ECOLOGICAL ASPECTS OF THE INTERACTION OF RIVER AND GROUND WATERS IN THE LOWER AMUR

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ECOLOGICAL PROBLEMS IN BASIN OF AMUR RIVER

- 1996-2002 - “Phenol” pollution (smell of fish)
- 2002-2006 - fish polytoxicosis
- 2005-2006 - the technogenic accident in China (nitrobenzene, benzene and its isomers)
- 2002-2009 - chronic pollution by persistent organic matter

*Reliability of risk estimate is relative for every moment of time*

All approaches need to be corrected with an account of advantages of fundamental science, experiences of extreme situations in various regions
AMUR RIVER

left bank

right bank

Water of the Songhua river
Pollution of the Amur River by Suspended particles (mg/l)

(Π – surface waters, Д – bottom waters)

(1-3) - 2 km lower Blagoveschensk city;

(4-6) – 4 km lower the Songhua juncture;

(7-9) – upper Fuyanj city

(10-12) - 4 km upper Khabarovsk city;

(1,4,7,10) - left bank;
(2,5,8,11) - middle
(3,6,9,12) - right bank
«high consumption, high input, high pollution, ........high risk»

13 November 2005

13 ноября 2005 г
Pollution of the Amur and Songhua rivers after the technogenic accident in China

13 November 2005
100 tonns
Nitrobenzene, Benzene and its derivatives
Toxic substances in various components of the Amur River ecosystem

Freeze-up period (2005-2006)

- **Water:** Nitrobenzene, benzene, toluene, xylene, ethylbenzene, chloroform, dichloromethane, dichlorobenzene, PAH, heavy metals
- **Bottom sediments:** Chloroform, tetrachloromethane, chlorobenzenes, PAH, heavy metals
- **Fish:** Nitrobenzene, benzene, toluene, xylene, ethyl benzene, heavy metals, chlorine containing pesticides
May, July 2006

- **Water**: Phthalate, dibutyl phthalate, chlorphenols, pesticides: acetochlorine, atrazine, PAH, heavy metals

- **Bottom sediments**: Diethyl phthalate, dioctylphthalate, methylphenol, benzo(b)fluorantene, perylene, benzopyrene, benzene, xylene, toluene, chlorphenols, methylbenzene
Several tragic events happened in China in July, 2010. 11 provinces suffered the flood, most powerful for 100 years.
After floods destroyed two chemical plant warehouses in Jilin Province

- A total of 3,662 barrels were filled with colorless and highly explosive chemicals, mainly
- trimethyl chloro silicane
- hexamethyl disilazane
Vice Minister of Environmental Protection Wu told Russia's Ministry of Natural Resources and Ecology:

- "China has adopted resolute measures to prevent these chemical barrels from floating into Heilongjiang Province, and **they won't affect Russia at all**…"
- 7,107 barrels had been collected and disposed of, including 3,633 that were filled with chemical materials.
- The monitoring results have shown the **pH reading in the river water remains within the normal range**
- **No reports on other substances were given.**
Ecological risks

- the permanent transboundary flow of pollutants and their influence on hydrobionts in the Amur River;
- the problem of high-quality drinking water supplies for the population;
- the demand for alternative sources of water-supplies;
- the prevention of ground water pollution.
Based on **bank filtration the Northern** water intake facility has been under operation **for over 70 years**. A water-bearing horizon made of coarse sands with gravel and pebbles.

In natural conditions ground waters concentrations of iron (32 mg/l) and manganese (7.5 mg/l).

Due to many years of intake facility operation **a zone of iron-free waters has been formed.** Chemical composition (iron, manganese) of ground waters in the wells satisfies drinking water requirements.
The primary mission of researches to answer the following questions:

- When river waters get into the well?
- How do Fe and Mn concentrations in river and ground waters change?
- How do microbiological parameters of quality of water?

- A microbiological indication method was used to study penetration of organic matter from the Amur River into ground waters.
- Iron and manganese concentrations were measured with an ICP-MS method.
The placing of production wells on Northern water supply points in a flood plain of the Amur river

The area of distribution a Pliocene-Quaternary alluvial sand-gravel sediments

9, 17, 21- Investigated wells

Water samples were analyzed in October, 2009, and then in February, May, August and November, 2010

The right slope of a valley of the Amur river, combined metamorphized slates and sandstones carbon age (bedrock)
The hydrological regime of the Amur near Khabarovsk city

Red vertical lines is dates of selection of water tests on researches

**Yellow** – current level from September 2009 till December, 2010

**Blue** – average long-term 1/1/2001
The number of this group of bacteria reflects the total contents of organic substances in water.

In February and after the May-flood water was very clean.

In August after the flood in the Songhua basin the number of saprophytic bacteria increased in the Amur river and in all the wells. Even in the most distant well 9.
Seasonal change of number iron-manganese bacteria

The high number of Fe- Mn bacteria in May can be explained with the Amur water inflow rich in oxygen and iron – humic complexes.

August - ???
However in August such connection was not revealed. This question needs further studies.
It is possible to assume the inhibition of Fe-Mn bacteria growth by toxic substances which come with the Songhua river water.
Seasonal changes of iron concentrations in well 21 at the beginning of the infiltration row corresponded to iron concentrations in the Amur river.
Concentrations of manganese were high in the wells, especially in autumn. It can be connected with considerable inflow of organic substances.
Correlation analysis

- High positive correlation was found between water quality in Amur river and:

  - October - W 21 (r=0.92)
  - February - W 21 (r=0.99)
  - May - W 21 (r=0.96)
  - W 17 (r=0.94)
  - August - W 21 (r=0.94)
  - W 17 (r=0.97)
  - W 9 (r=0.90)

In well 21 the influence of the Amur River was observed during the whole period of monitoring.

In May the Amur river influence reached well 17.

During the flood in China water quality in all wells highly depended on Amur water quality.
Our research showed that toxic organic substances should be analyzed in ground waters especially in time of river floods.

In flood time due to bank infiltration greater amounts of organic mater of different origin get into ground waters.

Organic matter combined with oxygen that comes with river water affects the activity of iron-manganese bacteria, which cause the transformation of dissolved ion forms of iron and manganese into their non-dissolved compounds. Thus iron and manganese concentrations in ground waters are decreasing.
THANK You for ATTANTION !