RESEARCH OF CONTAMINATION OF WATER OBJECTS AT VARIOUS LEVELS OF ANTHROPOGENETIC LOAD (SURVEY HAS BEEN MADE AT THE UPSTREAM BASIN OF THE VOLGA), RUSSIA

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Introduction

The choice of an optimum water-protection strategy depends upon the general level of water basin pollution, its economic development, population density, orientation of an industrial, as well as an agricultural production, peculiarities of a hydrologic conditions, and consequently, should be supported by authentic and profoundly scientific research.
From the point of view as proposed above we are going to look at the Upstream Volga Water Basin (covering the area of 41,000 sq. km) and the Ivankovo Water Reservoir up to the closing range at Dubna (net volume is 1.12 cu. km), which is the major source of water supply for Moscow. This water reservoir level is adjusted by seasons : it is consumed in winter and is filled up again in spring, while it remains full throughout summer and autumn. A hydrological aspect in the process of formation of water quality is also of great importance because the water mass of the reservoir is built up by a surface run-off within the boundaries of the watershed in spring during the snow-melting; and discharge of ground water during the winter consumption.

Methods

The crucial scientific objectives can decisiv in research of formation processes of water quality with used a systematic approach, that has to focus around two correlated blocks, which should be treated as a complex: the first one is a hydrographic network of watershed with active sources of pollution , the second one is the water area of a reservoir with the typical inner aquatic processes. For the first block of such system the methods should be developed to assess a general anthropogenetic load, to describe long-term dynamics, and also to differentiate and compare the sources of pollution; the second one demands a careful study of a qualitative condition of a water object, water distribution throughout the year, long-term changes and development of biotics. When compiling this paper we have made use of a vast experimental material and the data collected by special expeditions functioning in different years and different sectors of the watershed.

Results and discussion

Intensive water protection activities were undertaken between 1968 and 1986, resulting in 5 to 10 fold decrease in concentration of the substances of technological genesis (zinc, copper, synthetic surface-active substances). However the quality of water did not improve in the least as regards the concentrations of suspended organic substances and biogenic elements. Our research performed at the watershed confirmed that it had been caused by a number of functioning sources as a rule being of diffusional character. Pollution from the sources of this type may be accompanied by a surface run-off from urban areas, industrial sites, farms, peateries and also by recreation and navigation in the water area of the basin. The entire range of the enumerated sources of pollution may be classified as non-stationary ones, and dispersed all over the area (except for the drain sewerage in towns and at the industrial sites), but the main thing about them is that they are absolutely out of control and hardly can be monitored by the state services due to an extreme complexity of measurement and count.

Our observations for many years and specially arranged expeditions allowed us to differentiate four basic sources of pollution as to a number of water quality indicators. During explorations and calculations our goal was to identify an optimum water-protection strategy in the Upstream Volga basin, directed at a possible reduction of the effect produced by uncontrolled diffusion sources because they exceeded pollution caused by the point sources in terms of oil products by more than 50 times, organic matter - by 18 times, nitrogen - by 8 times and phosphorous - by 5 times.

Thus, anthropogenetic effect of the diffusion sources of pollution was the most dangerous factor for the Ivankovo Water Reservoir as per a number of indicators observed in the economic environment typical for this region of the 80-ies. Furthermore, the dynamics of the major sources of pollution have sustained drastic changes since the beginning of the 90-ies when the Russian economy was directed along the market oriented path: disposal of waste water was decreased, utilization of the fertilizers was cut down, navigation became less intensive and the fleet of boats was reduced in number. The most dramatic changes for the diffusion-class sources of pollution occurred in the agriculture as the fertilizers now are used 10 times less frequently in comparison to the 80-ies. However the area of fertilized arable land covers 12 % which is quite insignificant as compared to an entire area of the watershed. The waters flushed off the surface of the urban areas and industrial sites are contaminated nowadays by increased concentrations of the oil products and certain heavy metals, which is easily attributed to a much more intensive motor road traffic. In our estimation, the problem of diffusion pollution of the Ivankovo Water Reservoir remains a very crucial one, particularly as regards such water quality indicators as organic substances, oil products and heavy metals. Thus it is possible to present hereby two anthropogenetic levels at the watershed of the Upstream Volga in terms of certain indicators typical of various degrees of functioning of the region under consideration (Table 1).

Table 1

Evaluation of two average levels of the general anthropogenic load in the Upstream Volga at various time periods (tonnes per year)

Indicator	1984-1990 (I)	1991-1997 (II)	Ratio II / I
Oil products	6,200	5,500	0.89
Organic matter	104,030	60,000	0.58
Nitrogen	25,300	5,000	0.20
Phosphorous	1,980	800	0.40
Copper	10	7	0.70
Zinc	20	13	0.65

Continuous research of hydrochemical and hydrobiological parameters at the Ivankovo Reservoir is under way for the past 20 years now. The primary objectives of this research comprise the following : transformation and drift of the particles in the reservoir, build-up of the hydrodynamic structure, processes of spreading of the upper aquatic plants, accumulation of heavy metals in water, bottom soil and biotics, influence of the waterside sources of pollution. Water samples are collected especially frequently at the main ranges of the Reservoir facilitating keeping of records of the extreme values of concentrations. Statistical processing of the long-term observations yields accurate computations of the characteristics typical of any time periods. Average indicators of water quality and hydrochemical components for each season are given in Table 2; these averages have been obtained for two time stretches covered by research (the first one from 1984 to 1990, and the second one from 1991 to 1997).

Table 2

Water quality characteristics in the Ivankovo Water Reservoir at various seasons

Ingredients	Winter		Spring		Summer		Autumn		II / I
	I	II	I	II	I	II	I	II	
Oil products	0.54	0.31	0.77	0.72	0.44	0.26	0.38	0.25	0.72
Organic matter	16.3	13.5	18.5	15.0	17.8	13.2	14.9	11.7	0.79
Nitrogen	1.86	1.62	1.81	1.44	0.98	0.69	1.12	0.82	0.81
Phosphorous	0.12	0.13	0.19	0.13	0.12	0.12	0.13	0.12	0.86
Zinc	0.06	0.04	0.04	0.03	0.05	0.03	0.06	0.04	0.80
Copper	0.005	0.003	0.005	0.004	0.004	0.003	0.005	0.003	0.67

Conclusions

It is seen, change of anthropogenetic load levels on the big watershed does not always influence water quality change of the water body. So further it is necessary to take into consideration some other factors. Our analyses of hydrological conditions for long time shows a high correlation between biogenic components and water column.

In the paper presented hereby we have dwelt upon a systematic approach in research of the processes of formation of certain water quality at the Upstream Volga Watershed and the Ivankovo Water Reservoir. There is no doubt that this methods may be applied in research of large water basins with the purpose of studying the dynamics of development and the influence of various factors upon the aqueous medium.

The choice of an optimum water-protection strategy depends upon the general level of water basin pollution, its economic development, population density, orientation of an industrial, as well as an agricultural production, peculiarities of a hydrologic conditions, and consequently, should be supported by authentic and profoundly scientific research.

Traditional water-protection polycy in Russia was directed, mainly, at reduction of disposal of trade effluent, technical household waste water. However, because of the huge finansial expenses required for improvement of the water treatment technology the reseachers sometimes could not obtain an expected effect in making the quality of water any better in the water objects, especially in the basins of large watersheds with the advanced industry and agriculture.

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