PUBLIC HEALTH AND DIOXIN IN THE DELTA OF THE RIVER OF VOLGA

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Introduction

Among contemporary problems which present a threat to the population the accumulation of Dioxin in natural environments in hazardous quantities as well as its structural analogues (PCDD/PCDF) is considered to be a priority issue. The wide spread of such substances in the environment and their extreme toxicity put them on top of the list of super ecological toxicants. A multi aspect problem has emerged which includes the necessity to determine possible sources for PCDD/PCDF contamination, to assess the degree of contamination danger for certain natural sites in the environment and for products of industry, the health condition of individuals who have had a direct or indirect contact with substances like Dioxin. The problem also includes the early detection of intoxication, justification of the selected methods for contamination risk reduction, rehabilitation of contaminated territories, the selection of existing means and methods for prevention and treatment of intoxication as well as the development of new ones for prophylactic responses.

In the Astrakhan Region 83 wood working and paper -and- pulp industrial facilities operate as well as 25 printing houses. They mainly pollute open natural water basins, soil, and may be the agricultural crops being grown there also.

Materials and methods

In 1997-1998 with due consideration for the geographic position of the Astrakhan Region and possible sources of industry generated PCDD/PCDF research has been carried out to determine the degree of contamination with those toxicants and their possible role in the morbidity rate among populations. Sample analyses were conducted for the content of toxic isomers of PCDD/PCDF, they were performed with the help of chromatographic mass spectrometric method and the use of internal standards ($^{13}ё_{12}$-PCDD).

In the framework of the Epidemiology Research Program, a retrospective study has been conducted for the morbidity and mortality rates of the population and certain indicators of the women reproductive function in the Astrakhan Region based on the official medical statistics for the 1991-1996 period. It was done with the aim of detection possible symptoms of chronic "Dioxin" effects.

Results

1. In the framework of this work soil sample analyses have been done, the samples were taken in different areas of the Astrakhan Region (Table 1).

Table 1

Quantity of PCDD/PCDF in Soil Samples (pg/g or ng/kg) in I-TEQ

Component to be determined	Sample Code						
	10s	3s	15s	19s	17s	1s	16s
1	2	3	4	5	6	7	8
2,3,7,8-TCDD	0.8	1.14	9.6	0.47	2.4	-	-
1,2,3,7,8-PCDD	-	1.23	0.55	-	0.55	-	-
1,2,3,4,7,8-HxCDD	-	0.529	-	-	-	-	-
1,2,3,6,7,8-HxCDD	0.31	0.316	-	-	0.22	-	-
1,2,3,7,8,9-HxCDD	-	0.111	-	-	0.20	-	-
1,2,3,4,6,7,8-HpCDD	0.026	0.096	0.034	0.026	0.054	0.029	0.018
éîÑÑ	0.0128	0.06	0.0755	0.012	0.0259	0.022	0.017
2,3,7,8-TCDF	-	1.824	0.08	0.158	0.62	-	0.099
1,2,3,7,8-PCDF	-	0.16	-	0.042	-	-	0.020
2,3,4,7,8-PCDF	-	2.355	0.45	0.58	1.85	-	0.355
1,2,3,4,7,8-HxCDF	-	-	0.46	-	1.38	-	-
1,2,3,6,7,8-HxCDF	-	1.953	-	-	0.73	-	-
2,3,4,6,7,8-HxCDF	-	0.559	-	-	0.44	-	-
1,2,3,7,8,9-HxCDF	-	-	-	-	0.22	-	-
1,2,3,4,6,7,8-HpCDF	0.022	0.091	-	0.012	0.136	-	0.059
1,2,3,4,7,8,9-HpCDF	-	0.013	-	-	-	-	-
éCDF	0.0046	0.019	0.0178	0.002	0.0077	-	0.012
Total Concentration in I-TEQ	**1,171**	**10.786**	**11.27**	**1.302**	**8.83**	**0.051**	**0.579**

All the samples which were analyzed, except for 1s, were taken in the zones, which are not used in agriculture. As was well expected, the highest soil pollution level in the Astrakhan Region was found in the residential areas close to the Integrated Pulp and Cardboard Mill in the city of Astrakhan and in the communal land fill of the town of Akhtubinsk. The detected contamination level can be characterized as permissible.

Migration of Dioxin in the soil has a gas phase; the vertical Dioxin transport connected with the water phase is not considerable. This is why the ground waters are not likely to be polluted with PCDD/PCDF to reach a dangerous level for humans. However, part of PCDD/PCDF is washed down from the soil surface with rain waters into open basins. Besides, dioxins and benzo-furanes get into open basins with waste waters, they settle down and accumulate in the bottom silt layers.

A quantitative and qualitative analyses of the bottom sediments were done, from the samples taken in open water basins of the Astrakhan Region (Table 2).

The presented data demonstrate existence of dioxin and its analogues in different locations of open water basins in the Astrakhan Region territory. The highest content level was detected in the natural preserve area. This can be explained with the fact that open water

basins in the Astrakhan Region collect water from the huge water highway - the Volga River which takes in the waste from so many industrial facilities, and that waste contains PCDD/PCDF.

Table 2

Quantity of PCDD/PCDF in the bottom silt samples (pg/g or ng/kg) in I-TEQ

Component to be determined	Sample Code								
	2b	5b	9b	12b	23b	25b	27b	28b	3b
1	2	3	4	5	6	7	8	9	10
2,3,7,8-ïïÑÑ	-	-	-	1.5	3.8	1.1	-	-	1.33
1,2,3,7,8-èÂïÑÑ	-	-	-	-	0.65	-	-	-	-
1,2,3,4,7,8-ÉÍïÑÑ	-	-	-	-	-	0.33	-	-	0.599
1,2,3,6,7,8-ÉÍïÑÑ	0.15	-	0.33	-	0.07	0.29	-	-	-
1,2,3,7,8,9-ÉÍïÑÑ	-	-	-	-	-	0.24	-	-	-
1,2,3,4,6,7,8-ÉÔïÑÑ	0.023	-	0.036	0.041	0.031	-	0.076	0.019	0.046
éïÑÑ	0.0142	0.008	0.009	0.016	0.022	0.095	0.064	0.009	0.036
2,3,7,8-ïïÑî	-	-	-	0.04	0.07	-	-	-	0.088
1,2,3,7,8-èÂïÑî	-	-	-	-	-	-	-	-	-
2,3,4,7,8-èÂïÑî	-	-	-	-	-	-	-	-	-
1,2,3,4,7,8-ÉÍïÑî	-	-	-	-	-	-	-	-	-
1,2,3,6,7,8-ÉÍïÑî	-	-	-	-	-	-	-	-	-
2,3,4,6,7,8-ÉÔïÑî	-	-	-	-	-	-	-	-	-
1,2,3,7,8,9-ÉÍïÑî	-	-	-	-	-	-	-	-	-
1,2,3,4,6,7,8-ÉÔïî	0.043	-	0.016	-	-	-	-	-	-
1,2,3,4,7,8,9-ÉÔïÑî	-	-	-	-	-	-	-	-	-
éïÑî	-	-	-	-	0.007	0.084	-	-	.003
Total Concentration in I-TEQ	**0.230**	**0.008**	**0.375**	**1.597**	**4.650**	**2.14**	**0.140**	**0.028**	**.114**

2. The general morbidity rate, according to the International Disease Classification, and judging by the complaint rate of adult population in the Astrakhan Region between 1991-1996 was 1260,4 per 1000, which is 20 % higher than the mean level for the Russian Federation in the same time frame.

Average annual number nervous diseases, sensory disorders and those of musculoskeletal system and connective tissues in the Astrakhan Region surmounted the similar mean values for the Russian Federation accordingly by 12.7%, 4.5% and 8.1%, which, apparently, could be accounted for possible Dioxin effect. However, basic indicators in the correlation-and regression analysis of the disease incidence which was based on the complaint rate among adult population of the Astrakhan Region in 1991-1996, arise doubt about considerable role of the PCDD/PCDF effects to cause the above mentioned diseases in the Astrakhan Region. To justify this conclusion it should be noted that no high rates were found or proved changes in the dynamics of skin and subcutaneous fat tissue diseases (Class XII).

Children are more sensitive to Dioxin exposure and they unlike the adults are not

subjected to harmful effects of hazardous occupational factors. Therefore it was deemed desirable to conduct a retrospective analysis of disease incidence in this category of population.

The mean level of crude morbidity rate among child populations in the Astrakhan Region in 1991-1996 was 1,391.0 per 1,000, which did not have substantial differences from the child disease level in general for the Russian Federation during the same period (1,419.1 per 1,000).

The leading disease classes among the children age groups from 0 to 14 years old in the Astrakhan Region in 1991-1996 were the following: respiratory diseases which accounted for 645.3 per 1,000 of child population (767.2 in Russian Federation in general), diseases of the nervous system and sensory organs - 114.7 per 1,000 (143.8 in RF), infectious diseases and parasitosis (Class I) - 109.3 per 1,000 (121.6 in RF), skin and hypodermic tissue diseases (Class XII) - 92.9 per 1,000 (86.0 in RF), traumas and poisonings - 68.1 per 1,000 (59 in RF). That is, Class XII is the only one in which the Astrahkan children's rate is substantially higher than the national level, at the same time exactly this class is the most decisive one in determining the Dioxin exposure effects.

Similar to adults the rate of blood and hemopoietic organ diseases (Class IV) of the Astrakhan Region children was 9% higher than the mean rates in RF (15.0 and 13.7 per 1,000 respectively). Also equally to adult population 86,2% of such disorders were cases of anemia. Most substantial differences were observed in congenital anomalies, which, similar to the chloracne, are rather characteristic of chronic Dioxin effects.

In the Astrakhan Region the occurrence of this kind of pathology among children was 24.7 per 1,000 (13.0 in RF). For the analyzed period six disease classes for the children population of the Astrakhan Region had a marked growth trend, and an absolute majority of them were found to be environmentally predetermined, including developments which are somewhat characteristic of the Dioxin effects (neoplasm, endocrinopathy, nutritional, metabolic and immune disorders, nervous diseases).

In the Astrakhan Region a high level of congenital anomalies is noted, the main reasons for that are chronic hypoxia of the fetus, jaundice, perinatal encephalopathy, which deserves special attention in connection with the Dioxin effects, and anomalies of the muscloskeletal system. On the other side, anticipated growth of congenital hypotrophy cases was not determined. But still, it is to be admitted that a high rate of congenital development anomaly (defects) and other environmentally predetermined diseases among children in the Astrakhan Region should be studied as possible consequences of "dioxin" chronic effects.

Discussion

The completed research on the pollution levels of soil, bottom silt in the open water basins, agricultural soil and grains grown in the Astrakhan Region, showed a moderate degree of pollution with PCDD/PCDF and allowed the investigators to locate main pollution sources. They turned out to be associated with traditional well known sources. Concerning the general spread background, it is determined by the wash down pollution downstream in the Volga River basin and also by the global pollution factors.

The negative trends which were found in the population health status of the Astrakhan Region can be treated as consequences of chronic chemical effects part of which can be related to possible effects by PCDD/PCDF.

This research should be viewed only as preliminary, further special research is required.