POLICHLORINATED DIBENZO-*para*-DIOXINS AND DIBENZOFURANS IN FISH OF THE ANGARA RIVER.

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Introduction

The investigation of contents of PCDD/F and PCB in environment of Lake Baikal, the Irkutsk Region and Buryatia was made in during of 1994-1998[1,2,3]. Data obtained allow to make some interesting conclusion about the distribution of these toxicants in Lake Baikal ecosystem and about impact of industrial emission to the formation of congener pattern in soil of the region. However, considerable part of sources of PCDD/F discharging toxicants into the Angara River was not under consideration. Aims of this study are to determinate PCDD/F levels in fish from the Angara River, to evaluate topicality of the problem of PCDD/F contamination in ecosystem, to find zones with maximum contamination and technology furnishing PCDD/F in environment.

Methods and Materials

The sampling was made during the expedition in July-Augest, 1999, under assistance of fishermen teams and fishermen-amateurs. Fish was sampled upstream and downstream the location of discharge of chemical enterprises along the Angara River in the Irkutsk Region (Fig.).

PCDD/F analyses were made in Bishkortostan Regional Ecological Center (Ufa). PCDD/Fs concentrations were determined in compliance with the method EPA 1613. The measurement system consisted of a chromatograph Carlo Erba 8035 and a mass spectrometer AutoSpec Ultima.

Toxic equivalents were calculated in wet weight using of TEF-WHO for human. Daily consumption of fish for the calculation of daily intake of PCDD/F was received from Regional Committee of Statistics. Cancer risk was calculated using of [4].

Results and Discussion

Data obtained indicate the presence of PCDD/F along whole cascade of Angara River Reservoirs (Fig.).

PCDD/F TEQ levels in fish investigated in "clear" zones of the Angara River are 10-30 times higher then PCDD/F TEQ levels in perch and roach from delta of the Upper Angara River and the Kichera River investigated in 1997 and accepted as the background for the Baikal Region[7]. PCDD/F TEQ levels in fish from zones of strong contamination are about 100 times higher than those in fish from the Upper Angara River and the Kichera River.

Maximum concentration was found in *Thymallus arcticus baicalensis* sampled in 60 km downstream of Ust'-Ilimsk water-power plant barrage (Ust'-Ilimsk reservoir) and comes to 2.11 pg *TEQ/g wet weight that is 8.8 times higher than in similar species of fish from the mouth of the* Angara River (the Irkutsk reservoir).

The increasing of TEQ accrues irregularly and corresponds to locations of areas of the highest concentration of enterprises along river. The severe increasing of TEQ occur in the the Balagansk area that associated withdischarges and emissions of "Khimprom" located in t. Usol'e-Sibirskoe. Further, 1.5-4 times decreasing of TEQ levels is observed in the cape of Porozhskiy (Bratsk) that is probably due to the sorption of PSDD/F on suspended matter and natural process of sedimentation. However, next increasing of TEQ occurs downstream of the Bratsk water-power plant barrage and inflowing of the Vikhorevka River contaminated with discharges of enterprises of t. Bratsk (Fig.). Maximum increasing of TEQ is observed downstream of the Ust-Ilimsk water-power plant barrage in Ust'-Ilimsk reservoir as mentioned above. Ust'-Ilimsk pulp and paper mill discharges to Ust'-Ilimslk reservoir and this affect to congener pattern. The ration of 2,3,7,8-TCDD and 2,3,7,8-TCDF in fish samples is characteristic of bleaching by chlorine or the using of caustic soda. Interestedly, that a similar ratio was characteristic of Lake Baikal zooplankton sampled in 1.5 km away from the location of Baikalsk pulp and paper mill discharging[2]. This phenomenon attests about particular importance of pulp and paper mill in formation of PCDD/F congener pattern in the Angara River and Lake Baikal.

Table 1. The description of fish samples from Angara River.

Species of fish	Amount	Age (years)	Situation and time of sampling	Condition of river[5,6]
Grayling (***Thymallus arcticus baicalensis***)	15	2-3	Irkutsk reservoir The mouth of the river (habitation Nikola) October, 1999	Conditionally clear
Roach ***(Rutilus rutilus lacustris)***	14	6-12	Irkutsk reservoir The mouth of the river, B. Alanka August, 1999	Conditionally clear
Roach ***(Rutilus rutilus lacustris)***	5	4-5	Bratsk reservoir Balagansk aggrandizement August, 1999	Medium contaminated
Perch (***Perca fluviatilis***)	5	4	Bratsk reservoir Balagansk aggrandizement August, 1999	Medium contaminated
Roach ***(Rutilus rutilus lacustris)***	10	7-16	Bratsk reservoir Bratsk (the cape of Porozhskiy) August, 1999	Medium contaminated
Perch (***Perca fluviatilis***)	20	4-8	Bratsk reservoir Bratsk (the cape of Porozhskiy) August, 1999	Medium contaminated
Perch (***Perca fluviatilis***)	5	4-7	Bratsk reservoir 50 km upstream of Ust'-Ilimsk water-power plant barrage. August, 1999	Medium contaminated
Grayling (***Thymallus arcticus baicalensis***)	5	2-4	Ust'-Ilimsk reservoir 60 km downstream of Ust'-Ilimsk water-power plant barrage. August, 1999	There is not data

If one can suggest that whole consumption of fish by population of the Irkutsk Region is the consumption of fish from the Angara River, daily intake for account of fish comes to 0.12 pg TEQ-WHO/kg BW/d in the mouth of the Angara River and 1.05 pg TEQ-WHO/kg BW/d downstream t. Ust'-Ilimsk. Herewith cancer risk comes to 19 cases among 1 million in the mouth of the Angara River and 163 cases downstream t. Ust'Ilimsk. Daily intake does not exceed Russian sanitary limits but level of cancer risk is more then reasonable cancer risk accepted in US EPA.

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References

1. Mamontov A.A., Tarasova E.N., Mamontova E.A., McLachlan M.S. (1997) Chemosphere, 34, *11*, 2419-2427.
2. Mamontov A.A., Mamontova E.A., Tarasova E.N., Pastuhov M.B., Lutz H., McLachlan M.S. (1997) Organohalogen Compound, 32, 272-277.
3. Mamontov A.A., Mamontova E.A., Tarasova E.N., McLachlan M.S. (2000) Environ. Sci. Technol., 34, *5*, 741-747.
4. U.S. Environmental Protection Agency. (1989) Risk assessment guidance for superfund. Volume I. Human health evaluation manual (Part A). Interim Final. EPA/540/1-89/002.
5. State account (1997) "About condition of environment of Irkutsk Region in 1996" (Udodov Iu.N. Ed.), Irkutsk Regional Committee of environment protection, ISBN 5-7699-0004-0
6. Annual account (1998). The protection of Lake Baikal and provision of rational using of nature in The Lake Baikal Region (Danilov-Danil'yan V.I., Ed.), Governmental committee on Lake Baikal.
7. Mamontov A.A., Mamontova E.A., Tarasova E.N. and McLachlan M.S. (1998) Organohalogen Compounds, 39, 323-326.

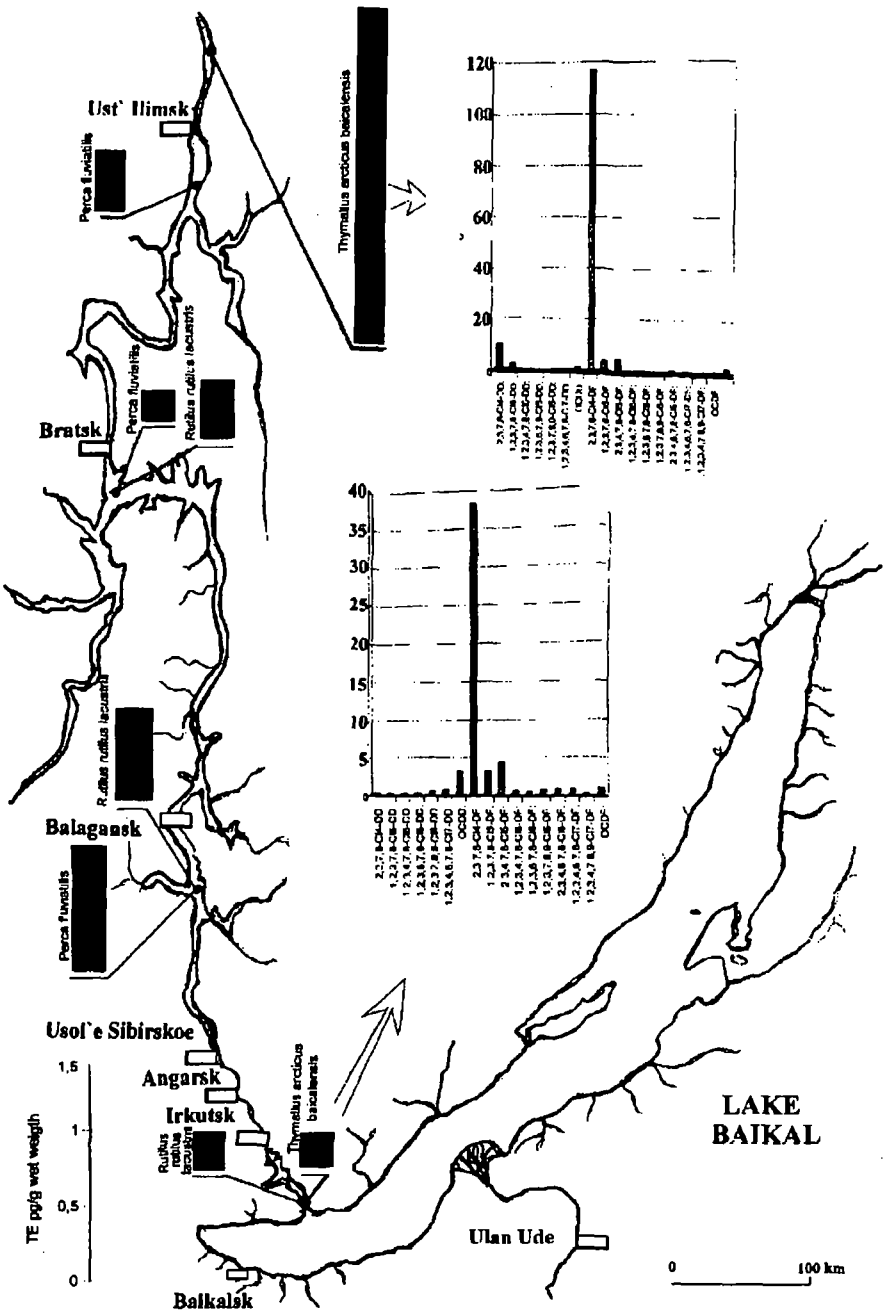

Fig. The scheme of location of fish sampling, level TEQ in these samples and most characteristic congener pattern.