2,3,7,8-Tetrachlorodibenzo-p-dioxin in Russian Environmental Samples

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At present environmental with polychlorinated dibenzo-pdioxins (PCDD) and dibenzofurans (PCDF) is considered to be one of the global problems.

This problem has been intensively studied abroad since mass injury in Vietnam, Sevezo, Missouri became known. However as a result of numerous studies found were also the stationary long-term sources of PCDD and PCDF emissions occuring in any industrial country. These xenobiotics are not the special production of the mankind and present as admixtures in various forms of human activities. Their main danger consists in the fact that having possess high biological activity, they can be accumulated in living organisms and cause distant negative consequences.

Therefore, in last decades the danger of global biosphere contamination arose from the development of industry and transport in many countries.

The republics of former USSR, including Russia are not the exception. And if so far the occasions of mass injury as a result of accidents are not known, some types of production as well as the foreign ones can be the source of such xenobiotics and contribute to biosphere contamination.

Unfortunately, the own papers on the environmental contamination levels for some territories of our country are not published.

One of the reasons is the lack of reliable precision equipment necessary for analyzing PCDD, PCDF. Therefore such an analysis of dioxins has been performed in over country quite recently.

The "Typhoon" has the analytical centre equipped with chromato-mass-spectral apparatus of the leading western firms: Hewlett-Packard, Finnigan, Nermag, Carlo Erba which permits to solve the complex analytical problem of estimating dioxins at the level of 10 pKg/Kg accepted in the world practice.

The five-year experience of the centre in assimilating the best foreign methods and in developing own methods of analysis allows to determine PCDD and PCDF in various media, including biota and air [1,2].

The laboratories of the centre participated in the

interlaboratory calibration with the positive result on PCDD isomer analysis in water.

The monitoring of the most toxic of isomers 2,3,7,8-TCDD in the environmental objects has been carried out by the Goskomhydromet network. Studied were the territories of plants producing chlorphenols, 2,4-dichlor- and 2,4,5-trichlorophenoxyacetic acid and pesticides on their basis as well as incinerator discharges in industrial cities.

Analysed were the chemical products of these plants, soil in the plant territories and the near the plant, river silts in the place of waste water discharge and some dust samples on plants and dwelling houses.

2,3,7,8-tetrachlorodibenzo-p-dioxin levels in samples were estimated by the chromato-mass-spectrometer method. The sample extraction was carried out on the Sohxlet apparatus with azeotropic benzol and ethyl alochol mixture (68:32), after cleaning with silicagel and aluminium oxide the extracts were analyzed on ITD-800 Finnigan MAT with the capillar column 50 m x 0,32 mm, the DB-DIOXIN phase 5 with the labelled standard C13-2,3,7,8-TCDD.

In consequence of these studies established was the contamination of chemical products and natural environment in the regions of related Chimprom facilities (production of chlorophenols and herbicides on their basis) in Moscow and Samara regions, Bashkiriya, Rubezhnoe. The levels of 2,3,7,,8-TCDD in various objects in the area of these sources are presented in Table 1.

Table 1

2,3,7,8-TCDD in some objects from "Chimprom" plant regions

Region, district, town	Object	2,3,7,8-TCDD level
Bashkiriya	Chlorphenol	0.29 μg/kg
	Amine salt 2,4-D	0.60-0.22 μg/kg
	Soil (in the plant territory)	0.9; 9.6; 40 μg/kg
	Silt (accident release place)	0.5-4.0 μg/kg
	Snow (1 km from the plant)	3.5 ng/l (4.5 ng/m^2 day)
Moscow region	Trichlorometaphos	5 μg/kg
	2,4,5-trichlorphenole	140 μg/kg
	Soil (in the plant territory)	1.0-4.8 μg/kg
Samara region	Pentachlorophenolat	83.30 μg/kg
	Soil (in the plant territory)	18.70 μg/kg
	Silt (sludge accumulator)	150.80 μg/kg
	Water	0.01 ng/l
	Dust from the road (housing area)	0.056 μg/kg
	Washout from the leaves (Kinder-garten)	0.002 μg/kg
	Dust from the house roof	0.170 μg/kg
Rubezhnoye	Hexachlorophen	902 μg/kg

Unfortunately, our country has no scientifically justified norms of these substance contens in various media (except the MPC in water equal to 20 pg/l) to estimate the danger of these dioxin levels for a person. The existing foreign MPC's of dioxins in air, soil and water calculated from permissible intake norms into a person (from 0.1 to 10 pg/kg day) differ significantly in various countries. However even the most maximum of them are by orders of magnitude lower than those presented in Table 1. The presence of dioxins in the products of Chimprom facilities which then are utilized in various branches of national economy, extends the sphere of dioxin influence on the society transformating these facilities from local to global dioxin sources.

So, the bactericide fabric treated with hexachlorophenol containing 902 μg/kg of 2,3,7,8-TCDD poses a real danger when its utilization, causing the "chloraKne" disease. The application of trichlorometaphose-3, 2,4,5-trichlorophenol and sodium pentachlorophenolate as herbicides favours the comtamination of soil, plants, food products and then in food-chains the accumulation of dioxins in human organisms.

The data of Table 1 clearly evidence the environmental contamination in the region of Chimprom plants. So, soil contamination in the plant territory (from 0.9 to 40 μg/kg) corresponds to contamination in the maximum zone after the Sevezo accident (5-545 μg/kg) [3]. The enormous of dioxins accumulated in the sludge accumulators (tens and hundreds of thousands tons of sludge with the concentration of 150.8 μg/kg in ChapaevsK) as well their possible ingress into ground and river water make the problem of sludge utilization urgent which in our country has not been solved yet. It is worth noting the high levels of dioxins in the natural environment in the areas adjacent to the plants (Table 1); in soil, leaves, dust on roofs and roads. It is the direct way of dioxin ingress into the human organism.

The accumulation of 2,3,7,8-TCDD in river silt can be the cause of this toxicant accumulation in zoobentos, fish and then in a person.

The results of inspecting regions of incinirators in Moscow, Murmansk, Kiev and Rubezhnoye shoved the high levels of 2,3,7,8-TCDD in ash (Table 2).

Table 2

2,3,7,8-TCDD level in incinirator ash

Town	2,3,7,8-TCDD in μg/kg
Moscow	0.1-0.2
Kiev	0.1
MurmansK	0.9
Rubezhnoye (industrial wastes)	2.3

This fact arouses the alarm because these incinirators are located in the residential districts, the technologies of ash utilization or burial after burning are missing.

Unfortunately, the obtained results of inspecting various sources give the episodic, selective information which does not allow to estimate the environmental dioxin load for the whole regions. More detailed complex studies of the effects of dioxin sources as well as the establishment of new sources are necessary to recognise the contamination scales and to estimate its danger for population.

The following problems are suggested to be considered in the nearest future:

1. To organize the dioxin monitoring in the country. On the basis of national dioxin monitoring data to compile the maps of contaminated regions, to calculate the hazard dioxin concentrations for human health in isolated regions.

2. To participate in the international collaboration on the dioxin problem in the framework of national programs to study the global transfer of these hazarad substances as well as to work out joint solutions on preventing dioxin releases by various types of technology in industry, agriculture and public services of the country.

References

Rakhmanova T. V., Samsonov D. P., Pervunina R. I., Kiryukhin V. P. Determination of 2,3,7,8-tetrachlorodibenzo-p-dioxin in ash of garbage disposal plants. *Journal of analytical chemistry* 1991;46:6-1163-1168.

Rakhmanova T. V., Samsonov D. P., Pervunina R. I., Kiryukhin V. P. Determination of 2,3,7,8-tetrachlorodibenzo-p-dioxin in some pesticides. *Agrochemistry* 1991; 7-114-115.

Merlo F., Puntoni R., Cerlesi S., Raschetti R. and Strigini P. The assessment of exposure to 2,3,7,8-tetrachlorodibenzo-p-dioxin (TCDD) in the Sevezo area: a novel approach. *Chemosphere 1989; 18:1-6, 913-920*