

## ASSESSMENT OF HYDROCHEMICAL CONDITIONS OF ARTIFICIAL RESERVOIR (ON THE EXAMPLE OF PECHENIGY STORAGE RESERVOIR)

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### Abstract

Based on a decade-long research of hydrochemical parameters it has been found out that oxygen regime in Pechenigy reservoir is satisfactory on the whole, organohalogen pesticides and triazine herbicides concentrations in water are below the allowable. Today water parameters in Pechenigy reservoir exceed 4 times maximum permissible in copper, 2 times in chromium, the oil content of 0.05 mg / l - corresponds to MAC.

Possible sources significantly affecting the balance of Pechenigy reservoir's ecosystem including water have been identified and the ways to solve the problems and to improve the reservoir's ecosystem have been outlined.

**Keywords:** Pechenigy reservoir, hydrochemical indicators, oxygen regime, pesticides.

## ОЦЕНКА ГИДРОХИМИЧЕСКОГО РЕЖИМА ВОДОХРАНИЛИЩЕ (НА ПРИМЕРЕ ПЕЧЕНЕЖСКОГО ВОДОХРАНИЛИЩА)

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### Аннотация

На основании десятилетнего исследования гидрохимических параметров обнаружено, что кислородный режим Печенежского водохранилища в целом удовлетворителен, концентрации органохалогенных пестицидов и триазинов в воде ниже максимально допустимых. Сегодня параметры воды в Печенежском водохранилище превышают в 4 раза максимально допустимую концентрацию по меди, в 2 раза по хрому, содержание нефтепродуктов в 5 раз - отвечает ПДК.

Были определены возможные источники загрязнения, которые значительно влияют на баланс экосистем, включая Печенежское водохранилище, были изложены пути решения проблем и улучшения экосистемы водохранилища.

**Ключевые слова:** Печенежское водохранилище, гидрохимические показатели, кислородный режим, пестициды

### Introduction

Pechenigy storage reservoir is a great channel reservoir on the river Siversky Donets located in Kharkiv region. The reservoir basin covers the area of three districts in Kharkiv region, such as Vovchansky, Pechenizhsky and Chuguevsky. Pechenigy reservoir has been established mainly to supply the city of Kharkiv with fresh water on the site of a small Koshetoksky reservoir, built in 1936.

The reservoir is used for industrial, municipal and agricultural water supply of Kharkiv, fisheries and recreation. It is a strategic object which supplies water for approximately 50% of Kharkiv and the region's users. Therefore, an important issue is the environmental conditions of the reservoir, biological productivity of aquatic organisms and water quality in general.

To receive the data on the ecological conditions of the central part of Pechenigy reservoir basin a theoretical description of the study area has been carried out; the area from the map image has been studied; water samples have been selected and analyzed at the laboratory.

The essence of the experiment is that the central reservoir contains a landscape profile. Along it we sampled water, soil and vegetation. This paper analyzes the research results of water.

Fisheries play an important role in providing population with food and national economy with raw materials. Environmental pollution and its consequences negatively affect the ecological conditions of lakes by decreasing the number of the main species of fish, animals and birds. Therefore, it is so important to regularly control hydrochemical conditions of lakes nowadays.

The conditions of the water conservation zone, including coastland, is one of the most important factors in water bio-resources' reproduction of Pechenigy storage reservoir because it is a valuable water- bog which includes water table with factions of real water plants, islands with brushwood's green, coastland with boggy and meadow plants, as well as a flood plain in the springhead of the storage reservoir, has a great importance for sustainable biodiversity of numerous birds, animals and fish. Rare species from the European Red List, the Red Book of Ukraine (the landrail, white- tailed eagle, osprey, crane gray, etc.) and the Red List of Kharkiv region are presented in the ornithological complexes. There

are colonies of the gray heron, black-headed gull, ducks, and mute swan. Part of the storage reservoir is a migration passage, the resting and feeding place for numerous flocks of migrant water and near- water birds (geese, ducks, drakes, stints, etc.) Rare mammals mentioned in the European Red List and The Red Book of Ukraine also live in the area (river otter, European mink).

Thus, the purpose of the article is to study hydrochemical characteristics of Pechenigy storage reservoir and influence of unlawful dumps and sewage on these characteristics.

According to the indicated purpose the tasks of the article were as follows:

- to study hydro-chemical conditions of Pechenigy storage reservoir;
- to analyze the life conditions of fish and wild animals on the territory of the storage reservoir;
- to find out the causes of pollution and ways to improve hydro-chemical conditions of Pechenigy storage reservoir.

### Analysis of previous studies

Hydro- chemical indicators' dynamics of Ukrainian rivers were studied by many scientists [Beling, 1934], [Vladimirova, 1978], [Golovko, 2003], [Markovskij, 1938], [Shcherbak, 2001], [Jakushin, 2001]. Systematic monitoring on chemical structures of rivers, lakes and marine waters in Ukraine started in 1930s by hydrometeorological service points. These facts were published in "Hydrological annuals" (section "Chemical composition of water"), from 1968 - in quarterly "Hydro-chemical bulletins ", from 1984 - in "Annual facts about quality of surface waters of Ukraine" published by the Central geographical observatory of hydrometeorological service (at present is affiliated to the Ministry of Emergency of Ukraine).The departmental hydrochemical monitoring is conducted also by units of Ministry of Environment, State water agency of Ukraine.

Great contribution to formation and development of hydrochemistry of surface waters of dryland was made by Burkser, Almazov, Nabyvanets', Denysova, L.O. Zhuravlova, P.M. Lynnyk, who studied the formation of hydro chemical regime in mouth parts of rivers, estuaries, and hard metals contents in water.

The scientists of the department of hydrology and hydroecology of the geographical faculty of T. Shevchenko Kyiv National University have researched the interrelation and mapped chemical composition of different types of natural water in Ukraine [Peleshenko, 1997], the role of anthropogenic factors in its formation was found out, the research in reclamation hydrochemistry [Gorev, 1995], agricultural hydrochemistry and hydrochemistry of surface-hillside flow on little headers [Hil'chevs'kij, 1996].

The experimental research and thermodynamic modeling of processes in migrating polluted materials in surface waters, the researches on humus materials, the use of GIS-technologies in hydrochemistry are studied by the Ukrainian research hydrometeorological institute [Osadchij, 2012].

During the integrated regional hydrogeological researches of the Ukrainian territory the scientists –hydrogeologists have studied the main laws of chemical structure formation in ground water [11]. The researches in theoretical questions of underground water chemistry and processes of radioactive nuclides migration in water caused by technological activities at the institute of Geology NAS of Ukraine [11].

But none of the research is connected with the dynamic of hydrochemical indicators of Pechenigy storage reservoir.

Results of the research

Recently in Pechenigy storage reservoir oxygen regime has been satisfactory, in general. It should be noticed that BSC<sub>5</sub> has the tendency to growth (in 2008 increased from 1.73mgO<sub>2</sub>/dm<sup>3</sup> to 2.21 mgO<sub>2</sub>/dm<sup>3</sup> in comparison with 2007, but not beyond MAC; in 2009 increased – from 2.21 mgO<sub>2</sub>/dm<sup>3</sup> to 2.36 mgO<sub>2</sub>/dm<sup>3</sup> and continued to prevail in MAC. Index of HSC in 2008 increased in comparison with the last year- from 19.8 mgO/dm<sup>3</sup> to 21.2 mgO/dm<sup>3</sup> (continues to exceed MAC). And in 2009 HSC index insignificantly decreased up to 20.0 mg O/dm<sup>3</sup>, but continues to exceed MAC. In 2010 index of HSC exceeded MAC by 1.4 times.

In 2011 oxygen regime in Pechenigy storage reservoir was satisfactory. The requirements of SanPin № 4630-88 were broken only by HSC, which exceeded MAC by 1.3 times. The average concentrations of salt indexes and heavy metals don't exceed the sanitary standards. The contents of others polluting substances have hardly changed and stayed in limits of MAC. General hardness of water remained at the level of

the last year and is 5.8 m/dm<sup>3</sup>. The class of water quality, like in the last year is -3 «moderately polluted», IZV is 1.269.

Halogenorganic pesticides (α-GHZG, γ-GHZG, treflan, 4.4-DDE, 4.4 – DDD, 4.4-DDT) and threeazine herbicides (propazine, atrazine, simazine, prometrine) have been identified in water tests according to toxicological observations. The concentrations of halogenorganic pesticides and treeazine herbicides in water of water-objects during 2011 were lower than MAC.

On the whole, at present, according to the results of 2011 observations certain improvements in surface water quality of Pechenigy storage reservoir have been noticed in comparison with the same period last year.

Conclusions

Thus, we can affirm that unsatisfied hydro- chemical conditions of Pechenigy storage reservoir negatively influence ecosystem as a whole. Moreover, BSC<sub>5</sub>, HSC, copper, chrome indexes, although have improved for the last years, but still are higher than MPC. Possible sources which essentially influence on the ecosystem's balance of Pechenigy storage reservoir including water, are the following:

- towns with life waste products, treatment, production facilities including agricultural- fields, animal farms, MTS situated along the storage reservoir and the rivers, filling it (15),
- recreation centres (52) –polluting with waste, without treatment facilities;
- users of plots of lands with the aim of reaction (37) - legal, illegal building, pollution with waste products, availability and conditions of treatment facilities;
- ways of filling the storage reservoir by the river Siversky Donets, its tributaries, rain and water from melted snow;
- wild animals, birds–ways of their migration, illnesses (causative agents of a disease);
- unauthorized junkyards in a coastal protected strip;
- pollution of the storage reservoir with household waste by fishermen-amateurs in the winter period.

In our opinion, there are the following ways to solve the problems in question, to improve the ecosystem of the storage reservoir:

Tab. 1. Data of radiological research of water and bottom sediments of Pechenigy water reservoir in 2008-2011

Year	Strontium -90, Bq / dm <sup>3</sup> , kg			Cesium -137, Bq/dm <sup>3</sup> , kg		
	min	max	Average annual	min	max	Average annual
1	2	3	4	5	6	7
2008	0,016	0,028	0,022	0,040	0,066	0,051
2009	0,015	0,023	0,019	0,053	0,068	0,061
2010	0,017	0,021	0,019	0,063	0,052	0,057
2011	0.013	0.028	0.021	0.041	0.064	0.057

Tab 2. Conditions of water quality in Pechenigy storage reservoir according to the research results in 2011.

Index	measures	Indexes	Requirements for water quality of fish ponds according to GTS 5.372-87
Ammonium-ion	mg N /dm <sup>3</sup>	within normal limits	to 1.0
Nitrite-ion	mg N /dm <sup>3</sup>	within normal limits	to 0.2
Nitrate-ion	mg N /dm <sup>3</sup>	within normal limits	to 3.0
Phosphate-ion	mg P /dm <sup>3</sup>	within normal limits	to 0.5
Hydrocarbonates	mg /dm <sup>3</sup>	within normal limits	-
BSC <sub>5</sub>	mg O /dm <sup>3</sup>	10.1 - 11.6	4.0-15.0 (admissible 20.0)
HPC	mg O /dm <sup>3</sup>	Excess in 1.3	35-70 (admissible 100,0)
Chlorides	mg /dm <sup>3</sup>	within normal limits	till 300
Sulphates	mg /dm <sup>3</sup>	Excess in 1.4	till 100

- to establish effective control of the potentially dangerous objects, to repair the existing treatment facilities, to build the new ones, using new technologies of the flows treatment, domestic waste recycling.
- to restrict (ban) building near the coastal strip.
- to control the proper use of given lands, to eliminate encroachments.
- to establish a utility company of a regional level with multilateral work direction, such as fisheries, recreation facilities, regulation of given recreational services;
- to implement preventive measures to reduce the morbidity of wild life;
- to afforest the adjacent territory;
- to carry out systematic monitoring of the ecosystem of the storage reservoir;
- to preserve and restore the environment, including natural biodiversity, etc.

There are also ways to improve water quality in Pechenigy storage reservoir:

1. Water quality of the storage reservoir should be monitored annually and the causes of basic sources of pollution should be found and eliminated;
2. The owners of the enterprises, recreation centers of other institutions and organizations situated on the banks of Pechenigy storage reservoir should be made responsible for developing a package of integrated measures as to the localization of potentially dangerous substances.
3. A laboratory studying the water quality in Pechenigy storage reservoir should be established on the basis of the utility company and accredited according to general indexes.

#### References

- [1] Beling D., Korotun M., Markovs'kij Ju., Citovich V. Materiali do gidrobiologichnoi charakteristiki dniprov's'kih zaplavnih vodojm i viznachennja ih riboproduktivnosti (Materials to hydrobiological characteristics of the Dnieper flood waters and determination of their fish productivity) // Tr. gidrobiol. st. – 1934. – № 7. – S. 3–52.
- [2] Vladimirova K. S. Fitomikrobentos Dnepra, ego vodohranilishh i Dneprovsko-Bug'skogo limana (Phytomicrobentos of the Dnieper, its reservoirs and Dnieper- Bug estuary). – Kiev: Nauk. dumka, 1978. – 228 s.
- [3] Gidrobiologicheskij rezhim Dnepra v uslovijah zaregulirovannogo stoka (Hydrobiological regime of the Dnieper in terms of regulated flow). – Kiev: Nauk. dumka, 1967. – 387 s.
- [4] Golovko T. V., Jakushin V. M., Tron'ko N. I. Bakterioplankton Kanevskogo vodohranilishha i ego produkcionnye karakteristiki (Bacterioplankton of Kaniv water reservoir and its production characteristics) // Gidrobiol. zhurn. – 2003. – T. 39, № 4. – S. 58–71.
- [5] Markovs'kij Ju. M. Zavdannja doslidzen' morfologii zaplavnih vodojm v zv'jazku z vstanovlennjam ih tipiv i produktivnosti (Research objectives of flood water morphology in connection with the establishment of its type and productivity) // Tr. gidrobiol. st. – 1938. – № 16. – S. 51–80.
- [6] Shherbak V. I., Majstrova N. V. Fitoplankton Kiivs'koï diljanki Kanivs'kogo vodojmishha ta chinniki, shho jogo viznachajut' (Phytoplankton in Kyiv part of Kaniv water reservoir and factors that determine it). – K.: In-t gidrobiologii NANU, 2001. – 70 s.
- [7] Jakushin V. M., Shherbak V. I., Pligin Ju. V. ta in. Mehanizmi funkcionuvannja ekosistemi verhn'oi chastini Kanivs'kogo vodojmishha (Functioning mechanisms of the ecosystem of the upper part of Kaniv reservoir) // Nauk. zap. Ternop. derzh. ped. un-tu. Ser.: Biologija. Spec. vip.: Gidroekologija. – 2001. – № 3(14). – S. 114–116.
- [8] Gorev L.M., Peleshenko V.I., Hil'chevs'kij V.K. Gidrohimiya Ukraïni (Hydrochemistry of Ukraine). - K., 1995.
- [9] Hil'chevs'kij V.K. Rol' agrohimichnih zasobiv u formuvanni jakosti vod basejnu Dnipra (Role of agrochemical facilities in the formation of water quality of the Dnieper basin). - K., 1996.
- [10] Peleshenko V.I., Hil'chevs'kij V.K. Zagal'na gidrohimiya (General hydrochemistry). - K., 1997.
- [11] Ukraïns'ki gidrologi, gidrohimiiki, gidroekologi (Ukrainian hydrologists, hydrochemists, hydroecologists) / Za red. V.K.Hil'chevs'kogo - K., 2004.
- [12] Hil'chevs'kij V.K., Osadchij V.I., Kurilo S.M. Osnovi gidrohimiï (Basics of hydrochemistry). - K., 2012.



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