# RUSSIAN DIOXIN "HOT SPOT"–UFA. COMPARISON WITH SEVESO.

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## Introduction

Monitoring of areas with high level of dioxin pollution caused by production, accidents, application of phenoxyherbicides and problems of rehabilitation of these areas present an important social and scientific aspect of research in the field of POPs. Review of PCDD/Fs levels in soil of most polluted areas in the world (up to 100 ppb) is given in the report of Fiedler at al[1].

Earlier we reported about a source of dioxin pollution in the city of Ufa situated in the South Ural, Central Russia. The source of dioxin is a chemical plant Khimprom, including its sludge pits, a toxic waste disposal site, chlororganic waste incinerators, polluted territory and production buildings. The plant produced 2,4,5-T during the 60s, trichlorphenol to the late 80s and chlorine and some herbicides [2, 3] – up to its shutdown in 2005. The polluted territory still remains a source of PCDD/Fs emission spreading over residential areas. The area of the city with the population of 1.2 million is 753.7 km$^2$. The city stretches for 33 km from the east to the west and for 42 km from the north to the south. The industrial zone is situated in the north-east, prevalent wind direction is south-west. The large land size of the city and the prevailing winds allow for a high gradient of soil pollution – from background levels (2-4 ppt) to scores of ppb. PCDD/Fs concentrations in blood and breast milk exceed the background level in the region by 30-40%[2,4].

The results of PCDD/Fs monitoring in Ufa are compared with the data published on Seveso. These are two zones of extreme pollution with similar problems but different solutions.

## Methods and Materials

In this report we analyze the samples obtained in 1995-2005. Soil, material of buildings and sludge were sampled in the areas of the plant and of the city. Donors of breast milk were women living in the district very close to the plant and women living in the district of comparison which was situated far away from the plant. All requirements of the WHO methods for sampling were fulfilled. Thirty samples of fat tissue were obtained in 2004 by the method of biopsy. The samples were taken from inhabitants of the industrial zone who died of cardiovascular diseases. No emaciation of patients was observed. Therefore, adipose tissue concentrations of PCDD/Fs were not being rapidly transferred to the blood but rather the usual blood lipid/adipose tissue equilibrium was ongoing. Eight samples were available from residents in the area of comparison (1); some of them had been obtained earlier[5].

Data on PCDD/Fs concentrations in blood of 85 exposed workers of Khimprom (17-8520 TEQ pg/g lipids) [6] were used for characterizing the zone F. Data on blood analysis of the population (n=102) that had been obtained earlier[4, 5,7] were critically revised; inhabitants of the industrial district were selected from the list of donors and blood was sampled from 6 more people living close to the plant. All samples were analyzed individually. Methods for PCDD/Fs/PCBs determination in serum[7], milk[8], soil and waste[9] were described earlier. Data for comparison with parameters of polluted zone in Seveso were taken from the published reports[10-12].

## Results and Discussion

For the period of studying the polluted zone (1995-2005) close to the Khimprom plant in Ufa over 200 samples of environmental objects and human biological tissues were taken and analyzed. The analytical data permitted the defining of 3 zones: of extreme (F), high (G) and increased (H) pollution.

Mapping of the city area was performed on the basis of experimental data on soil and buildings pollution at present

time (table 1). Exact definition of borders was made by the results of PCDD/Fs determination in blood and breast milk. Thus, the highest content in breast milk (n=4, TEQ=20-53.7, medium – 35.8 pg/g lipids) was found in the leeward zone of Khimprom (Figure 1, microdistrict L).

Table 1**. Mean TEQ PCDD/Fs ppt, lipids based (biota) and d.w. (soil, sludge)**

| Zone | F | G | H |
|---|---|---|---|
| **Soil** | 10870.8 (n=31) | 143.7 (n=23) | 13.8 (n=12) |
| **Buildings** | 5658.2 (n=15) | 71 (n=3) | - |
| **Breast milk** | - | 30.4 (n=5) | 21.2 (n=20) |
| **Human fat** | - | - | 62.5 (n=28) |
| **Blood/serum** | 364 (1992, n=39), 230.8 (1995/97, n=32), 900.5 (1998/01, n=21) workers | 84 (n=6), population | 54.8 (n=29), population |

The area of real environmental pollution in Ufa now exceeds the scale of the incident in Seveso during the 70s[10] (Figure 1). TCP production volume by 10 times exceeded the capacity of the plant ICMESA. Besides, about 150 tons of 2,4,5-T had been produced. In the archive of the Fire Fighting Department there are data on fires and explosions in the buildings where 2,4,5-T and TCP were produced. As the workers witnessed, there was a spill of 10 tons of reaction mass in the territory of the plant. The situation is aggravated by the fact that accumulated reaction mass as a result of technological adaptation of 2,4,5-T production is stored outside the territory of Khimprom and is neither controlled nor properly protected and consequently is getting into the environment. In fact the situation in Ufa is a model of the incident in Seveso “diffused in time” but without appropriate decontamination.

At present the Khimprom plant is shutdown, all equipment is preserved, the source of emission – chlororganic waste incinerator – is dismantled. But the problem of the polluted area and toxic waste is not yet solved. Now a program is being developed for liquidation of this dangerous plant and decontamination of the territory.

Many years of polluting the city naturally influenced the background level of the whole population including far away districts of the city. Gradient of soil pollution is rather high. PCDD/Fs content in blood and fat of the city dwellers is increased by bioaccumulation during lifetime and considerably depends on the age. Breast milk as a matrix reacts on the gradient of dioxin load in the less degree because there are age limitations. However the available data on exposure of inhabitants of a distant district of the city (zone K, Figure 1, Table 3) confirm the existing difference in the exposure level.

Table 2. **Comparison of Ufa incident with explosion in Seveso**

| Parameter | Seveso[10-12] | Ufa[2-9] |
|---|---|---|
| **Incident type** | Explosion of reactor | Production, emergency emission |
| Period of operation | 1970-1972, 1975-1976 (TCP, 150 ton/year) | 1965-1967 (2,4,5-T, 100 ton/year)<br>1962-1987 (TCP, 1000 ton/year) |
| Incident time | 1976 | 1962-1987 |
| The area of the impact | Zone A – 0.8 $km^2$<br>Zone B – 2.7 $km^2$<br>Zone R – 14.3 $km^2$ | Zone F – Khimprom – 1.4 $km^2$<br>Zone G – industrial zone – 5 $km^2$<br>Zone H – district of Ufa – 134 $km^2$ |
| Soil pollution level, 2378-TCDD | Zone A – 2.3 – 54 ppb<br>Zone B – 0.01 – 0.4 ppb<br>Zone R – 100 ppt | Zone F – 10-200 ppb<br>Zone G – 0.01 – 0.2 ppb<br>Zone H – 3-9 ppt |
| Human impact | 187 cases of chloracne | More than 135 cases of chloracne |
| Number of exposed people | Zone A - 736<br>Zone B – 4,737<br>Zone R- -31,800<br>Non-ABR-185,225 | Zone F - >3,000 (workers)<br>Zone G – 2,500<br>Zone H - >300,000<br>Non-FGH-800,000 |
| 2378-TCDD in blood samples, ppt, lipids based, mean or interval | Zone A - 828–56,000 (n=19, 1976), 61.5 (n=6, 1992/3), 16.6-262.1 (n=33, 1993/1998)<br>Zone B – 16.8 (n=52, 1992/3), 7.0-95.0 (n=36, 1993/1998)<br>Zone R-0.5-18.4 (n=73, 1993/1998)<br>Non ABR–5.3 (n=52, 1992/3) | Zone F – 267 (n=39, 1992), 125.1 (n=38, 1995/7), 548.9, max 4101.2 (n=32, 1998/01) -workers<br>Zone G – 26.6 (n=5, 2004)<br>Zone H – 15.9 (n=23, 1998-2004)<br>Non FGH–12.1 (n=35, 1998/2005) |
| Utilized materials | Tank Seveso – 200,000 $m^3$<br>Tank Meda – 80,000 $m^3$ | 530,000 $m^3$ of sludge, (>11.2 ppb)<br>46,200 $m^3$ of soil, (>10ppb), 50,000 $m^3$ of toxic waste (up to 200 ppb)<br>>500,000 $m^3$ of buildings (<15 ppb)* |

*this value may be by an order higher because not all buildings have yet been examined.

Table 3. **Background levels of the city of Ufa (zone K), ppt, lipids based and d.w. (soil)**

| Sample | n | 2378-TCDD | TEQ PCDD/Fs |
|---|---|---|---|
| **Soil** | 15 | 1.7 | 4.7 |
| Breast milk | 7 | 7.2 | 18.2 |
| Human fat | 5 | 7.5 | 22.4 |
| Blood/serum | 9 | 7.4 | 27.7 |

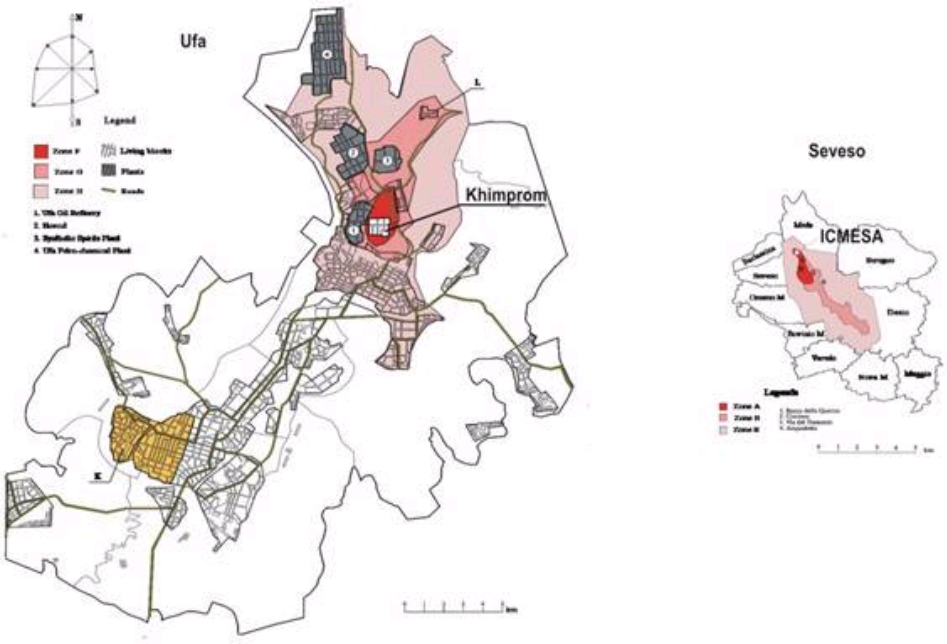


Figure 1. **Comparison of two regions of high PCDD/Fs pollution**

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**References**

1. Fiedler H., Buckley-Golden P., Coleman P., King. K., Petersen A. (1999) Organohalog. Comp. 43, 151.

2. Amirova Z., Amerkhanov K., Kruglov E., Loshkina E., Khalilov R. (1999) Organohal. Comp. 44: 299-302.

3. Maistrenko V.N., Kruglov E.A., Amirova Z.K., Chamitov R.Z. (1998) Chemoshpere.37, 9-12: 1699-1708.

4. Amirova Z., Kruglov E. (2001) Organohal. Comp.52: 269-273.

5. Amirova Z., Kruglov E., Loshkina E., Chalilov R.(1998) Organohal. Comp. 38: 105-108.

6. Ryan J., AmirovaZ.and Carrier G. (2002) Environ.HealthPersp. 110: 699-701.

7. Amirova Z., Matorova N., Kruglov E., Loshkina E., Khalilov R., Khalikova N.(2003) Org..Comp.64:199.

8. Amirova Z., Kruglov E., Kuramshina N., Loshkina E., Khalilov R. (2003) Organohal. Comp. 64: 108-111.

9. Amirova Z., KruglovE.. (2002) Organohal. Comp.57: 281-285.

10. Seveso.20 years after.From dioxin to the Oak Wood.(Ramondetta M., Repossi A. Eds.) (1998) 18-40.

11. IARC Monogr. Eval. Carc. Risk Hum, 1997, 69: 64-65..

12. Baccarelli A., Pesatori A., Consonni D., Mocarelli P., Patterson D., Bonzini M., Giacomini S., Caporaso N., Bertazzi A., Landi T. (2004) Organohal. Comp.66: 2694-2699.