

PCDD/PCDF and related compounds; the Bashkortostan Republic situation

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1. Introduction

The situation in the Bashkortostan Republic with respect to the environmental contamination by chlorinated dioxins (PCDD) and dibenzofurans (PCDF) were described in a most samples¹⁻⁴. The research program was initiated in 1990 by the detection of relatively high levels of PCDD/PCDF in drinking water in Ufa⁵. In 1993 the Parliament of Bashkortostan Republic began realisation of the program "Dioxin" - an environmental monitoring on the presence of dioxins and others chlorinated compounds. The main items of the program are:

- detection of dioxins and assessment of their emissions from chemical plants;
- the assessment of the dioxin contamination of the environment;
- the assessment of population health.

In 1990-1994 more than 600 samples of water, soil, air and food were analyzed. The detection of PCDD/PCDF levels were carried out in laboratories of the Institute of Evolutional Morphology and Ecology of Animals of Russian Academy of Sciences (Moscow, Dr. N. Kluev), the Scientific Research Center for Emergencies of Russia (Moscow, Dr. S. Semenov), the Institute of Problems for Applied Ecology and Natural Resources Use of Bashkortostan Republic (Ufa, Dr. F. Khizbullin) and the Ecological Center of Bashkortostan Republic (Ufa, Dr. E. Kruglov).

The results of these studies, as far as available at that moment, have been summarized in a "Concluding account on dioxins" which was published in December 1994 by Institute of Problems for Applied Ecology and Natural Resources Use of Bashkortostan Republic in Ufa, Russia⁶.

2. Emission

The main sources of environmental contamination by PCDD/PCDF in the Bashkortostan Republic are the chemical plants "Khimprom" in Ufa and "Kaustic" in Sterlitamak, which more then 40 years are manufacturing different chlororganic products including pesticide 2,4,5-T and 2,4-D produced at various times. Within manufacturing process of these products PCDD/PCDF (0,2-60 ppt, conc. TEQ) are formed, which are extracted by charcoal filters and the residual amount are going to biological water treatment installations by sewage and as a sludge is stored at special places.

During the operation of "Khimprom" is stored about 530 000 m³ of sludge with dioxins content 7-21 ppt. The plant territory and premises are also highly contaminated of PCDD/PCDF, which are themselves the secondary sources of dioxins emission. So, the soil around the installations, which are 2,4-D and trichlorphenol manufactured, contain about 300 ppt of 2,3,7,8-TCDD. The lime plaster of premises

5. Air

Here are not so many data concerning the detection of PCDD/PCDF presence in air in comparison with water and soil. It is noticed that at distance of 5 km from "Khimprom" the content of PCDD/PCDF in air is 0,1-0,2 pg/m³ and it depends from weather conditions. Based on data received from snow water analyses it was defined that per day on 1 m² of ground surface at the distance of 1 km from "Khimprom" is fallen 4,5 ng of dioxins. In 1995 is planning the detailed study of emission sources of dioxins in air: furnaces of incineration of toxic industrial waste, of household waste, metallurgic installations, thermal equipment of oil/chemical plants.

6. Food

First analyses on content of PCDD/PCDF in food were made in 1993 and it was connected with assessment of dioxins emission from "Khimprom" on the nearest gardens. The analyses data show that the vegetables (tomato, cabbage, dill etc.) contain from 118 to 812 ppq of PCDD/PCDF. Beginning from 1994 there is carried out the program of dioxins detecting in animal food: in milk, dairy, cheese, meat, sausage products. In each item there was detected the presence of dioxins, in most of them the PCDD/PCDF concentrations are exceeding the Russia norms from 1,3 to 3,6 times more. So, beef has 3,4 ppt of PCDD/PCDF (exceeds 3,6), pork - 1,3 ppt (exceeds 2,0), chicken - 1,5 ppt, cheese and dairy products - 6,9 ppt (exceeds 1,3). Preliminary calculations of daily coming of dioxins into human in Ufa and Sterlitamak show that only with meat and dairy products they are receiving about 500 pg PCDD/PCDF.

7. Biosamples

The presence of PCDD/PCDF in blood and breast milk of women from Ufa and Sterlitamak prove the environmental pollution by dioxins in Bashkortostan Republic. Dioxin concentration depends on place of location. If the women who live not far from chemical and oil/chemical plants have the concentration of PCDD/PCDF in breast milk equal to 5,6-23,5 ppt, then in general in Ufa this value is 1,1-1,7 ppt. The breast milk of women from Sterlitamak contain PCDD/PCDF equal to 40-110 ppt. The higher concentrations of dioxins have the women working at "Kaustik" - 160-180 ppt. Keeping these data in mind the PCDD/PCDF content in breast milk of women should be considered as a high one and arises the worry.

High level of PCDD/PCDF content is defined in blood of workers from "Khimprom" and "Kaustik". So, content of 2,3,7,8-TCDD in blood of Ufa inhabitant is 12 ppt²⁾. But the "Khimprom" workers have the dioxins concentration 10 times higher, and their children - 4 times more. The content of 2,3,7,8-TCDD in fat layer of Ufa population is 16-22 ppt, though maximum values reach even 129 ppt.

8. Conclusion

Therefore, the above data prove the considerable contamination of environment in Bashkortostan Republic by PCDD/PCDF. Despite the fact that maximum contamination is more characteristic for industrial area of Ufa and Sterlitamak, dioxins emission from "Khimprom" and "Kaustik" lead to their entering into water, air, soil at the zones of living and accumulating in human.

To eliminate the environmental pollution by dioxins is developed a complex of measures which include:

- gradual transference of chlororganic productions at "Khimprom" and "Kaustik" on safely technologies with decreasing manufacturing and transference in future on products manufacture without chlor;
- construction of equipment on thermal burning of sludge;
- treatment and rehabilitation of contaminated territories;
- conservation of installations where herbicide 2,4,5-T and trichlorphenol is produced;

these installations contain more than 570 ppb of 2,3,7,8-TCDD. The considerable amounts of 2,3,7,8-TCDD are effluent into an atmosphere by exhaust-ventilation fans - from 310 to 950 $\mu\text{g}/\text{m}^3$. It was made a conclusion according to a content of PCDD/PCDF in snow that dioxins emission from "Khimprom" is 900 g per year.

PCDD/PCDF are defined also in sewage and sludge from "Kaustik". For example, sewage contain 0,5 ppt of PCDD/PCDF, sludge - 40 ppt and soil of plant territory - up to 380 ppt dioxins.

The another source of dioxins emission into the environment is the Ufa municipal dump of industrial and household waste. During exploitation of the dump more than 6 000 000 m^3 of waste are stored, which contain from 50 to 2500 ppt of PCDD/PCDF. Dioxins are detected in rain water from dump (560-560 ppq) and in subsurface water at the depth of 8-10 m with concentrations from 1 to 8 ppt that prove the presence of dioxincontaining waste.

3. Water

Emission of PCDD/PCDF with sewage and gas effluents from "Khimprom" and "Kaustik" lead to contamination of open water storage by dioxins. First messages of PCDD/PCDF presence in water of Belaja river and Ufa river were appeared in 1990⁵⁾. Analyses showed that the content of PCDD/PCDF in drinking water is equal to 0,5-1,0 ppq. The majority amount of dioxins comes to water reservoirs with air effluents and at spring-time - with surface and subsurface waters. Data on dioxins concentration in river water are shown below:

Belaja river above Sterlitamak	2,3 ppq
Belaja river below Sterlitamak	5,7 ppq
Belaja river above Ufa	1,7 ppq
Belaja river below Ufa	6,0 ppq
Ufa river near south water intake	1,0 ppq
Ufa river near north water intake	0,6 ppq
Inzer river	1,8 ppq
Zilim river	0,2 ppq

80% of total analyzed samples show the presence of non toxic di- and trichlorinated PCDD. But they may be chlorinated during water treatment and become dangerous. As it should be expected the content of PCDD/PCDF in Belaya river is increased below the Ufa and Sterlitamak, and then gradually reduced to background level. The pollution of open water reservoirs by dioxins clearly seen from data received after river sediments analyses:

Belaja river near "Khimprom"	28,5 ppt
Ufa river near south water intake	2,0 ppt
Ufa river at confluence of Shugurovka river	12,7 ppt
Shugurovka river	110,9 ppt

4. Soil

According to soil analyses taken in Ufa and Sterlitamak the concentrations of PCDD/PCDF in soil of urban territories is on the level of 1 to 20 ppt and does not exceed the norms for Russia. High concentrations of PCDD/PCDF are detected in industrial zones not far from chemical and oil/chemical plants of Ufa - 280-980 ppt. In majority of farm regions PCDD/PCDF content in soil is 0,01-0,13 ppt and does not exceed the allowable level of 10 ppt. Main source of PCDD/PCDF entrance in soil in farm regions is 2,4-D in which the content of dioxins is 0,1-0,2 ppb.

- realisation of technical solutions for decrease of dioxins discharge into air;
- treatment of surface and subsurface waters from "Khimprom", "Kaustik" and urban dumps;
- building of municipal solid waste incineration plants;
- modernisation of urban treatment installations;
- building of the plant to solid waste incineration from industrial enterprises;
- reconstruction of water intake structures;
- to transfer the gardens from industrial zones to suitable environmental areas.

9. References

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