

Dioxins and furans in industrial aerosols of Altaiskii Krai

**Yu.I. Vinokurov, A.E. Kaplinskii, M.A. Mal'gin, S.V. Morozov,
V.E. Pavlov, A.V. Puzanov, I.A. Sutorikhin, and M.A. Fedulkina**

*Institute of Water and Ecological Problems,
Siberian Branch of the Russian Academy of Sciences, Barnaul
N.I. Vorozhtsov Institute of Organic Chemistry,
Siberian Branch of the Russian Academy of Sciences, Novosibirsk
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Samples of snow polluted with an anthropogenic aerosol were analyzed chemically for highly dangerous toxins such as polychlorinated dibenzoxines and dibenzofurans. Snow was sampled in most industrial centers of Altaiskii Krai and in Gorno-Altai. Zones of toxin accumulation in the environment were detected, as well as the sites where the concentration of toxins in thawing snow exceeded the permissible level.

Polychlorinated dibenzodioxins (PCDD) and dibenzofurans (PCDF) usually come to the environment from industrial processes that use of chlorous organic compounds, and waste recovery.¹⁻⁴ Already first studies of the abundance of these highly dangerous toxins in soil of Altaiskii Krai have shown that there are at least two towns: Slavgorod and Yarovoe, where their concentration could markedly exceed the permissible levels.⁵ This gave rise to the necessity in extensive studies of pollution of industrial centers and rural areas with these substances. At the same time, it was necessary to answer the question whether soil is being currently polluted or pollution is the result of accumulation of industrial discharges. This paper presents some results of such studies.

According to literature, dioxins and furans, during their formation in some or other technogenic

processes, are usually sorbed on aerosols.¹ Snow cover is a good natural accumulator of aerosol in winter season. Starting from these grounds, snow was sampled during the time before it starts to thaw, from February 25 to March 6 of 1998 over the territory of Altaiskii Krai and in Gorno-Altai. The sampling was carried out in accordance with the rules of snow sampling, which are accepted in meteorology and hydrology.⁶ Snow cover was tested in the areas of medium pollution. In this study we have recorded the thickness of the snow cover and sampling volume, as well as the sediment of insoluble substances in the melted snow was estimated. All the results obtained are given in Table 1.

Concentrations of dioxins and furans in non-filtered samples of melted snow were determined using the techniques described in Ref. 2.

Table 1. Characteristics of the snow samples.

No. of a sample	Sampling site	Height of the snow layer, m	Volume of the sample, m ³	Sediment, mg/l
1	Zarinsk, territory of a coke baking plant	0.72	0.07	266
2	Biisk, industrial zone	0.57	0.09	221
3	Gorno-Altai, heat and power station	0.42	0.11	1286
4	Tal'menka, the north-east outskirts	0.60	0.08	286
5	Aleisk, the north-east outskirts	0.57	0.09	297
6	Rubtsovsk, industrial zone of a heat and power station	0.38	0.05	2065
7	Rubtsovsk, the south-east side of a tractor works	0.43	0.05	450
8	Gornyyak, the north outskirts	0.45	0.04	1009
9	Zmeinogorsk, center	0.45	0.06	116
10	Blagoveshchenka, center	0.37	0.09	251
11	Yarovoe, north-east side of Altaikhimprom Plant	0.15	0.08	359
12	Yarovoe, the north part of the plant, 200 m from the Yarovoe Lake	0.19	0.09	208
13	Slavgorod, 0.5 km from an elevator	0.35	0.08	734
14	Kamen'-na-Obi, near a railway	0.25	0.6	489

Table 2. Content of dioxins and furans in the snow samples from different sites of the Altaiskii Krai.

Compounds, pg/l	Dioxin equivalent weight	No. of a sample													
		1	2	3	4	5	6	7	8	9	10	11	12	13	14
2,3,7,8-Tetra CDD	1.0	no	no	no	no	no	no	no	no	no	no	no	no	no	no
1,2,3,7,8-Penta CDD	0.5	no	no	no	no	no	no	no	no	no	no	no	no	no	no
1,2,3,4,7,8-Hexa CDD	0.1	no	no	no	no	no	no	no	no	no	no	no	no	no	no
1,2,3,6,7,8-Hexa CDD	0.1	no	no	no	no	no	no	no	no	no	no	no	no	no	no
1,2,3,7,8,9-Hexa CDD	0.1	no	no	no	no	no	no	no	no	no	no	no	no	no	no
1,2,3,4,6,7,8-Hepta CDD	0.01	no	no	no	no	no	no	no	no	no	no	70.5	no	no	no
1,2,3,4,6,7,8,9-Octa CDD	0.001	no	no	no	no	no	no	no	no	no	no	222	no	no	no
Dioxin equivalent weight of the sum of PCDD, pg/l		–	–	–	–	–	–	–	–	–	–	0.93	–	–	–
2,3,7,8-Tetra CDF	0.1	no	no	no	no	no	no	no	no	no	no	no	no	no	no
1,2,3,7,8-Penta CDF	0.01	no	no	no	no	no	no	no	no	no	no	no	no	no	no
1,2,3,6,7,8-Hexa CDF	0.1	15	30	150	17.5	30	400	12.5	10	14	16	72	6	37.5	22.5
1,2,3,4,7,8-Hexa CDF	0.1	9	21	150	12.5	70	500	20	20	18	12	64.5	9	27.5	22.5
1,2,3,4,6,7,8-Hepta CDF	0.01	49	93	350	60	31	1850	90	45	12	72	160.5	48	70	70.5
1,2,3,4,6,7,8,9-Octa CDF	0.001	36	900	900	50	20	1750	90	30	16	28	187.5	40.5	25	34.5
Dioxin equivalent weight of the sum of PCDF, pg/l		2.92	6.07	34.4	3.65	10.33	110.2	4.24	3.48	3.34	3.55	15.45	2.02	7.23	5.54
Dioxin equivalent weight of the sum of PCDD/PCDF, pg/l		2.92	6.07	34.4	3.65	10.33	110.2	4.24	3.48	3.34	3.55	16.38	2.02	7.23	5.54

Table 2 presents the results on determination of PCDD and PCDF concentrations in the melted snow. It follows from the table that the presence of dioxins 1,2,3,4,6,7,8-hepta CDD and 1,2,3,4,6,7,8,9-octa CDD is found reliably only in the sample No. 11 from Yarovoe, near the Altaikhimprom Plant. Furans 1,2,3,6,7,8-hexa CDF, 1,2,3,4,7,8-hexa CDF, 1,2,3,6,7,8-hepta CDF, and 1,2,3,6,7,8,9-octa CDF have been detected in practically all samples from industrial centers.

The total equivalent weight of PCDD/PCDF in the sample No. 6 from the industrial zone of the Rubtsovsk heat and power station is more than three times larger than the maximum permissible value, which is 25 pg/l for water. High content of furans has also been detected in the above-mentioned sample No. 11 from Yarovoe. In the rural areas no toxins were found.

The half-life of dioxins and furans in the environment is about 10 years,¹ so PCDD and especially PCDF are accumulated in soil and waters of most industrial regions of Altaiskii Krai. Therefore, routine monitoring of these substances is necessary.

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