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HYDRO-ECOLOGICAL ASSESSMENT OF POND WATER QUALITY

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The quality of surface waters of Ukraine, their ecological condition and prospects for use by the country's population for industry, agriculture and everyday life are analyzed. Surface waters in modern times are constantly exposed to pollution, damage and destruction. Due to the fact that the water supply of the population of Ukraine is carried out to a greater extent at the expense of surface water. The high percentage of pollution of hydrological objects, the loss of clean fresh water, the reduction or complete disappearance or extinction of biodiversity, among which there are few and rare species, provokes the fact that the issue of the ecological state of surface water objects becomes more and more acute and acquires even greater importance. actuality In particular, it is worth noting that ponds are one of the artificial and semi-artificial surface water bodies. Although the intensity of industrial production has decreased in recent years, a large number of hydrological objects have been contaminated as a result of russia's full-scale military aggression.

When hydrochemical parameters were studied in the selected water samples, using the example of the Tashlyk pond in the village of Verbka, Tulchyn district, Vinnytsia region, the highest concentration was found in the third sample (an unauthorized landfill located on the shore), where the pH value was 6.5, which indicates an alkaline water environment. The concentration of ammonium nitrogen in the water was 0.5 mg/l, the nitrite indicator was 3.2 mg/l. The nitrate content was found at a concentration of 43.0 mg/l. An excess of calcium content of 347 mg/l was recorded. The content of chloride concentration was 248 mg/l. The indicator of total hardness was 3.1 mg-eq./l, and mineralization (dry residue) was 73 mg/l. The study of hydro-ecological indicators (heavy metals) showed their highest concentration also in the third sample, where the content of Pb in the sample was 0.09 mg/dm³, Cd was 0.008 mg/dm³, Zn in sample 3 was 3.7 mg/dm³, Cu was 0.8 mg/dm³, but no exceedances of maximum permissible concentrations were detected.

Key words: pond, surface water, pollution, ecological condition, concentration, hydro-ecological indicators.

Врадій О.І. Гідроекологічна оцінка якості ставкової води

Проаналізовано якість поверхневих вод України, їх екологічний стан та перспективи використання населенням країни для промисловості, сільському господарстві та побуті. Поверхневі води в сучасний час постійно піддаються забрудненню, пошкодженню та руйнуванню. Через те, що водозабезпечення населення України здійснюється в більший мірі за рахунок поверхневих вод. Високий відсоток забрудненості гідрологічних об'єктів, втрата чистої прісної води, зниження або повне зникнення чи вимирання біорізноманіття, серед яких є малочисельні та рідкісні види, провокує те, що питання стосовно проблеми екологічного стану поверхневих водних об'єктів стає все гострішим і набуває ще більшої актуальності. Зокрема варто відмітити, ставки як один із штучних та напівштучних поверхневих водних об'єктів. Хоч за останні роки інтенсивність промислового виробництва зменшилася, велика кількість гідрологічних об'єктів піддалась забрудненню внаслідок повномаштабної військової агресії росії.

При дослідженні гідрохімічних показників у відібраних пробах води на прикладі ставка Ташлик у селі Вербка Тульчинського району Вінницької області було встановлено найбільшу їхню концентрацію у третьому зразку (на березі розташоване несанкціоноване сміттєзвалище), де показник рН становив 6,5, що вказує на лужне середовище води. Концентрація амонійного азоту у воді склала 0,5 мг/л, показник нітритів становив 3,2 мг/л. Вміст нітратів було виявлено в концентрації 43,0 мг/л. Було зафіксовано перевищення вмісту кальцію 347 мг/л. Вміст концентрації хлориду склав 248 мг/л. Показник загальної твердості склав 3,1 мг-екв./л, а мінералізації (сухого залишку) 73 мг/л. Дослідження

гідроекологічних показників (важких металів), показав найбільшу їхню концентрацію також у третьому зразку, де вміст Pb у пробі склав 0,09 мг/дм³, Cd склала 0,008 мг/дм³, Zn у пробі 3 склав 3,7 мг/дм³, Си становив 0,8 мг/дм³, але перевищень гранично допустимих концентрацій не виявлено.

Ключові слова: ставок, поверхневі води, забруднення, екологічний стан, концентрація, гідроекологічні показники.

Formulation of the problem. Pollution of water resources is one of the main problems of Ukraine. The high percentage of discharge of polluted substances into reservoirs provokes serious concern for the ecological situations of water bodies [5]. After all, this will lead to serious, sometimes irreversible consequences. The conduct of any agricultural, industrial, or food activity poses a threat to the environment. Deterioration of the state of water bodies can be associated with many factors [11].

First of all, this concerns the impact of industry and agricultural activities, as well as improper handling of water bodies, use, care, protection. To solve this kind of problem, it is necessary to agree and join efforts at all levels of government, industry, and local communities [3].

The pond is an important factor in the aquatic ecosystem. Its main role is the constant accumulation and storage of fresh water. Also, as a hydrological object, it plays a significant role in such processes as: water supply for the rural population, regulation of water flows, water storage, prevention of flooding of territories. Water from ponds is actively used in agriculture, in particular, irrigation of agricultural plots, active development of fish farming, breeding of waterfowl and animals. It is also worth noting their recreational, tourist and protected role [10].

Ponds are an important factor in the ecosystem of Ukraine. For the period of 2023, there are more than 4.940 ponds with a total area of more than 2.890 km² on the territory of Ukraine. With a volume of more than 3969 million m³ of water. If compared with the number of lakes in Ukraine, there are only more than 3.000 of them [7].

Ponds occupy a rather significant place in the water supply of territories. They regulate water flow, prevent areas from flooding and store water. Pond water is actively used in agriculture, for irrigation of agricultural plots, development of fisheries, and for other aquatic animals. It plays an important role in recreation and tourism [5]. Ponds often attract tourists, lovers of fishing and other active recreation. Ponds are also an important source of income for the local population engaged in fishing or other activities closely related to ponds [11].

However, in recent years there has been a trend that ponds are getting more and more polluted. And their condition is becoming more and more unsatisfactory. A large number of reservoirs are overgrown with reeds and other vegetation, which hinders the ability of ponds to regulate water quality and water protection function. Also, a large number of water bodies are polluted by domestic and industrial wastewater. The irrational activity of enterprises and producers of agricultural products should not be ignored. Outright indifference of the local population, inefficiency of treatment facilities and outdated methods, as well as outright disregard for environmental standards [12].

Analysis of recent research and publications. Problems of the ecological state of surface waters are studied by a number of scientists [1-4], because they are now a factor in the ecological security of human existence at all levels – from local to global. It is undeniable that these issues are becoming more acute in areas that are under significant anthropogenic pressure [6]. Along with other components of environmental problems, the problems of environmental assessment of the state of

water resources are noted for their relevance today. Water quality plays a decisive role in the development of the biosphere. However, the growth of cities, the development of industry and agriculture led to the XX century to the pollution of water sources by consumer substances, mainly biogenic elements, which negatively affects the functioning of water ecosystems [5]. Water is a natural resource and an integral component of the existence of all living things on the planet. The problem of providing drinking water to mankind is currently extremely urgent, since the available water resources in many areas are insufficient to provide all consumers not only in the future, but also today. The share of water suitable for use by the population and industry is very limited. Both the quantitative and qualitative composition of water is anthropogenically affected. Indicators of the qualitative composition of water are among the determining factors in the assessment of the ecological situation. Thus, it can be argued that the most promising method of identifying zones of increased ecological danger is the assessment of the ecological state. This makes it possible to establish the maximum permissible anthropogenic pressure in order to preserve the natural balance of the environment. Assessment of the ecological status of surface water quality is the basis for establishing ecological standards of water quality for individual water bodies 196 and their parts, groups of water determination and management of ecological risk of anthropogenic load on environmental objects [7].

The purpose of the research is to carry out an ecological and hydrological assessment of the state of the Tashlyk pond within the limits of the village of Verbka, Tulchyn district, Vinnytsia region.

Research materials and methods. Hydro-ecological assessment of pond water was conducted in the spring of 2024, taking samples from the Tashlyk pond, located within the village of Verbka, which is a settlement of Horodkivska rural territorial community, Tulchyn district, Vinnytsia region. The only river Markivka flows through the village. The climate is moderately continental.

According to the research scheme, water samples were taken from the Tashlyk pond, according to generally accepted methods of water sampling. The first (control) sample was taken from the right bank, where there are no nearby homesteads or other objects that could affect the hydrological parameters of the pond water. The second sample was taken in the middle of the pond. The third sample was taken from the left bank of the reservoir, where an unauthorized landfill is located. The selected water samples were sent for research to the scientific and measuring agrochemical laboratory of the Educational and Scientific Institute of Agricultural Technologies and Environmental Sciences of the Vinnytsia National Agrarian University. The obtained indicators were compared with the standards of MPC of substances in water, and its hydrochemical and hydroecological parameters.

Presentation of the main research material. The Tashlyk Pond is one of two man-made water bodies located on the Tashlyk River, the right tributary of the main Markivka River (Dniester basin). The length of the Tashlyk River is 19 km. It is formed from a large number of nameless streams and reservoirs. The area of the water basin is 97.7 km². In some areas, it is drying out. The tributaries are: Melnykiv Yar (right). It originates in Savchyny, flows mainly to the southwest and flows into the Markivka, a left tributary of the Dniester, in the village of Verbka. The settlements along the coastal strip are Maryanivka and Leonivka. The Tashlyk pond plays an important recreational role, as it is a place of rest for the villagers. For some time it was used in fish farming (Fig. 1).



Fig. 1. Map of the location of the Tashlyk pond within the village of Verbka, Tulchyn district, Vinnytsia region

The pond plays an important role in agriculture, particularly animal husbandry, as it is a watering place for livestock. Also, the pond is a source of replenishment of underground sources of wells and pits, a habitat for rich flora and fauna, which has suffered impoverishment in the recent period.

According to the results of research in laboratory conditions, the hydrochemical indicators in the water of the Tashlyk pond within the village Verbka, Tulchyn district, Vinnytsia region was determined (Table 1).

Table 1

Hydrochemical indicators of the Tashlyk pond

Hydrochemical indicators	Sample 1	Sample 2	Sample 3	MPC
Hydrogen pH indicator	7.6	7.2	6.5	6.5-8.5
Ammonium nitrogen, mg/l	0.1	0.3	0.5	0.5
Nitrites, mg/l	2.9	3.0	3.2	3.3
Nitrates, mg/l	37.8	39.5	43.0	45.0
Calcium, mg/l	143.2	254.8	347	180
Chlorides, mg/l	98	157	248	350
Total hardness, mg-eq./l	1.9	2.7	3.1	-
Mineralization (dry residue), mg/l	61	68	73	-

In the first sample taken from the Tashlyk pond, the hydrogen pH was 7.6 with a permissible concentration of 6.5-8.5 pH. From this, it can be concluded that the reaction of the water environment is neutral. The content of ammonium nitrogen was found at a concentration of 0.1 mg/l with a limit of MPC of 0.5 mg/l, which is also within the normal range. The presence of nitrites in the pond water of the Tashlyk pond was 2.9 mg/l, with a permissible limit concentration of 3.3 mg/l. The content of nitrates was 37.8 mg/l, according to the norm of the MPC of 45.0 mg/l, which is, accordingly, less than the permissible level. No excess of calcium content in the water was detected,

which was 143.2 mg/l, with the MPC – 180 mg/l. The chloride indicator was 98 mg/l, which is less than the MPC indicator. Total hardness was 1.9 mg-eq/l, and mineralization (dry residue) was 61 mg/l.

In the second sample from the Tashlyk pond, the pH indicator was 7.2, which is 0.4 less than in the first, with a pH limit of 6.5-8.5 and is neutral. Ammonium nitrogen was 0.3 mg/l, which also does not exceed the permissible content of 0.5 mg/l, and is higher than the value of the first sample by 0.2 mg/l. The content of nitrites was 3.0 mg/l, with MPC – 3.3 mg/l, which is also not exceeded, but 0.1 mg/l more than the indicator in the first sample. The nitrate indicator was 39.5 mg/l, which, according to the MPC indicator of 45.0 mg/l, does not exceed the MPC, but is already 1.7 mg/l more than the indicator of the first sample. An excess of calcium of 254.8 mg/l was recorded, with a limit of 180 mg/l, which is 74.8 more than the permissible norm. The content of chlorides in the second sample was – 157 mg/l, which is permissible under the MPC. Total hardness was 2.7 mg-eq./l, and mineralization (dry residue) was 68 mg/l.

In the third sample of water from the Tashlyk pond the pH indicator was 6.5, with a maximum permissible limit of 6.5-8.5, but it indicates an alkaline water environment. The concentration of ammonium nitrogen in the water was 0.5 mg/l, which according to the norm of 0.5 mg/l is permissible, but at the same time it is 0.4 mg/l more than the indicator of the first sample, and 0.2 more than the second sample.

The nitrite concentration indicator was 3.2 mg/l, at the permissible level of 3.3 mg/l and is 0.1 mg/l more than the value in the first sample and 0.2 mg/l more in the second sample. The content of nitrates was detected at a concentration of 43.0 mg/l at the MPC – 45.0 mg/l is not an excess, but this indicator increased by 5.2 mg/l in the first sample and by 3.5 mg/l in the second sample. An excess of calcium content of 347 mg/l was recorded, which according to the permissible standards is 180 mg/l and is dangerous because the concentration exceeds 167 mg/l. The content of the chloride concentration was 248 mg/l, which is allowed according to the maximum permissible concentration, but it is 150 mg/l more than the content in the first sample and 91 mg/l more than the indicator in the second sample. The indicator of total hardness was 3.1 mg-eq./l, and mineralization (dry residue) was 73.

According to the results of research in laboratory conditions, the hydroecological indicators of the Tashlyk pond within the village Verbka, Tulchyn district, Vinnytsia region were also studied (Table 2).

Table 2

Hydro-ecological indicators of the Tashlyk pond

Hydro-ecological indicators (heavy metals), mg/dm ³	Sample 1	Sample 2	Sample 3	MPC
Pb	0.03	0.06	0.09	0.1
Cd	0.001	0.004	0.008	0.01
Zn	1.1	2.1	3.7	5.0
Cu	0.1	0.3	0.8	1.0

The concentration of Pb in the first sample was 0.3 times less than the MPC indicator. The Cd content was 0.001 mg/dm³, which is 0.1 times less than the permissible content. The Zn indicator was 0.22 times lower than the permissible norm. The concentration of Cu content in sample 1 was 0.1 times less than the maximum permissible concentration.

The content of Pb in the second sample was 0.6 times less than the MPC indicator. The concentration of Cd in the second sample is 0.4 times lower than the permissible

value. The presence of Zn was 0.42 times less than the permissible norm of the MPC indicator. The Cu indicator was 0.3 mg/dm³, which is 0.3 times less than the maximum permissible concentration.

The highest concentration of heavy metals was found in the third sample. The Pb indicator in the sample was 0.09 mg/dm³, which is 3.0 times and 1.5 times higher than the indicators in the first and second samples, respectively. The concentration of Cd was 0.008 mg/dm³, which is 8.0 times higher than the indicator values in the first sample, and 2.0 times higher in the second sample. The content of Zn in the third sample was 3.7 mg/dm³, which is 3.3 times more than the previous indicators, in the first sample and 1.8 times in the second sample. The Cu concentration indicator in the third sample was 0.8 mg/dm³, which is 8.0 times higher than the indicators of the first sample and 2.6 times higher, respectively.

Conclusions and suggestions. When the hydrochemical indicators were examined in the selected water samples of the Tashlyk pond of the Tulchyn district, their highest concentration was found in the third sample, where an unauthorized landfill is located on the shore of the pond. The pH indicator was 6.5, which indicates an alkaline water environment. The concentration of ammonium nitrogen in the water was 0.5 mg/l, the nitrite indicator was 3.2 mg/l. The nitrate content was found at a concentration of 43.0 mg/l. An excess of calcium content of 347 mg/l was recorded. The content of chloride concentration was 248 mg/l. The study of hydro-ecological parameters (heavy metals) showed their highest concentration also in the third sample, where the content of Pb in the sample was 0.09 mg/dm³, Cd was 0.008 mg/dm³, Zn – 3.7 mg/dm³, Cu – 0.8 mg/dm³, which does not exceed the MPC.

The main proposals for improving the pollution control of the Tashlyk pond are: to establish coastal protective strips on both banks of the pond in the average multi-year limit period within 100 m.

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