp mill workers 40.4 pg/g lipids were found. There is difference in breast milk pollution between the area of the pulp mill – 22.1 pg/g PCDD/F and the city of Syktyvkar – 16.3 pg/g lipids.

In 1999 the research was continued. PCDD/PCDFs content in pool blood samples of workers from Madmas village where woodsmen live and of workers from the oil – refining plant and its ground in the city of Ukhta was analysed. No considerable pollution was found 1.2 pg/g of dry weight of ground and 17.22 pg/g lipids of the pool blood sample.

The third step of research in 2001 included: butter from Ezhvinsky district, a distant district, drinking water from Ezhvinsky water supply system and drinking water from the city of Krasnogorsk, as well as donor blood from the city of Ukhta.

The concentrations of PCDDs/Fs in human [pg.g ⁻¹ lipids] WHO-TEQ		
Site	Concentration	Reference
Villiges near city Ukhta, whole blood, pool, n=28	14.3 pg/g	New data, Amirova, 2002
SWC workers, n=20, pool whole blood	40.42	Amirova et.al. Organohal. Comp. 38,1998, 97-100
Control group, pool, n=20, whole blood	26.44	Amirova et.al. Organohal. Comp. 38,1998, 97-100
Breast milk, pool Eshva, n=6	22.14	Amirova et.al. Organohal. Comp. 38,1998, 97-100
Breast milk, pool, n=10, City Syktyvkar	16.4	Amirova et.al. Organohal. Comp. 38,1998, 97-100
Oil refinery workers, Ukhta, n=24, pool whole blood	25.95	Unpublished data, Amirova, 1999

The concentrations of PCDDs/Fs in food [pg.g ⁻¹ lipids]		
Site	Concentration	Reference
Butter, near (5 km) SLPK	0.64 pg/g lipids	New data, Amirova 2002
Butter, 40 km from SLPK	0.38 pg/g lipids	New data, Amirova 2002
Fish from Vichegda River	173 pg/g lipids	Amirova et.al. Organohal. Comp. 38,1998, 97-100

The concentrations of PCDDs/Fs in water [pg.l ⁻¹]		
Site	Concentration	Reference
Drinking water, city Krasnogorsk	0.15 pg/l	New data, Amirova, 2002
Drinking water, city Ezhva	0.6 pg/l	New data, Amirova, 2002
Vichegda River water up to sewage discharge	4.09 pg/l	Amirova et.al. Organohal. Comp. 38,1998, 97-100
Vichegda River water after sewage discharge	13.5 pg/l	Amirova et.al. Organohal. Comp. 38,1998, 97-100

The concentrations of PCDDs/Fs in soil [pg.g ⁻¹ d/w/]		
Site	Concentration	Reference
Location, near silicate plant, Ukhta	0.5 pg/g	New data, Amirova 2002
Background, 1 km from city Ukhta	0.27 pg/g	New data, Amirova 2002
Soil from city Ukhta, n=3	1.96 – 2.9 pg/g	New data, Amirova 2002
City, Syktyvkar	0.92	Amirova et.al. Organohal. Comp. 38,1998, 97-100
Industrial region of city Syktyvkar	0.57	Amirova et.al. Organohal. Comp. 38,1998, 97-100
Oil refinery plant, Ukhta	1.19 pg/g	Unpublished data, Amirova, 1999

The concentrations of PCDDs/Fs in sediment [pg.g ⁻¹ d.w.]		
Site	Concentration	Reference
Bottom sediments of Vichegda River	0.27 pg/g	Amirova et.al. Organohal. Comp. 38,1998, 97-100

PCDD/Fs Monitoring in Environmental Objects from the Chita region, Siberia, Russia.

The concentrations of PCDD/Fs in sediment [pg.g ⁻¹ d.w.]		
Site	Concentration	Reference
Bottom, lake Canon, Chita region, n=3	0.16-0.23 pg/g	New data, Amirova 2002
Coast, lake Canon, Chita region, n=2	0.15-5.54 pg/g	New data, Amirova 2002

The concentrations of PCDDs/Fs in soil [pg.g ⁻¹ d/w/]		
Site	Concentration	Reference
Location, near silicate plant, Chita	0.5 pg/g	New data, Amirova 2002
Background, 1 km from city Chita	0.27 pg/g	New data, Amirova 2002
Soil from city Chita, n=3	1.96 – 2.9 pg/g	New data, Amirova 2002

PCDD/Fs Monitoring in Environmental Objects and Biological Samples from Chuvash Republic, Russia.

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 ng TEQ/kg of dry weight (in sludge pits) and from 11 to 72 ng TEQ/kg of dry weight in active sludge.

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 ng TEQ/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).

The concentrations of PCDDs/Fs in sludge, plant Khimprom [pg.g ⁻¹] I-TEQ, d.w.			
Site	Concentration	Reference	
"Khimprom" sludge pit, n=5	11-195	Amirova et.al.	Organohal. Comp. 38,1998, 101-104

The concentrations of PCDDs/Fs in soil, plant Khimprom [pg.g ⁻¹] I-TEQ, d.w.			
Site	Concentration	Reference	
Background soil	0.24	Amirova et.al.	Organohal. Comp. 38,1998, 101-104
"Khimprom" soil, n=5	0.7-0,8	Amirova et.al.	Organohal. Comp. 38,1998, 101-104

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.

The concentrations of PCDDs/Fs in human [pg.g ⁻¹ lipids] WHO-TEQ			
Site	Concentration	Reference	
"Khimprom" workers (Novocheboksarsk), whole blood, individual sample, n=4	8.77-18.47	Amirova et.al.	Organohal. Comp. 38,1998, 101-104
Teenagers, whole blood, city Novocheboksarsk	11.66	Amirova et.al.	Organohal. Comp. 38,1998, 101-104
"Khimprom" worker, adipose tissue, male, age-29	10.44	Amirova et.al.	Organohal. Comp. 38,1998, 101-104
"Khimprom" worker, adipose tissue, male, age-70	33.32	Amirova et.al.	Organohal. Comp. 38,1998, 101-104
Breast milk, pool, n=5, age=22, Novocheboksarsk	7.95	Amirova et.al.	Organohal. Comp. 38,1998, 101-104

The concentrations of PCDDs/Fs in food [pg.g ⁻¹ lipids]			
Site	Concentration	Reference	
Cow milk	1.07 pg/g lipids	Amirova et.al.	Organohal. Comp. 38,1998, 101-104

PCDD/Fs Monitoring in Environmental Objects and Biological Samples from Republic of Udmurtia, Russia.

Воткинска, месте планируемого строительства завода по уничтожению твердотопливных ракет по заданию Удмуртского центра Госсанэпиднадзора.

The concentrations of PCDDs/Fs in soil [pg.g^{-1}], d.w. I-TEQ		
Site	Concentration	Reference
Soil, near city Votkinsk, n=30	0.05-0.25	Unpublished data

The concentrations of PCDDs/Fs in air [pg.cub.m^{-1}]		
Site	Concentration	Reference
Soil, near city Votkinsk, n=7	0.023-0.067	Unpublished data

PCDD/Fs Monitoring in Environmental Objects and Biological Samples from Sverdlovsk region, Russia.

Sverdlovsk region (North Ural) is a centre of metallurgy, heavy mechanical engineering, and chemical and coke industry.

By an order of the Sverdlovsk Centre of Sanitary and Epidemiological Service the first study of several industrial centres in Sverdlovsk region was carried out in 1995. Analytical determination was carried out at the Environmental Research and Protection Centre (ERPC) in the Republic of Bashkortostan. The purpose of the study was to determine the background PCDD/Fs levels for the urban population.

In the cities of Nigny Tagil, Kamensk-Uralsky, Ekaterinburg and Kirovgrad representatives of Sanitary and Epidemiological Service selected 4 pool samples of whole blood from 30 permanent inhabitants of these cities. The donors were of approximately equal age. 20 ml of whole blood samples were taken from each of them, except for Ekaterinburg, where the pool sample was presented by blood serum taken from 115 people, 2.5 ml from each. In the city of Nigny Tagil a pool sample of breast milk was taken from 4 women of the same age. Food samples were also taken: chicken from Kirovgrad and butter from Krasnoufimsk.

The concentrations of PCDDs/Fs in human [pg.g ⁻¹ lipids], I-TEQ				
Site	Concentration	Reference		
Nigny Tagil, population, whole blood, pool, n=34 age=34	26.6	Amirova et.al.	Organohal.	Comp.
		38,1998, 93-96		
Kamensk-Uralsky, population, whole blood, pool, n=35, age=30-55	24.4	Amirova et.al.	Organohal.	Comp.
		38,1998, 193-96		
Ekaterinburg, population, plasma, pool, n=115, age=30-35	59.9	Amirova et.al.	Organohal.	Comp.
		38,1998, 93-96		
Kirovgrad, population, whole blood, pool, n=33, age=32	38.1	Amirova et.al.	Organohal.	Comp.
		38,1998, 93-96		
Nigny Tagil, population, breast-milk, n=4, age=30-34	13.7	Amirova et.al.	Organohal.	Comp.
		38,1998, 93-96		

The concentrations of PCDDs/Fs in food [pg.g ⁻¹ lipids]				
Site	Concentration	Reference		
Butter, Krasnoufimsk	1.41 pg/g lipids	Amirova et.al.	Organohal.	Comp.
		38,1998, 101-104		
Chicken, Kirovgrad	2.54 pg/g lipids	Amirova et.al.	Organohal.	Comp.
		38,1998, 101-104		

Apart from analysing biological samples the risk assessment of PCDD/Fs contamination of the water system for Ekaterinburg, Nigny Tagil and Turinsk was made. In Ekaterinburg drinking water was sampled and active sludge from municipal water treatment facilities. In drinking water samples PCDD/Fs isomers were present at the detection limit, except for hepta- and octa- isomers (0.7 – 1.8 pg/l). I-TEQ sample was 1.2 p/l (ND=1/2 MDL). I-TEQ sample of active sludge in Ekaterinburg was 16 ng/kg, 2.6 ng/kg for 2,3,7,8-TCDD. Active sludge sample in Nigny Tagil (the first stage of purification of industrial wastewater from “Uralchimplast” plant) contained 8.4 ng TEQ/kg 2.6 ng/kg for 2,3,7,8-TCDD. Wastewater sample from the paper and pulp factory in Turinsk contained 23 pg TEQ/l. The character of isomer spectre corresponded to the processes of pulp bleaching with chlorine.

If we take mean value of TEQ for pool blood samples for the cities of Russia that are known at present, this value will be 27.7 (Table).

Table. The PCDD/Fs concentration in whole blood samples of big industrial centres of Ural and Volga regions.

The towns	I-TEQ, pg/g lipids	References
Nigny Tagil	26.6	ERPC, 1997
Kamensk-Uralsky	24.4	ERPC, 1997
Ekaterinburg	59.9	ERPC, 1997
Kirovgrad	38.1	ERPC, 1997
Novocheboksarsk	14.6	ERPC, 1996
Syktyvkar	26.4	ERPC, 1997
Ufa	35.6	ERPC, 1997
Sterlitamak	17	ERPC, 1995
Baikalsk	17	A. Schecter, 1993
S. Petersburg	18	A. Schecter, 1993
Mean	27.7	

PCDD/Fs Monitoring, Perm region, Russia.

The concentrations of PCDDs/Fs in water [pg.l ⁻¹]		
Site	Concentration	Reference
Sewage, plant Soda, city Beresniki, n=3	22.2-28.9 pg/l	Amirova et.al. Dioxins. Regions of Russia, v.3, 1998, p.150-164 (rus)

PCDD/Fs Monitoring, city Volgograd, Russia.

The concentrations of PCDDs/Fs in water [pg.l ⁻¹], I-TEQ		
Site	Concentration	Reference
Sewage, plant Khimprom, city Volgograd, n=4	70-2158 pg/l	Amirova et.al. Dioxins. Regions of Russia, v.3, 1998, p.150-164 (rus)

PCDD/Fs Monitoring, Samara Region, Russia.

The concentrations of PCDDs/Fs in water [pg.l ⁻¹] , I-TEQ		
Site	Concentration	Reference
Drinking water, city Tolyatti, n=4	0.65-0.72 pg/l	Unpublished data

PCDD/Fs Monitoring, Bryansk Region .

The concentrations of PCDDs/Fs in soil [pg.g ⁻¹ d.w.], I-TEQ		
Site	Concentration	Reference
Bryansk	0.26-0.73	Unpublished data

Organohal.Comp. vol. 51, 2001, Dioxin-2001, page 298-301.

Control instrumentation of PCDD/Fs content in foodstuff in Russia

Zarema Amirova, Edward Kruglov, Irina Donnic¹, Elena Grosheva²

Environmental Research&Protection Centre, 147, October Avenue, 450075, Ufa, Russia

¹Ural State Agricultural Academy, 42, Libknecht Street, 620219, Ekaterinburg, Russia

²Institute of Ecological Toxicology, 665932, P.O. Box 78, Baikalsk, Irkutsk Region, Russia

Introduction

Monitoring of PCDD/Fs content in fat-containing foodstuff has not been carried out on national basis in Russia though health standards of permissible PCDD/Fs concentration have been set by the Regulations of the Chief sanitary inspector of the Russian Federation. The standards are as follows: in milk and dairy 5.2 ng/kg of fat; in fish and fish products: in eatable part – 11.0 ng/kg, converting into fat – 88.0 ng/kg; in meat and meat products: in eatable part – 0.9 ng/kg, converting into fat – 3.3 ng/kg. The allowable PCDD/Fs intake admitted in Russia is 10 pg/kg of body burden.

In the absence of industrial emission sources PCDD/Fs primarily get into human organism via foodstuff. The degree of toxicity load on people due to PCDD/Fs in foodstuff has been determined in the Republic of Bashkortostan [1] and in Irkutsk region [2]. Data on other regions of Russia are occasional [3] but they don't point to the problems of the main fat-containing products' pollution.

By the present time new data were obtained at the Environmental Research&Protection Centre, Ufa, Russia in the course of inventorying dioxin sources in Russia – PCDD/Fs content in butter from different regions (grant of the USEPA X827697-01-0); as a result of research carried out by the Ural Agricultural Academy in Ekaterinburg in 2000; as a result of analysing meat and dairy produce in Irkutsk region; as a result of test checks of polluting marketable products by some enterprises in Russia.

Besides, taking into consideration a possibility of importing to Russia some meat and poultry with high PCDD/Fs content control testing of large lots of meat and poultry coming to the Republic of Bashkortostan, from Belgium, France, Denmark, Holland and USA was carried out in 1999.

The present report summarises the results of these studies.

Materials and Methods

Foodstuff was sampled in different regions of Russia and was stored at -20°C up to the moment of analysing. A sample (20g of meat/liver, 10g of sausage, 5g of butter, 100g of cow milk) after adding surrogate compounds, homogenising and drying with Na₂SO₄ was extracted by a mixture of solvents (CH₂Cl₂/C₆H₁₄ = 2.5/3.5). Lipids were determined and then decomposed. The extracts were purified by column chromatography with the use of SiO₂, Al₂O₃ and Carbowax-C/Celite 545. PCDD/Fs quantitative analysis was performed by the method of HRGC/HRMS in compliance with 1613B US EPA methods with the use of capillary column DB-5 MS (60m) and a high-resolution mass spectrometer Autospec-Ultima, Micromass (10000).

For toxicological assessment of polluting the samples with PCDD/Fs the scale WHO-TEQ was used. Duplicate and blank experiments on model matrixes were performed for all samples. The degree of recovery made 43-116%, MDL made from 0.4 ppt (TCDD) to 0.9 ppt (OCDD).

Table 1 The sampling from regions of Russia and imported foodstuff from EU and USA

Produced in	Number of samples	Sample
Primorsky Territory, Russia	1	Butter
Kurgan Region, Russia	1	Butter
The Republic of Adygea, Russia	1	Butter
Bashkiria, Russia	6	Butter
Sverdlovsk Region, Russia	3	Butter
Irkutsk Region, Russia	2	Butter
Sverdlovsk Region, Russia	4	Cow milk
Bashkiria, Russia	26	Cow milk
The Republic of Komi	2	Cow milk
Bashkiria, Russia	17	Beef

Bashkiria, Russia	14	Pork
Sverdlovsk Region, Russia	3	Cow liver
Sverdlovsk Region, Russia	4	Beef
Irkutsk Region, Russia	4	Beef
Irkutsk Region, Russia	2	Pork
Samara Region, Russia	3	Cow milk
Bashkiria, Russia	7	Chicken
Sverdlovsk Region, Russia	2	Chicken
Bashkiria, Russia	12	Sausage
Nizhegorodskaya Region, Russia	4	Sausage
Moscow, Russia	7	Sausage
USA*	5	Turkey
Denmark*	2	Pork
Belgium*	4	Chicken
France*	2	Chicken
France*	2	Turkey

* - samples of food bought in Ufa

Results and Discussion

The results of PCDD/PCDFs determination are given in Tables 2 and 3.

Table 2. PCDD/Fs in the samples of products imported from European countries and USA (market of Ufa, Russia), WHO-TEQ, pg/g lipids

Object	Region	PCDD/Fs	Object	Region	PCDD/Fs
Butter	Holland	0.89±0.21	Poultry	France	1.46 ±0.32
Meat	France	2.03	Poultry	Belgium	1.1±0.43
Meat	Denmark	0.96±0.04	Poultry	USA	1.48 ±0.97

Table 3. PCDD/Fs in the samples from Russian regions, WHO-TEQ, pg/g lipids

Object	Region	PCDD/Fs	Object	Region	PCDD/Fs
Butter	Bashkiria	0.47±0.12	Meat	Bashkiria	1.63±0.05
	Sverdlovsk region	1.37±0.04		Sverdlovsk region	4.38±0.22
	Irkutsk region	1.11		Irkutsk region	1.12±0.07
	Kurgan region	0.60	Milk	Komi republic	1.38±0.3
	Primorsky Territory	1.02		Bashkiria	2.22±0.21
	Adygea	1.13		Sverdlovsk region	1.61±0.55
Liver	Sverdlovsk region	4.29±0.16		Samara region	2.34±0.04
Poultry	Bashkiria	1.33±0.30	Sausage	Bashkiria	1.43±0.78
	Sverdlovsk region	2.37		Moscow	2.19±1,12
				Samara region	0.78±0.12

As a rule the content of PCDD/PCDF high-chlorinated isomers in samples from Russia is lower than in samples from other regions of the world (Table 4).

Table 4 Content of isomer groups in samples of different origin (poultry fat, pg/g lipids)

PCDD/Fs	Russia	USA	PCDD/Fs	Russia	USA
TCDD	0,23	0,21	TCDF	0,25	3,57
PnCDD	0,15	0,38	Σ PnCDF	2.28	0,52
Σ HxCDD	1.09	1.87	Σ HxCDF	2.31	3.41
Σ HpCDD	1.63	3.70	Σ HpCDF	1.63	2.89
OCDD	2,63	9,57	OCDF	1,07	2,33

Mean values of individual PCDD/Fs isomer concentrations in different kinds of foodstuff produced in Russia are given in Table 5.

Table 5. Mean values of PCDD/Fs content in samples of foodstuff produced in Russia

PCDD/Fs	Milk	Butter	Liver	Sausage	Poultry
2378-TCDD	1.9±0.29	0.14±0.1	0.81± 0.47	0.18 ±0.10	0.18± 0.13
12378-PnCDD	0.51± 0.41	0.06±0.05	1.78± 1.60	0.26 ±0.24	0.38± 0,25
123478-HxCDD	0.55± 0.76	0.11±0.10	0.85± 1.05	0.26 ±0.20	0.28± 0,14
123678-HxCDD	0.96± 0.82	0.25±0.24	1.84± 0.93	0.29 ±0.22	0.45± 0,17
123789-HxCDD	0.97± 1.12	0.15±0.15	2.58± 4.25	0.24± 0.23	0.19± 0,07
1234678-HpCDD	2.89± 1.57	0.98±0.75	6.82± 3.15	0.85± 0.51	1.11± 0,67
OCDD	8.13± 4.58	2.79±2.06	18.5± 3.59	2.87± 1.19	3.2± 2.08
2378-TCDF	0.71± 0.49	0.55±0.29	3.62± 1.73	1.69± 1.02	1.7± 0.42
12378-PnCDF	0.96± 0.83	0.25±0.10	1.5± 0.31	0.73± 0.38	0.71± 0.19
23478-PnCDF	1.25± 0.70	0.87±0.36	2.41± 0.54	1.54± 1.19	1.15± 0.36
123478-HxCDF	2.40± 2.51	0.66±0.45	3.2± 1.90	1.12± 1.02	0.76± 0.25
123678-HxCDF	1.17± 0.94	0.28±0.15	1.7± 1.13	0.65± 0.68	0.40± 0.21
123789-HxCDF	1.07± 1.53	0.2±0.07	1.11± 0.26	0.3 ±0.22	0.20± 0.07
2346678-HxCDF	0.96± 0.80	0.27±0.1	2.16± 1.73	0.59± 0.49	0.42± 0.20
1234678-HpCDF	3.1 ±1.36	0.92±0.82	5.65± 1.23	2.74± 4.19	0.98± 0.60
1234789-HpCDF	1.11± 1.79	0.20±0.04	0.95± 0.3	0.39± 0.58	0.20± 0.08
OCDF	5.74± 3.23	1.31±1.68	11.1± 2.73	1.8± 3.24	1.07± 0.30
WHO-TEQ	2.44 ±1.62	0.91±0.36	4.76± 1.52	1.68±1.06	1.42± 0.44

ND = ½ MDL

Of course these data may be used as a preliminary characteristic of foodstuff pollution in Russia taking into account vast territories and different levels of load on them.

However as far as in the examined regions there is no considerable excess over the Russian standards and comparison with the published data on Europe and North America is more often in favour of Russian products it is obvious that the level of PCDD/Fs pollution in Russia on the whole is lower and the risk of human exposure through the food chain in Russia is within admissible limits of content.

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PCDD/Fs Monitoring in Environmental Objects and Biological Samples from Irkutsk region, lake Baikal, Russia.

The concentration of PCDDs/Fs in some environmental matrices		
Site	Concentration	Reference
Products [pg.g ⁻¹ d..w. TEQ-WHO]		
Unblanched pulp, Baikal pulp&paper mill (BCBK)	0.66	Tarasova, Amirova et.al. Org. Comp., 43, 1999, 429-432
Blanched pulp, Baikal pulp&paper mill (BCBK)	0,49	Tarasova, Amirova et.al. Org. Comp., 43, 1999, 429-432
Caustic soda, mercurial electrolysis	5.75 pg/l	Tarasova, Amirova et.al. Org. Comp., 43, 1999, 429-432
Caustic soda, diaphragm method	5.24 pg/l	Tarasova, Amirova et.al. Org. Comp., 43, 1999, 429-432
BSBK sewage	2.16 pg/l	Tarasova, Amirova et.al. Org. Comp., 43, 1999, 429-432
polyphepan	0.15 pg/g	Tarasova, Amirova et.al. Org. Comp., 43, 1999, 429-432
The soot of burning of BCBK waste	7.22 pg/g	Tarasova, Amirova et.al. Org. Comp., 43, 1999, 429-432
Food salt	0.26 pg/g	Tarasova, Amirova et.al. Org. Comp., 43, 1999, 429-432

Sediments [pg.g ⁻¹ dry wt]		
Smut, wood burning	715.5	
Smut, coal burning, city Irkutsk	0.55	
Smut, coal burning, small boiler house,Irkutsk	2.47	

The concentrations of PCDDs/Fs in biota [pg.g ⁻¹ lipids] , I-TEQ		
Site	Concentration	Reference
Lake Baikal, seal, <i>phoca sibirika</i> , different sex and age, n=9	12.9-45.0	Unpublished data
Makpozooplanckon, lake Baikal	0.75	Org. Comp., 43, 1999, 429-432
Omul, lake Baikal	0.12	Unpublished data
Beef, vil. Kasianovka, Irkutsk region	1.36	Organohal.Comp. vol. 51, 2001, Dioxin-2001, page 298-301.
Butter, city Igorjievsk, Irkutsk region	1.33	Organohal.Comp. vol. 51, 2001, Dioxin-2001, page 298-301.
Pork, vil. Kasianovka, Irkutsk region	1.36	Organohal.Comp. vol. 51, 2001, Dioxin-2001, page 298-301.
Beef, Usolye region, Irkutsk region	2.25	Organohal.Comp. vol. 51, 2001, Dioxin-2001, page 298-301.

Pork, vil. Hadahan, Irkutsk region	0.51	Organohal.Comp. vol. 51, 2001, Dioxin-2001, page 298-301.
Fish, city Balagansk (окунь)	26,6	Mamontov&Amirova Organohal.Comp. vol. 46, 2000, page 503-506.
Fish, city Balagansk (плотва)	9,9	
Fish, city Bratsk (окунь)	7,6	
Fish, river Selenga (окунь)	7,5	
Fish, river Selenga (сапога)	4,2	
Fish, city Ust-Ilimsk (окунь)	13,6	
Fish, city Bratsk (сапога)	7,8	
Fish, city Irkutsk (плотва)	5,78	
Fish, city Irkutsk (хариус)	7,0	
Fish, city Ust-Ilimsk (хариус)	27,5	

The concentrations of PCDDs/Fs in human [pg.g ⁻¹ lipids] , I-TEQ		
Site	Concentration	Reference
Population, city Sajansk, pool, whole blood, pool, n=10	28.6	Amirova et.al., Org. Comp., 2001, v.52, 217-221
Cohort of firefighters, Shelekhovo, pool, n=6	24.7	Amirova et.al., Org. Comp., 2001, v.52, 217-221
Cohort of firefighters, Shelekhovo, individual, n=9	26.5-42.9	Amirova et.al., Org. Comp., 2001, v.52, 217-221
Cohort of firefighters, Shelekhovo, pool, n=7	30.1	Amirova et.al., Org. Comp., 2001, v.52, 217-221
Workers of Cable factory, pool, n=25, Shelekhovo		Amirova et.al., Org. Comp., 2001, v.52, 217-221

Kurgan city, soil	3.69	Final report US grant #827697801
Bottom sediment, Kurgan city Tobol river, artificial lake	0.87	Final report US grant #827697801
Bottom sediment, Adygeya republic	4.94	Final report US grant #827697801
Soil, Chita city	9.03	Final report US grant #827697801
Soil, Ufa city, industrial area of chemical and petrochem. Factories	12.0	Final report US grant #827697801
Soil, Kurgan city	3.69	Final report US grant #827697801
Soil Vladivostok city, 500-1000 v from municipal waste insinirator	407.8	