Dioxin Pollution in the Sediments from the Middle and Lower Volga River, Russia.

S.Yu.Semenov, G.V.Zykova, G.M.Mikhailov*, V.N.Smirnov, G.G.Finakov,

Russian Research Center of Emergency Situations, 46/4, Shabolovka st., Moscow 117419, Russia.
*Enviromental State Committee of Astrakhan region, 113, Bakinskaya st., Astrakhan, 414000, Russia.

Introduction

In the last decade investigations were conducted in a number of industrial regions of Russia with the aim of determining level of environmental pollution by dioxins and its analogs.

The objective of this study was to conduct reconnoitering survey of the middle and lower Volga basin for the estimation of its contamination by PCDD/Fs. It is just in this part of the river large industrial towns are situated. The bottom sediments which characterize water ecosystems integrally were selected as the object of research.

31 Sediment probes were received for analysis from 8 Volga riverside regions. Sampling was carried out by the workers of Astrakhan ecological control service between N. Novgorod and Astrakhan at a period from 1 to 26 June 1999 y.

Materials and methods

Dried and ground samples of river sediments (40 - 50 g) were spiked with the mixture of labeled internal standards (Cambridge Isotope Laboratories, USA). PCDD/Fs were soxhlet-extracted with toluene for 20 h. Glass columns with acid and basic silica gel and basic aluminum oxide were used for extracts cleaning. The methods of cleaning and detection (HRGC/LRMS) were described in details earlier[1]. Identification and quantitative analysis was performed on Hewlett-Packard GC/MS 5890/5971 A using Ultra-2 capillary column by Hewlett-Packard.

Results and Discussion

Performed analyses disclosed that all sediment samples are contaminated by dioxins. As Fig. 1 demonstrates, concentrations of dioxins in samples taken over more than 2000 km of river length vary in the wide range from 0.08 to 9.36 pgTEQ/g. Increase in dioxin content was observed in sediments downstream large towns: downstream N. Novgorod (sample 3), Samara (sample 11), Saratov (sample 22), Kamyshin (sample 25) and Volgograd (sample 29). Maximum PCDD/Fs concentrations are recorded in the sample 13 taken in the estuary of Chapaevka river (9.36 pgTEQ/g), downstream Chapaevsk, town with developed manufacture of chlorine-containing substances.

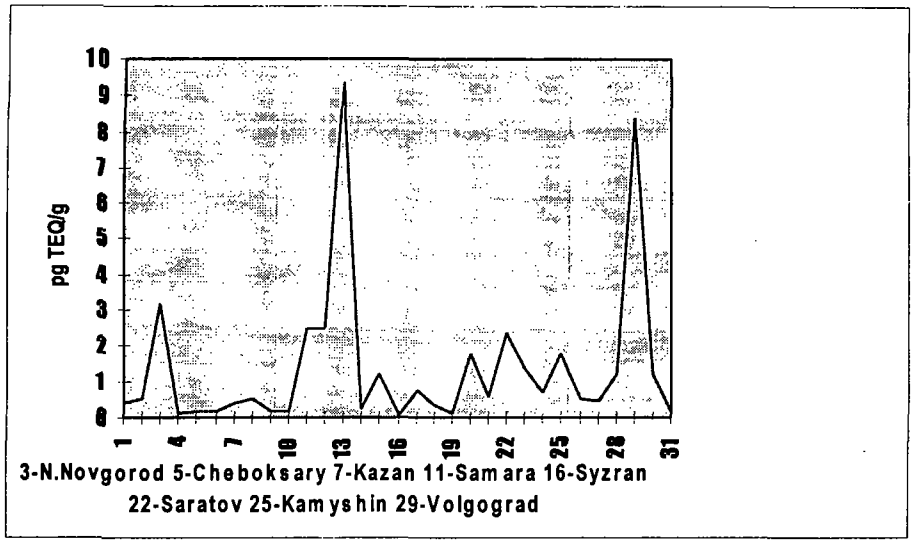

Fig.1 PCDD/Fs Concentrations in the Sediments (Samples 1-31) from the middle and lower Volga

However, sediments composition varies significantly throughout surveyed territory, hence changes their capacity for PCDD/Fs sorption. Therefore, comparison of towns influences on the dioxins emission is hardly achieved. Carbon mass share of humic substances in all samples was determined for the comparative assessment of sediments composition. Data obtained varied in wide interval from 0.06 to 3.14%. Attempt was undertaken to consider this circumstance using normalizing coefficients to carbon mass share of humic substances in all samples. As a result of this normalization procedure maximal dioxins concentration was observed in the sample 29 (Volgograd). Other samples exhibited somewhat lower dioxin concentrations, e.g., sample 11 (Samara) - 1.5 times less, sample 25 (Kamyshin) - 2.3 times less, sample 22 (Saratov) - 4 times less, sample 3 (N.Novgorod) - 6.7 times less.

Thus, maximal dioxins contamination of sediment samples is observed in big towns vicinities. It testifies negative influence of the industrial activity on regional environment.

Fig. 2 presents profiles of the PCDD/Fs congeners in samples 13 and 29. These probes contain practically all toxic PCDD/Fs, yet their congeners profiles differ. As fig.2 demonstrates, contributions of PCDD and PCDF in sample 13 are comparable but PCDFs are major contributors in sample 29. Furans are predominant, as a rule, in a metallurgical industry discharges.

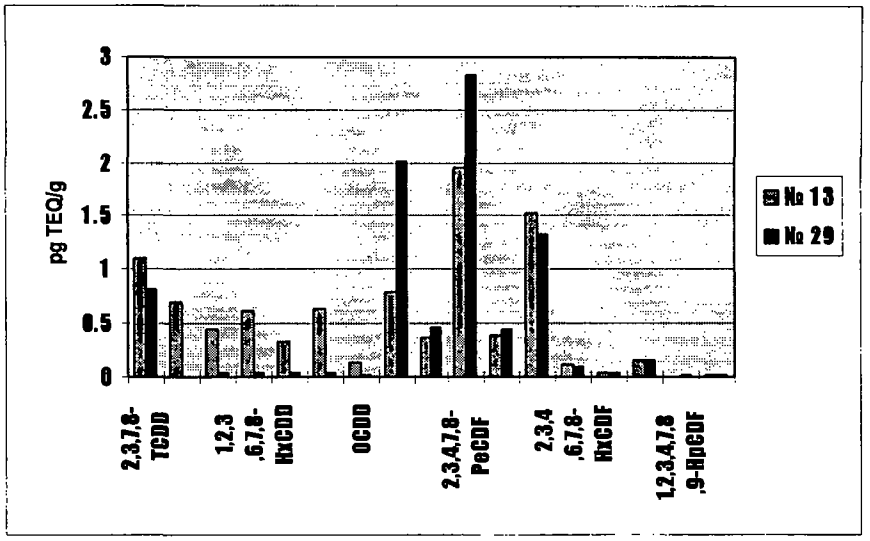

Fig.2 Profiles of PCDD/Fs Congeners Concentrations in the Samples 13, 29

Assessment of the background contamination, which is significant regional characteristic, was carried out. Accordingly to the results of analyses of the samples, possessing minimal dioxin concentrations, 9 samples with identical PCDD and PCDF profiles were selected (Fig.3). Background contamination of the middle and lower Volga basin amounts to 0.1 - 0.2 pgTEQ/g.

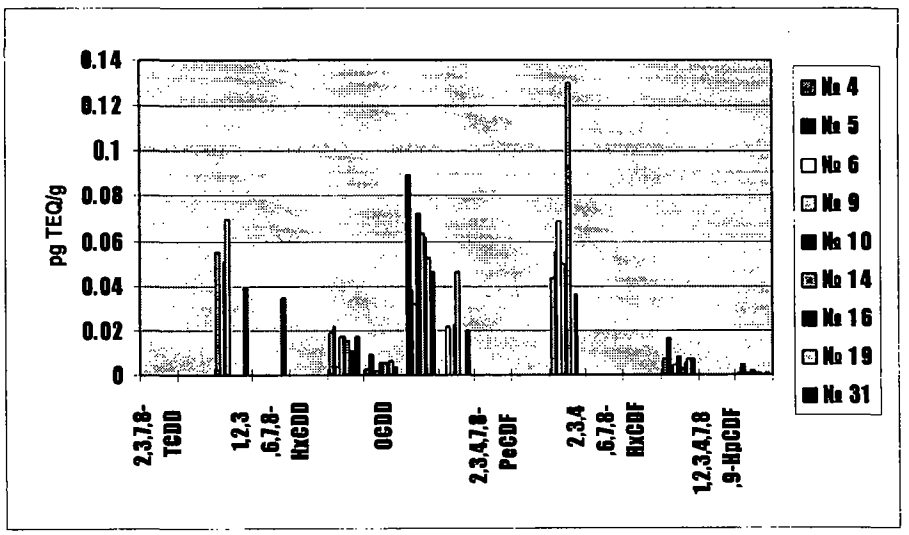

Fig.3 Profiles of PCDD/Fs Congeners Concentrations of the nine Samples with Minimum Sum Values of TEQs

Overall level of the contamination of the middle and lower Volga basin correlates with results obtained during the survey of the lower Volga basin in Astrakhan region in 1997 (0.36-4.65 pgTEQ/g) (2), and exceed sediment dioxin content in S. Dvina river in Arkhangelsk region (0.9-3.1 pgTEQ/g) (3).

Acknowledgments

This work was supported by Enviromental State Commettee of Astrakhan region and Federal Ecofund of Russia.

References

1. EPA.Method 8280: The Analysis of Polychlorinated Dibenzo-p Dioxin and Polychlorinated Dibenzofurans.
2. G.M.Mihkailov,B.N.Filatov, S.Yu.Semenov, V.N.Simonov.Dioxins as Supertoxicants of XXI Century.Regions of Russia.Moscow: 1998, N3, p.126-149 (in Russian).
3. S.S.Yufit, N.A.Klyuev, E.S.Brodsky.Ibid. p.10-35.