ASSESSMENT OF QUALITY OF WATERS OF THE CUT BEND OF THE RIVER OF KAZANKI (BIOTESTING METHOD)

Assoc. Prof. Dr. Ilyasova Alisa[1].

[1] Kazan (Volga Region) Federal University, **Russia**

ABSTRACT

Now the composition of natural waters of reservoirs is substantially formed under the influence of anthropogenous loading. In the conditions of an urbanization of territories especially important there is a preservation of the water objects which are an element of a city landscape and environment. Diverse polluting substances, getting to environment, can undergo in it various changes, strengthening thus toxic action. And the problem of quality of water, certainly, is one of actual environmental problems.

Keywords: bioindication, acute toxicity, natural waters, sewage, test objects, environmental monitoring, chemical pollution

INTRODUCTION

Plural introductionsIn case of territories' urbanization it becomes extremely important to preserve water objects which are elements of a city landscape. The main technogenic load of reservoirs is carried out in the locations of the large cities and the industrial enterprises, including production of the sewage, unorganized receipts of polluting substances.

Among city water objects, whose assanation is actively discussed in recent years, is dead-arm of the Kazanka river. Kazanka's river is designated water area, a nature landmark of regional significance, and ecological balance conservation of this nature landmark demands special attention. Kazanka rivers' channel was cut by two whartwalls and new artificial water system called "bend of river of Kazanka" was formed, with a length of waterway 3,5 km, width 30m and depth 0,5-1,5m. It represents a drain which serves the purposes of adjacent territories' ground-water lowering and regulatory pool for stormwater discharge and meltwater followed by pumping in the Kuibyshev reservoir. For many years in the bend of the Kazanka river dumped untreated industrial and domestic wastewater with a significant catchment area, diffuse runoff from land allotment gardens and snow dumps city warehoused watershed [8]. In designated water area of dead-arm river are located private buildings, garage complexes, the industrial enterprises, railroad tracks and the highway generating negative impact on a condition of water object. Under the existing system, a complex and multi- flows in the Kuibyshev reservoir overflow proximity of the bend to the Volga water intake can be a factor negatively affecting the water quality of a water source and population health [10]. Since 2000, environmental scientists are paying attention to this project. Studies have found that the ecological balance of the natural system is broken, self-cleaning ability is reduced, and the degree of contamination is extremely high. Now the given water object is a source of the increased sanitary and epidemiologic danger and low esthetic appeal [8].

There is a need for integrated quality control methods for objects of the environment, to assess their quality and potential hazards of various sources of pollution. To assess the degree of anthropogenic impacts on aquatic ecosystems, along with methods of chemical analysis using bioassay as an integral indicator of toxic pollution [1]. The main task consists in obtaining the fast and guaranteed answer – whether the environment is toxic in the conditions of so-called

"total effect" all polluting substances. These methods are widely used for environmental monitoring, both in Russia and abroad. Despite the fact that chronic method is able to give a more in-depth assessment of toxicity, acute experiments contribute significantly to reducing the amount of work, allowing a significantly shorter time to obtain information on the water quality [3].

The aim of this work - to assess water quality clipping path meanders Kazanka river bioassay method.

Given the location of pollution sources were identified sampling sites (Fig.1): № 1 - Kirov district bridge (highway), № 2 - "Hunchback" bridge (private, horticultural development, Vinegar Factory), № 3 - Bridge "Zilantova monastery "(private land, Linen mill), № 4-garage complex area (garage complex, Powder mill).

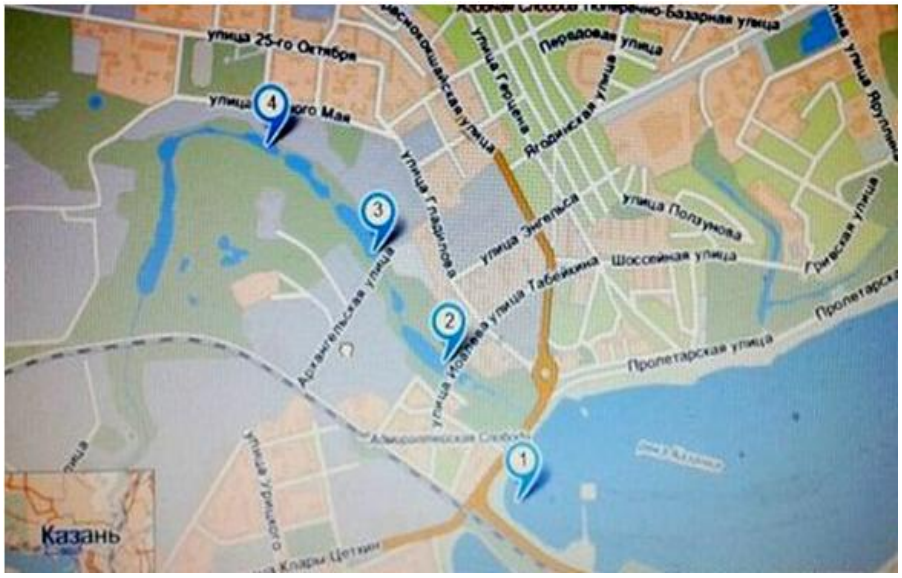


Fig. 1. The sampling card on sites of 1-2-3-4 bends of Kazanka river

Water samples were taken in accordance with the requirements of generally accepted standards (GOST 17.1.5.01-80, GOST 17.1.5.05-85, GOST R 1592-2000). Chemical analysis of water was carried out in an accredited laboratory Federal State University "Sredvolgavodhoz". To assess the individual elements of the water balance bend, as well as for complex analysis of contemporary geo-environmental condition bend Kazanka river served stock, reference and analytical reporting materials research [8]. Experiments on short-term acute toxicity biotesting conducted procedure Stroganov N.S.[11,12]. This method is sufficiently sensitive and the most developed. This method is rather sensitive and the most developed. As test object for determination of toxicity of water of a bend of the river it was used laboratory cultures of water fleas – *Daphnia magna Str*., 1826 [6,11].

Results and their discussion

In order to determine the anthropogenic load of the unauthorized discharge was conducted chemical analysis of water surface water bend of Kazanka river.

Table I.

Results of research of quality of water of a bend of river of Kazanka – for 2012-2013 (the most rigid standards for reservoirs of different type of water use (the recommendation about RD 52.24.643 - 2002) are used)

Indicators or ingredients	Site 1	Site 2	Site 3	Site 4	Max. concentration limit or standard of quality of water
CCO, mgO_2/dm^3	90, 2	51,1	70,5	155,4	30
BIO5, mgO_2/dm^3	21,8	13,4	16,5	40,9	2
O_2, mg/dm^3	1,45	3,6	0,9	1,6	4
$NH^{4+,}$ mg/dm^3	0,3	4,4	3,5	2,7	0,5
NO^{2-}, mg/dm^3	0,03	0,3	0,6	0,6	0,08
NO^{3-}, mg/dm^3	4,5	7,06	3,2	1,6	40
PO_4^{3-}, mg/dm^3	0,04	0,4	0,06	0,2	0,2
CI-, mg/dm^3	13,5	78,3	170,9	136,7	300
SO_4^{2-}, mg/dm^3	30	96	116	66	100
Fe , mg/dm^3	1,7	0,6	0,8	0,2	0,1
Oil products, mg/dm^3	0,2	0,4	0,2	0,2	0,05
The weighed substances, mg/dm^3	40	120	12	27	-
pH,	6,7	6,8	6,7	6,8	6,5-8,5

Water quality in the bend Kazanka river do not meet specifications (Maximum permissible concentration, 2003) requirements for reservoirs of drinking and cultural and community use, value ratios significantly exceeded that show the results of long-term geo-environmental monitoring [8].

The quantitative heterogeneity of chemical distribution in all areas that may be associated with their receipt of certain sources of pollution: in this case we can say that contaminants such as petroleum products (industrial effluent, wastewater unauthorized

garage complex), iron (secondary pollution of water due to release of iron ions from the bottom sediments under oxygen deficiency), organic matter (sewage and industrial enterprises economic profile of household) and chemical industry - are higher than maximum concentration limit on all studied sites that can be connected with unauthorized intake of industrial sewage, including from Acetic, Powder plants, and also from Linen combine and garage complexes. Excess of standards were on the following indicators: BIO5, CCO, oil products and content of the general iron. The ANOVA method (the dispersive one-factorial analysis) carried out the comparative analysis of data on different sites. The analysis showed lack of reliable distinctions on a chemical composition on these sites. (Fig.2,3)

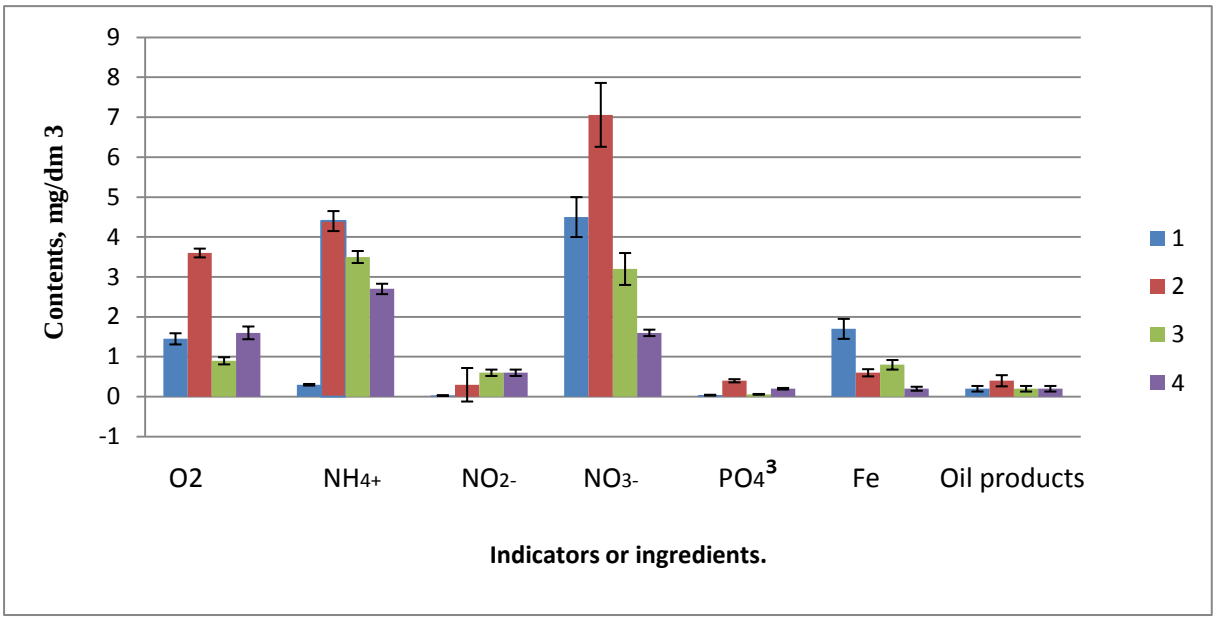
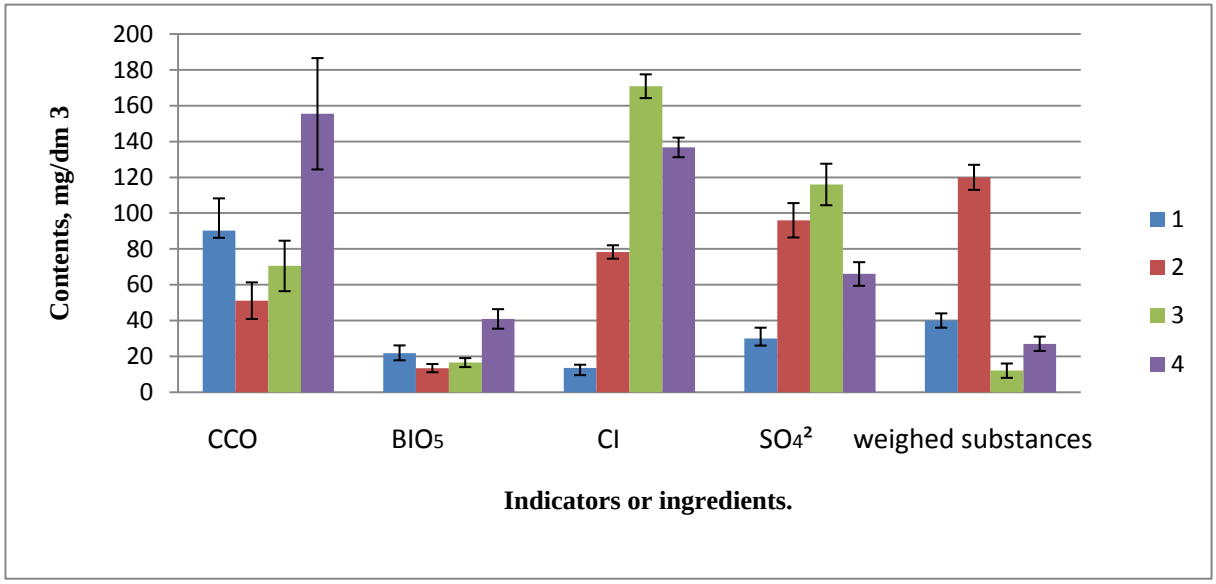


Fig. 2. Chemicals (mg/dm3) of water of a bend of Kazanka river on different sites

Fig. 3. Chemicals (mg/dm³) of water of a bend of Kazanka river on different sites.



The ground deposits created in former years, are strongly polluted by heavy metals, they are toxic for live organisms and represent a constant source of secondary pollution of water which amplifies in anaerobic conditions of benthonic sheets of water. Researches of ground deposits indicate high level of pollution by heavy metals (Pb, Zn, Cd, Cu, Co, Ve, Cr, Ni, Mn, Fe) repeatedly exceeding background values [4].

Bioassay (acute experiment) was carried out in autumn (November) and winter (January) periods. Short-term experiment (96 hours) allowed to determine the acute toxic effect on Daphnia water in their survival rate (mortality). Acute toxicity is the death of 50% or more in the test water Daphnia compared with the control for 24, 48 and 96 hours. Based on the results of bioassays conducted a comparative analysis of mortality data Daphnia in autumn and winter (Fig.4). After the end of experiment counted arithmetic average of the worried water fleas in control and experience. Calculated also standard deviation and percent of death of water fleas in experience in relation to control. Data processing was made in the Microsoft Office Excel program.

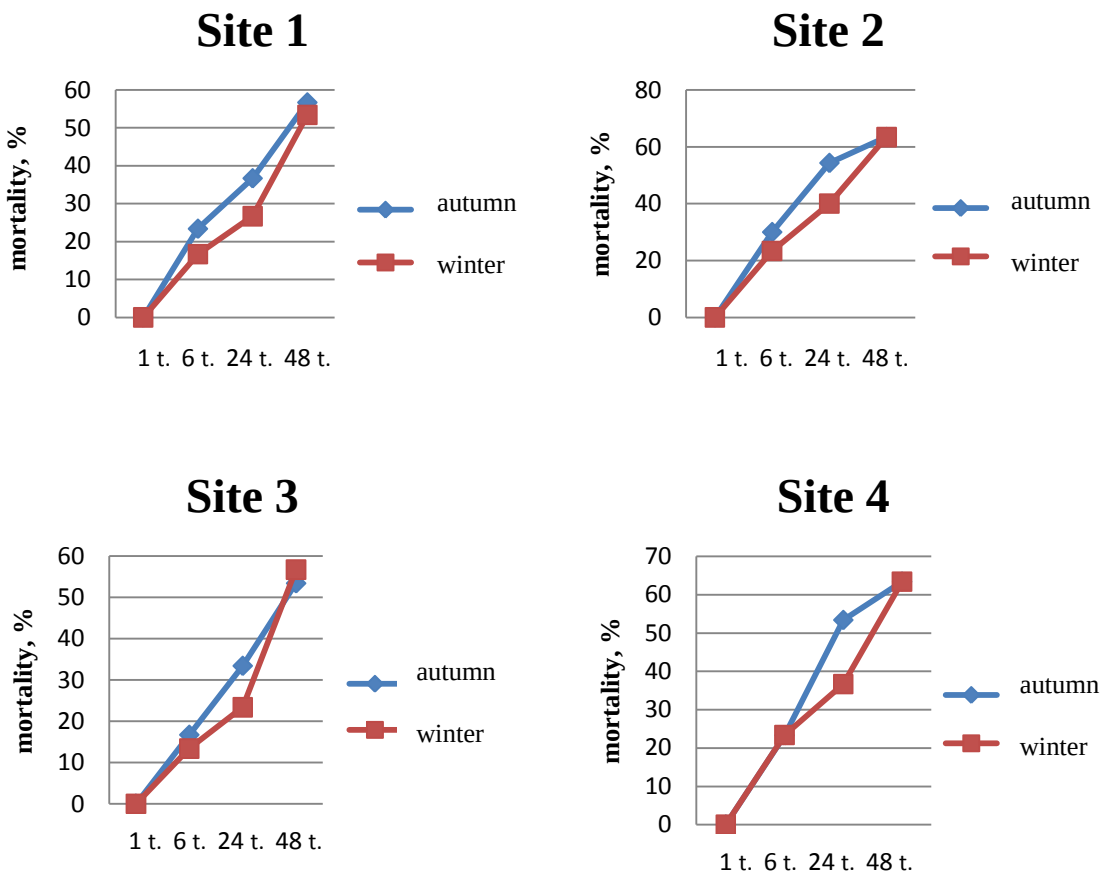


Fig. 4. Dynamics of mortality of water fleas in November and January

Table II.

Indicators of toxicity of water (November)

Experiment time	Site 1	Site 2	Site 3	Site 4
24 hours		LC_{50}=53,4%		LC_{50}=53,4%
48 hours (acute toxicity)	LC_{50}=56,7%	LC_{50}=63,4%	LC_{50}=53,4%	LC_{50}=63,4%

(LC_{50} - the lethal concentration answering to death of 50% of individuals in experience).

During the autumn period water on a bend of the river of Kazanka remained rather warm. The dissolved oxygen was spent for ensuring biochemical processes of a mineralization of organic substances that could lead to formation of toxic connections as a result of approach of anaerobic conditions (secondary pollution at the expense of an exit of toxic metals from ground deposits). Thus, over 50 % mortality of the test culture in the autumn samples occurred at 24 hours in the areas 2 and 4.

Table III.

Toxicity of water (January)

Experiment time	Site 1	Site 2	Site 3	Site 4
48 hours (acute toxicity)	LC 50=53,4%	LC 50=63,4%	LC 50=56,7%	LC 50=63,4%

(LC_{50} - the lethal concentration answering to death of 50% of individuals in experience)

In winter time biochemical processes proceed slowly. Besides, on sites 2 and 4 open sites of water where there is a saturation by water oxygen are observed in the winter. due to processes of dissolution of oxygen. As a result of biotesting of all studied sites the assessment was given to tested water: on Stroganov's scale it made 4 points. Thus, the carried-out experimental assessment of toxicity in sharp experience allows to carry them to the 4th class of danger. Biotesting with use of standard test object of *Daphnia magna Str*. showed that analyzed water possesses "sharp toxic action" that will be coordinated with results of long-term geoecological and chemical analysis researches [3].

Conclusion.

Water quality of a water body or any part of the most fully characterized on the basis of a series of seasonal, annual their observations. Hydrochemical data indicate suppression of the nitrification process, which is typical for such polluted waters. The long-term geo-environmental studies (2006-2009years) Scientists Kazan State University indicate unfavorable ecological condition of the bend.

Bioassay surface waters bend Kazanka river showed that the analyzed water has "acute toxic effects". Use of biotesting showed that this method of monitoring of environment differs simplicity, efficiency and availability. Thus, biotesting allows to define the integrated toxicity caused by set of all dangerous chemicals present at tests and their metabolites. The results received by means of chemical analysis control and biotesting, supplement each other. Since 2002 scientists conducting scientific survey work in order to select a set of measures aimed at its rehabilitation and recovery and to create a comfortable microclimate intercity and recreational environment.

"This research was supported by the subsidy of the Russian Government to support the Program of Competitive Growth of Kazan Federal University"

REFERENCES

[1] Biological control of environment: bioindication and biotesting: studies. grant for the student. / O. P. Melekhova, E.A Egorova, Sarapultsev, T.I Evstegneev, etc.; under the editorship of O. P. Melekhova, E.A Egorova. - M.: Publishing center "Akademiya", 2010. - 288 p.

[2] GOST 2761-84. Sources of the drinking water supply centralized hozyaystvenno. Hygienic, technical requirements and rules of a choice. Resolution of Gosstandart of the USSR of 27.11.1984 No. 4013. Moscow: Standartinform. 2006.10.

[3] Ilyasova A.R. Minakova E.A. Sungatullina I.I. Biotesting as an ecological assessment of quality of water of the cut bend of river the Kazanka / Collection of works IV of the International Congress "Clear water. Kazan": науч. prod. – Kazan: JSC Kuranty, 2013, pp 64-69.

[4] Ivanov D.V., Ziganshin I.I. Osmelkin E.V.Metodika of an assessment natural and technogenic making heavy metals in reservoirs of the urbanized territories / "Georesursa's" Scientific and technical magazine, No. 5(41) 2011. – pp 27-30.

[5] Latypova V.Z. Stepanova N. Yu. Minakov E.A.Vosstanovleniye of intracity reservoirs with use of modern methods of optimization (on the example of the cut bend of river of Kazanki) // Materials conferences on studying of ecology and geography of Central Volga Area. Kazan, 2008. - pp 52-53.

[6] Methodical guide to water biotesting: RD 118-02-90. - M., 1991. - 48 pages.

[7] Minakova E.A. Voda of river of Kazanki as a factor of formation of quality of a surface water of the Kuibyshev reservoir around water intake / E.A.Minakova, O.G.Yakovleva, V.Z.Latypova // VII nauch-prakt. Volga region region. 1999. pp 22-23.

[8] Nikitin O.V., Latypova V. Z., Shagidullin R. R., Pozdnyakov Sh. R. Geoekologichesky monitoring of a bend of the river of Kazank as factor of chemical pollution of the Kuibyshev reservoir / "Georesursa" No. 2(38), 2011 Scientific and technical magazine. pp 27-30.

[9] Maximum permissible concentration of chemicals in water of water objects of economic and drinking and cultural and community water use. Hygienic standards. GN2.1.5.1315-03. 2003.

[10] Rumyantsev V. A. Otsenka of an ecological condition of a bend of river of Kazanki / Century A. Rumyantsev, Sh. R. Pozdnyakov, V. Z. Latypova // Modern aspects of ecology and ecological education: Materials of all-Russian conference. Kazan, 2005. - pp 477 - 478.

[11] Stroganov N.S., Isakov E.F, Kolosov.L.V. Bioassay method for water quality using Daphnia. In the book. Methods Bioindication and bioassay of natural waters, L. Leningrad Gidrometioizdat, 1987, Issue 1.

[12] Basic principles of bioassays and assessment of wastewater water quality of natural water bodies / N.S.Stroganov, O.F.FiLenka G. Lebedev and others // Theoretical questions biotestirotion / / Ed. V.I.Lukyanenko. Volgograd, 1983. Pp. 21-29.