

N.S. Mamytova¹, L.Kh. Akbayeva², N.K. Kobetayeva^{2*},
Y.A. Tulegenov³, Y.J. Makazhanov⁴

¹Kazakh University Technology and Business, Nur-Sultan, Kazakhstan

²L.N. Gumilyov Eurasian National University, Nur-Sultan, Kazakhstan

³Kazakh National Women's Teacher Training University, Almaty, Kazakhstan

⁴Bashkir State Pedagogical University named after M. Akmulla, Ufa, Republic of Bashkortostan, Russia

*Corresponding author: kobetaeva.nazira@mail.ru

Study of the self-cleaning ability of a reservoir and watercourses by hydrochemical indicators of Akmola region for 2018

Abstract. The article discusses the self-cleaning ability of lakes, rivers, and reservoirs of the Akmola region in terms of oxygen, as well as the influence of certain hydrochemical indicators such as (sulfates, chlorides, magnesium, salt ammonium, nitrite nitrogen, fluorides, total iron, zinc, manganese, copper, phenol). Among the chemical factors that inhibit the self-cleaning ability of reservoirs, one can note an increased content of salt sulfates, chlorides, calcium, magnesium, zinc, and copper phenol. ammonium, nitrite nitrogen, total iron, and copper. An assessment of the self-cleaning capacity of water bodies in the Akmola region was given based on oxygen indicators: the amount of dissolved oxygen in the water and the biological oxygen demand (BOD5). Rivers and lakes, based on the results obtained, were divided into six classes of self-cleaning ability, and a graph was also built from which among the studied water bodies, according to general annual indicators, lakes with low self-cleaning ability prevail. It has been established that the self-purification potential of waters can be influenced by both the excess of the content of individual hydrochemical components and the amount of the exceeded components, which can have a synergistic effect. Along with this, we studied which of the accompanying hydrochemical components affect the purification potential of water in lakes and rivers.

Keywords: reservoirs, watercourses, the self-cleaning ability of surface waters, biological capacity of oxygen, solubility of oxygen.

DOI: 10.32523/2616-7034-2022-139-2-86-96

Introduction

Justification of the necessity and relevance of the study: In the introduction, the authors focused only on the area of their research, I would suggest for the next article briefly highlight the problem in other regions, to present the global significance and applicability of the study.

Among the challenges of our time, the issue of the loss of the quality of surface water resources is becoming more acute [1,2]. Pollution of rivers and lakes is a hot topic in many countries of the world. Of course, measures should be taken to prevent pollutants from entering surface waters, but do not lose sight of the fact of natural self-purification in them. The ability to self-purify in lakes and rivers is a multifactorial process that allows you to maintain chemical homeostasis in water and ensure the vital activity of all hydrobionts. However, the problem of reducing and even losing this ability of reservoirs due to the ingress of persistent toxicants or a combination of different pollutants that can act with different activities under different hydrological regimes is increasingly being raised [3,4]. Knowledge of the conditions of self-purification, and their peculiarities in different types of rivers and lakes can help preserve the quality of water resources, the health of the entire aquatic ecosystem.

Natural waters differ from aqueous solutions of mineral and organic substances by the presence of complex communities of living organisms and a constant concentration of chemically active particles and compounds. With the participation of these organisms and particles, the synthesis and destruction of organic substances, the transformation of their forms, and, to a large extent, the migration of chemical elements are carried out.

The purpose of this work was: to carry out a comparative analysis of the self-cleaning ability of reservoirs and watercourses of the Akmola region in terms of oxygen indicators, as well as the influence of individual hydrochemical components [5,6,7,8,9].

In the Akmola region, the average results of hydrochemical studies for 2018 were taken in the following streams and reservoirs: river - Esil, Nura, Akbulak, Sarybulak, Zhabai, Bettybulak, Kypshakty, Shagalaly, lake - Sultangeldy, Zerendy, Kopa, Shabakty, Ulken, Kishi Shabakty, Sulukol, Karasye, Maybalyk, Tekekol, Katarkol, Lebyazhye. In total, 8 rivers, 13 lakes, one Nura-Esil canal, and the Vyacheslavskoe reservoir were considered.

Materials and research methods

We have studied such indicators as the amount of dissolved oxygen R and BOD₅ in the studied lakes and rivers. And calculated the ratio of these indicators as the ratio of photosynthetic activity in the reservoir to its destructive ability: R/BOD₅. The higher this ratio, the higher the potential for self-cleaning capacity in water bodies, and vice versa - the lower the ratio, the lower the self-cleaning capacity of the water body.

The content of the following components was studied in lakes and rivers: pH, sulfates, chlorides, calcium, magnesium, saline ammonium, nitrite nitrogen, fluorides, total iron, zinc, manganese, copper, phenol. Taking into account the concentration of substances in water (C_i) and their maximum permissible content (MPC_i), several components (n) were used to calculate the hydrochemical index of water pollution (WPI) (table 3) [10,11,12].

$$ИЗВ = \frac{1}{n} * \sum_{i=1}^n \frac{C_i}{ПДК_i} \quad (1)$$

According to the results of the analyses of BOD₅ and the content of dissolved oxygen R, the R/BOD₅ ratios were calculated (Table 1). The minimum value of 1,2 of the R/BOD₅ ratio was in Lake Maybalyk, the maximum value of 20,2 in the Bettybulak river (figure 1).

Table 1

Average annual oxygen indicators of surface waters of Akmola region for 2018

Name of reservoirs	BOD ₅ mg / dm ³	The amount of dissolved oxygen R, mg / dm ³	R / BOD ₅
reservoirs			
sil river	1,86±0,02	10,05±2,07	5,4
Akbulak river	3,21±0,008	8,18±1,25	2,5
Sarybulak river	3,34±0,08	7,69±2,14	2,3
Bettybulak river	0,51±0,05	10,30±3,04	20,2
Zhabay river	2,11±0,04	8,90±0,17	4,2
Kylshikty river	2,82±0,017	6,82±0,85	2,4
Chagalla river	1,69±0,03	8,87±1,54	5,2
Nura river	2,81±0,021	8,45±2,07	3
Nura-Esil Canal	2,32±0,07	7,20±1,22	3,1

Table 2

Classes of watercourses by the self-cleaning ability

Class	R / BOD ₅	f	Self-cleaning ability
I	1,2-4,3	9	very weak
II	4,4-7,5	7	weak
III	7,6-10,7	6	average
IV	10,8-13,9	-	average
V	17-17,1	-	good
VI	17,2-20,3	1	high

Results and discussions

As a result, the following graph was obtained (figure 2), from which it can be seen that among the studied rivers and lakes, according to annual indicators, rivers with a low self-cleaning ability prevail: Class I (R/BOD₅ ratio 1,2-4,3), which is 39% of all bodies of water and watercourses. This class of watercourses includes Nura, Akbulak, Sarybulak, Zhabay, Kylshakty, Nura-Esil Canal, and reservoirs - Sulukol, Katarkol, Maybalyk.

To class II (R/BOD₅ 4,4-7,5), the self-cleaning ability of the studied water bodies and watercourses was 30%. Rivers Esil and Shagalaly, lakes - Sultankeldy, Kopa, Burabay Kishi Shabakty, Tekekol.

III class 26% (R/BOD₅ 7,6-10,7) is attributed to the Vyacheslavskoye Reservoir, reservoirs - Zerendy, Ulken Shabakty, Shchuchye, Karase.

IV classes (R/BOD₅ 10,8-13,9) and V (R/BOD₅ 17 – 17,1) in terms of the self-cleaning ability of water bodies and watercourses was - 0%.

in terms of self-cleaning ability VI class (R/BOD₅ 17,2 – 20,3), the Bettybulak river accounted for 4,3% of all streams and reservoirs.

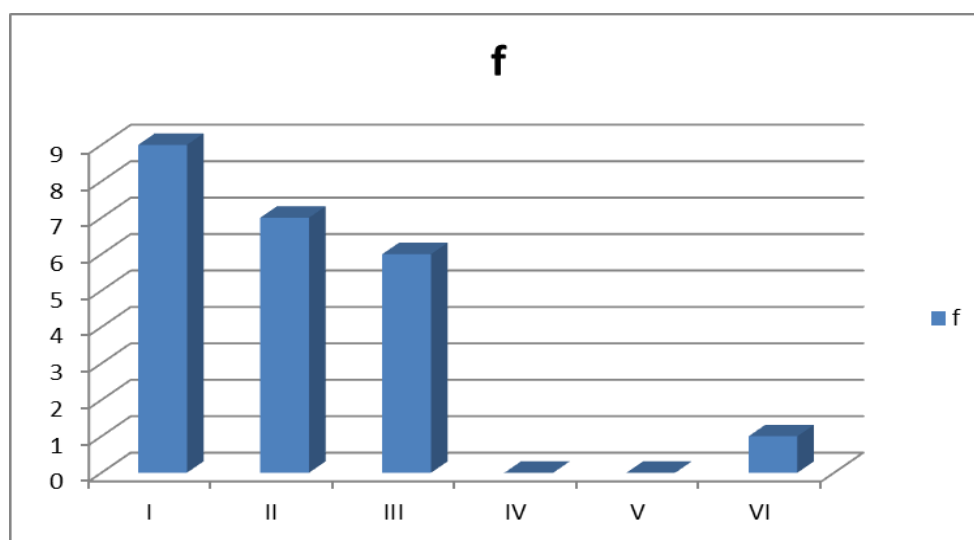


Figure 2. Numerical ratio of watercourses and reservoirs of Akmola region by class of ratio R/BOD₅

Hydrochemical components in the surface waters of the Akmola region for 2018 for the most priority pollutants are presented in (table 3).

Table 3

Hydrochemical components in surface waters of Akmola region for 2018

Name of reservoirs	pH	Class of reservoirs	The frequency rate of excess of MPC												
			Sulfates	Chlorides	Calcium	Magnesium	Ammonium Salt	Nitrite	Fluorides	Total iron	Zinc	Manganese	Copper	Phenol	
MPC (mg / l)	-	-	100	300	-	-	0.5	0.02	0.75	0.1	0.01	0.01	0.001	0.001	0.001
Akbulak river	7,62	I	4,7±0,02	2,2±0,44	1,6±0,15	1,8±0,8	7,2±0,52	1,9±0,01	5,1±2,7	-	1,4±0,21	-	1,6±0,15	-	-
Sarybulak river	7,71	I	6,1±1,01	1,7±0,65	-	2,1±0,6	5,7±0,41	2,3±1,5	1,3±1,32	-	2,5±0,12	-	1,7±0,16	-	-
Zhabay river	8,08	I	1,5±0,18	-	-	-	1,5±0,74	2,3±0,4	-	3,4±0,32	-	14,1±8,07	-	-	-
Kylshikty river	7,83	I	-	-	-	-	2,8±0,32	-	1,9±0,78	5,3±2,1	-	209,5±48,21	-	-	-
Nura river	8,03	I	2,4±0,07	-	-	-	-	-	-	-	1,3±0,36	-	2,9±0,22	-	-
Nura Canal Esil	8,03	I	4,5±1,24	-	-	1,5±0,87	2,5±0,84	1,5±0,74	-	-	-	-	2,3±0,4	-	-
Suluokol lake	7,27	I	-	-	-	-	2,3±0,89	-	4,6±1,44	7,3±0,87	-	-	-	-	1,1±0,98
Lake Katarkol	9,04	I	1,3±0,24	-	-	1,8±0,15	-	-	11,0±0,5	-	-	-	-	-	-
Lake Maybalyk	8,72	I	45,2±6,12	43,1±5,16	-	40,5±3,7	2,8±0,21	2,2±0,95	6,7±2,2	1,5±0,14	-	-	1,7±0,16	1,1±0,77	-
Esil river	8,14	II	1,3±0,01	-	-	-	-	-	-	-	1,3±0,07	1,5±0,07	2,4±0,4	-	-
Chagalla river	7,95	II	-	-	-	-	-	-	-	-	-	63,4±11,78	-	-	-
Sultankeldy lake	8,33	II	1,5±0,04	1,2±0,20	-	1,5±0,14	-	-	-	-	-	-	1,4±0,21	-	-
Lake Kopa	8,25	II	1,6±0,96	-	-	-	-	-	-	-	-	5,9±2,27	-	-	-
Burabay lake	8,00	II	-	-	-	-	-	-	4,1±1,5	-	-	3,6±0,25	-	-	-
Lake Kishi Shabakty	8,76	II	12,4±1,22	6,1±2,04	-	10,0±1,12	1,6±0,44	-	16,1±1,8	-	-	5,0±1,65	1,2±1,2	-	-
Lake Tekekol	8,96	II	1,4±0,11	-	-	2,1±0,06	-	-	12,1±0,9	-	-	-	-	-	-
Reservoir- Vyacheslavskoe	8,16	III	-	-	-	-	-	-	-	-	1,1±0,87	-	2,3±0,4	-	-
Lake Zerenda	8,45	III	1,2±0,48	-	-	1,5±0,32	-	-	3,5±1,7	-	-	3,2±1,32	-	-	-
Lake Ulken Shabakty	8,76	III	2,8±0,27	-	-	2,2±0,87	-	-	1,75±2,4	-	-	1,6±0,48	-	-	-
Lake Shchuchye lake Karasie	8,30	III	-	-	-	-	-	-	8,0±2,97	-	-	2,0±0,24	-	-	-
Lake Lebyazhnye Bettybulak river	7,77	III	-	-	-	-	9,1±5,1	-	3,1±1,98	1,1±2,3	-	-	-	-	-
	7,17	III	-	-	-	-	-	1,4±0,41	4,7±0,7	3,9±1,4	-	-	-	-	1,2±0,24
	7,54	V I	-	-	-	-	-	-	1,2±0,87	1,6±0,85	-	2,7±1,54	-	-	-

Excessive MPCs were recorded for substances from the groups sulfates, chlorides, calcium, magnesium, salt ammonium, nitrite nitrogen, fluorides, total iron, zinc, manganese, copper, and phenol.

In the Esil River, excess MPCs were recorded for substances sulfates – 1,3 MPC, heavy metals zinc (2+) – 1,3 MPC, manganese (2+) – 1,5 MPC, copper (2+) – 2,4 MPC.

In the Akbulak River, MPCs were exceeded for substances from the main ion groups: chlorides – 2,2 MPC, sulfates – 4,7 MPC, magnesium – 1,8 MPC, calcium – 1,6 MPC, nutrients: salt ammonium - 7, 2 MPC, fluorides – 5,1 MPC, nitrite nitrogen – 1,9 MPC, heavy metals: zinc (2+) – 1,4 MPC, copper (2+) – 1,6 MPC.

In the Sarybulak River, excess MPCs were recorded for substances from the main ion groups: sulfates – 6,1 MPC, chlorides – 1,7 MPC, magnesium – 2,1 MPC, nutrients: salt ammonium – 5,7 MPC, nitrite nitrogen - 2,3 MPC, fluorides – 1,3 MPC, heavy metals: zinc (2+) – 2,5 MPC, copper (2+) – 1,7 MPC.

In the Bettybulak River, MPCs were exceeded for substances from biogenic substances (fluorides – 1,2 MPC, total iron – 1,6 MPC), heavy metals (manganese (2+) – 2,7 MPC).

In the Zhabai River, the excess was found for substances sulfates – 1,5 MPC, nitrite nitrogen – 2,3 MPC, ammonium salt – 1,5 MPC, total iron – 3,4 MPC, manganese (2+) – 14,1 MPC.

In the Kylshakty river, the excess of MPC was revealed for substances from the groups of biogenic substances: salt ammonium - 2.8 MPC, total iron - 5.3 MPC, fluorides - 1.9 MPC, heavy metals - manganese (2+) - 209.5 MPC.

In the Shagalaly River, excess MPCs were detected for substances from the groups of biogenic substances (total iron – 1,5 MPC), and heavy metals (manganese (2+) – 63,4 MPC).

In the Nura River, excess MPCs were recorded from sulfate ions – 2,4 MPC, heavy metals: copper (2+) – 2,9 MPC, zinc (2+) - 1,3 MPC.

In the Nura - Esil channel, the excess of MPC was recorded for ions: (sulfates - 2,5 MPC, magnesium – 1,5 MPC), from biogenic substances (salt ammonium - 2,5, nitrite nitrogen - 1,6 MPC) and heavy metals (copper (2+) - 2,3 MPC).

In Lake Sultankeldy, excess MPCs were recorded for substances from the main ion groups: sulfates – 3,2 MPC, magnesium – 1,5 MPC, chlorides – 1,2 MPC, heavy metals - (copper (2+) – 1,4 MPC).

In the Vyacheslavskoye reservoir - excess of MPC was recorded for heavy metals (copper (2+) - 2,3 MPC, zinc (2+) - 1,1 MPC).

In Lake Kopa, the water temperature exceeding the MPC was recorded for substances from the groups of the main ions (sulfates – 1,6 MPC), heavy metals (manganese (2+) – 5,9 MPC).

In Lake Zerendy, the excess was detected for substances from the groups of main ions (sulfates – 1,2 MPC, magnesium – 1,5 MPC), biogenic substances (fluorides – 3,5 MPC), heavy metals (manganese (2+) – 3, 2 MPC).

In Lake Burabay, MPCs were exceeded for substances from the groups of biogenic substances (fluorides – 4,1 MPC), and heavy metals (manganese (2+) – 3,6 MPC).

In Lake Ulken Shabakty, the excess of MPC was recorded for substances from the groups of main ions (sulfates – 2,8 MPC, magnesium – 2,2 MPC), biogenic substances (fluorides - 17,5 MPC), heavy metals (manganese (2+) – 1,6 MPC).

In Lake Shchuchye, the excess of MPC was recorded for substances from the groups of biogenic substances (fluorides – 8,0 MPC), and heavy metals (manganese (2+) – 2,0 MPC).

In Lake Kishi Shabakty, excess MPCs were recorded for substances from the main ion groups (chlorides – 6,1 MPC, sulfates – 12,4 MPC, magnesium – 10,0 MPC), biogenic substances (fluorides – 16,1 MPC, ammonium salt – 1,6 MPC), heavy metals (manganese (2+) – 5,0 MPC, copper (2+) – 1,2 MPC).

In Lake Karasye, the excess of MPC was recorded for substances from the groups of biogenic substances (salt ammonium – 9,1 MPC, total iron – 1,1 MPC, fluorides – 3,1 MPC).

In Lake Sulukol, the excess of MPC was recorded for substances from the groups of biogenic substances (fluorides – 4,6 MPC, ammonium salt – 2,3 MPC, total iron – 7,3 MPC), organic substances (phenols – 1,1 MPC).

In Lake Katarkol - excess of MPC was recorded for substances from the groups of main ions (magnesium – 1,8 MPC, sulfates – 1,3 MPC), biogenic substances (fluorides – 11,0 MPC).

In Lake Tekekol, the excess of MPC was recorded for substances from the groups of main ions (magnesium - 2.1 MPC, sulfates - 1.4 MPC), and biogenic substances (fluorides - 12.1 MPC).

In Lake Maibalyk, the excess of MPC was recorded for substances from the groups of main ions (magnesium – 40,5 MPC, sulfates – 45,2 MPC, chlorides – 43,1 MPC), biogenic substances (total iron – 1,5 MPC, ammonium salt -2,8 MPC, fluorides - 6.7 MPC, nitrite nitrogen – 2,2 MPC), heavy metals (copper (2+) – 1,7 MPC), organic substances (phenols – 1,1 MPC).

In Lake Lebyazhye, MPCs were exceeded for substances from the groups of biogenic substances (total iron – 3,9 MPC, fluorides – 4,7 MPC, nitrite nitrogen – 1,4 MPC), organic substances (phenols - 1.2 MPC).

Conclusion

Thus, summing up the results of this section of research for 2018 on watercourses and reservoirs of the Akmola region, it should be noted that:

- in surface waters, exceeding the maximum permissible concentration for substances from the groups sulfates, chlorides, calcium, magnesium, saline ammonium, nitrite nitrogen, fluorides, total iron, zinc, manganese, copper, phenol was recorded;

- among the studied rivers, according to annual indicators, rivers with a low self-cleaning ability prevail: from class I (ratio R/BOD₅ 1,2-4,3), which is 30% of all watercourses. This class of watercourses includes the rivers Nura, Akbulak, Sarybulak, Zhabay, Kylshakty, the Nura-Esil Canal, and the reservoirs - Sulukol, Katarkol, Maybalyk;

- that the Bettybulak river prevails among the studied reservoirs in terms of annual indicators – 4,3% with a high self-cleaning ability - VI class.

References

1. Меринова Ю.Ю. Хаванский А.Д. О состоянии водных ресурсов в Ростовской агломерации. - 2014. - № 3 (181). - С. 96-101.
2. Донец М.М., Цыганков В.Ю., Боярова М.Д., Гумовский А.Н., Гумовская Ю.В.П., Христофорова Н.К. Хлорорганические соединения камбал рода *Hippoglossoides Gottsche*, 1835 из дальневосточных морей России. Морской биологический журнал. - 2020. - № 1. - С. 29-42.
3. Аршаница Н.М., Ляшенко О.А. Волховская губа Ладожского озера как источник загрязнения р. Невы. - 2016. - № 1. - С. 35-41.
4. Потемкина Т.Г., Потемкин В.Л., Федотов А.П. Климатические факторы как риски современных экологических изменений в береговой зоне озера Байкал. - 2018. - № 5. - С. 690-702.
5. Остроумов С.А. Биологический механизм самоочищения в природных водоемах и водотоках: теория и приложения. - 2004. - № 5. - 429-442 с.
6. Остроумов С.А. Роль биоты в экологических механизмах самоочищения воды. - Москва: Изд-во МАКС-Пресс, 2016. - 124 с.
7. Федоров В.Д. Практическая гидробиология. Пресноводные экосистемы: Учеб. для студ. биол. спец. Университетов. - Москва: ПИМ, 2006. - 367 с.
8. Щеголькова Н.М. Динамика экологического состояния основного водотока мегаполиса: на примере реки Москвы: дис. ... док. биол. наук: 03.00.16. - Москва, 2007. - 325 с.

9. Пивнева О.С. Использование математической модели для прогнозирования пороговых концентраций влияния пестицидов на санитарное состояние водоёмов // Гигиена и санитария. - 2018. - Т. 97, №6. - С. 520-524.
10. РД 52.24.419-2005. Массовая концентрация растворенного кислорода в водах. Методика выполнения измерений иодометрическим методом. - Введ. 2005-07-01. - Москва, 2005. - 14 с.
11. СТ РК ISO 10523-2013. Качество воды. Определение pH. - Введ. 2014-07-01. - Астана, 2014. - С. 16
12. Информационный бюллетень о состоянии окружающей среды Республики Казахстан за 2018 год. [Электронный ресурс]. - URL: <https://kazhydromet.kz/ru/p/ekologia> (дата обращения: 11.05.2018).
13. Акбаева Л. Изучение способности к самоочищению водоемов и водоемов Аршалынского района Акмолинской области // Экологический менеджмент и туризм. - 2020. - Т. 11. - №. 5. - С. 1095-1104.

Н.С. Мамытова¹, Л.Х. Акбаева², Н.К. Кобетаева², Е.А. Тулегенов³, Е.Ж. Макажанов⁴

¹Қазақ технология және бизнес университеті, Нұр-Сұлтан, Қазақстан

²Л.Н. Гумилев атындағы Еуразия ұлттық университеті, Нұр-Сұлтан, Қазақстан

³Қазақ ұлттық әйелдер мұғалімдер университеті, Алматы, Қазақстан

⁴М.Акмұлла атындағы Башқұрт мемлекеттік педагогикалық университеті, Уфа, Башқұртстан Республикасы, Ресей

Ақмола облысының 2018 жылғы гидрохимиялық көрсеткіштері бойынша су қоймасы мен су ағындарының өзін-өзі тазарту қабілетін зерттеу

Аңдатпа. Мақалада Ақмола облысының көлдерінің, өзендерінің және су қоймаларының оттегі көрсеткіштері бойынша Өзін-өзі тазарту қабілеті, сондай-ақ жекелеген гидрохимиялық көрсеткіштердің әсері (сульфаттар, хлоридтер, магний, тұзды аммоний, нитритті азот, фторидтер, жалпы темір, мырыш, марганец, мыс, фенол) қарастырылады. Су объектілерінің өзін-өзі тазарту қабілетін тежейтін химиялық факторлардың ішінде тұзды аммонийдің, нитрит азотының, жалпы Темірдің, Мыстың жоғарылауын атап өтуге болады. Ақмола облысы су айдындарының өзін-өзі тазарту қабілетіне оттегі көрсеткіштері негізінде баға берілді: судағы ерітілген оттегінің мөлшері және оттегінің биологиялық қажеттілігі (БПК₅). Алынған нәтижелер негізінде өзендер мен көлдер өзін-өзі тазарту қабілетінің алты класына бөлінді, сонымен қатар график жасалды, зерттелген су қоймаларының арасында жалпы жылдық көрсеткіштер бойынша Өзін-өзі тазарту қабілеті төмен көлдер басым екендігі көрінеді. Судың өзін-өзі тазарту потенциалына жекелеген гидрохимиялық Компоненттердің мөлшері де, синергетикалық әсер етуі мүмкін Компоненттердің мөлшері де әсер етуі мүмкін екендігі анықталды. Сонымен қатар, олар гидрохимиялық компоненттердің қайсысы көлдер мен өзендердегі судың тазарту әлеуетіне әсер ететінін зерттеді.

Түйін сөздер: су қоймалары, су қоймаларының өзін-өзі тазарту қабілеті, фотосинтез, оттегі, гидрохимия, ВРК₅.

Н.С. Мамытова¹, Л.Х. Акбаева², Н.К. Кобетаева², Е.А. Тулегенов³, Е.Ж. Макажанов⁴

¹Казахский университет технологий и бизнеса, Нур-Султан, Казахстан

²Евразийский национальный университет Л.Н. Гумилева, Нур-Султан, Казахстан

³Казахский национальный женский педагогический университет, Алматы, Казахстан

⁴Башкирский государственный педагогический университет имени М. Акмуллы, Уфа, Республика Башкортостан, Россия

Изучение самоочищающей способности водоемов и водотоков по гидрохимическим показателям Акмолинской области за 2018 год

Аннотация. В статье рассматривается самоочищающая способность озер, рек и водохранилищ Акмолинской области по показателям кислорода, а также влияние отдельных гидрохимических показателей, таких как сульфаты, хлориды, магний, аммоний солевой, азот нитритный, фториды, железо общее, цинк, марганец, медь, фенол. Среди химических факторов, угнетающих самоочистительную способность водоемов, можно отметить повышенное содержание сульфатов, хлоридов, кальция, магния, аммония солевого, азота нитритного, фторидов, железа общего, цинка, марганца, меди, фенола.

Была дана оценка самоочищающей способности водоемов Акмолинской области на основании кислородных показателей: количество растворенного кислорода в воде и биологическая потребность кислорода (БПК₅). Реки и озера на основании полученных результатов были распределены по шести классам самоочищающей способности, а также построен график, из которого видно, что среди изученных водоемов по общегодовым показателям преобладают озера с низкой самоочищающей способностью. Установлено, что на самоочистительный потенциал вод могут влиять как превышение содержание отдельных гидрохимических компонентов, так и количество превышаемых компонентов, которые могут дать синергетический эффект. Наряду с этим изучали, какие из сопутствующих гидрохимических компонентов оказывают влияние на очистительный потенциал воды в озерах и реках.

Ключевые слова: водоемы, водотоки, самоочищающая способность поверхностных вод, биологическая потребность кислорода, растворимость кислорода.

References

1. Merinova YU.YU. Havanskij A.D. O sostoyanii vodnyh resursov v Rostovskoj aglomeracii [On the state of water resources in the Rostov agglomeration], 3 (181), 96-101 (2014). [in Russian]
2. Donec M.M., Sygankov V.YU., Boyarova M.D., Gumovskij A.N., Gumovskaya YU.V.P., Hristoforova N.K. Hlororganicheskie soedineniya kambal roda Hippoglossoides Gottsche, 1835 iz dal'nevostochnyh morej Rossii. Morskoj biologicheskij zhurnal [Organochlorine compounds of flounders of the genus Hippoglossoides Gottsche, 1835 from the Far Eastern seas of Russia. Marine Biological Journal], 1, 29-42 (2020). [in Russian]
3. Arshanica N.M., Lyashenko O.A. Volhovskaya guba Ladozhskogo озера как istochnik zagryazneniya r. Nevy [Volkhovskaya Bay of Lake Ladoga as a source of pollution of the Neva River], 1, 35-41 (2016). [in Russian]
4. Potemkina T.G., Potemkin V.L., Fedotov A.P. Klimaticheskie faktory kak riski sovremennyh ekologicheskikh izmenenij v beregovoj zone озера Bajkal [Climatic factors as risks of modern ecological changes in the coastal zone of Lake Baikal], 5, 690-702 (2018). [in Russian]
5. Ostroumov S.A. Biologicheskij mekhanizm samoochishcheniya v prirodnyh vodoemah i vodotokah: teoriya i prilozheniya [The biological mechanism of self-purification in natural reservoirs and watercourses: theory and applications], 5, 429-442 (2004). [in Russian]

6. Ostroumov S.A. Rol' bioty v ekologicheskikh mekhanizmah samoochishcheniya vody [The role of biota in the ecological mechanisms of water self-purification]. (Moskva, Izd-vo MAKS-Press, 2016. 124 s.). [in Russian]
7. Fedorov V.D. Prakticheskaya gidrobiologiya. Presnovodnye ekosistemy: Ucheb. dlya stud. biol. spec. Universitetov [Practical hydrobiology. Freshwater ecosystems: Textbook. for stud. biol. specialist. Universities]. (Moskva, PIM, 2006. 367 s.). [in Russian]
8. SHCHegol'kova N.M. Dinamika ekologicheskogo sostoyaniya osnovnogo vodotoka megapolisa: na primere reki Moskvy [Dynamics of the ecological state of the main watercourse of the metropolis: on the example of the Moscow River]: dis. ... dok. biol. nauk: 03.00.16. - Moskva, 2007. - 325 s. [in Russian]
9. Pivneva O.S. Ispol'zovanie matematicheskoy modeli dlya prognozirovaniya porogovykh koncentracij vliyaniya pesticidov na sanitarnoe sostoyanie vodoyomov, Gigiena i sanitariya [Using a mathematical model to predict threshold concentrations of the influence of pesticides on the sanitary condition of reservoirs, Hygiene and sanitation], 97(6), 520-524 (2018). [in Russian]
10. RD 52.24.419-2005. Massovaya koncentraciya rastvorennoho kisloroda v vodah. Metodika vypolneniya izmerenij iodometricheskim metodom [Mass concentration of dissolved oxygen in water. Method for performing measurements by the iodometric method], - Vved. 2005-07-01. Moskva, 2005. 14 s. [in Russian]
11. ST RK ISO 10523-2013. Kachestvo vody. Opredelenie pH [Water quality. Determination of pH]. Vved. 2014-07-01. Astana, 2014. 16 s. [in Russian]
12. Informacionnyj byulleten' o sostoyanii okruzhayushchej sredy Respubliki Kazahstan za 2018 god [Information bulletin on the state of the environment of the Republic of Kazakhstan for 2018]. [Electronic resource]. Available at: <https://kazhydromet.kz/ru/p/ekologia> (Accessed: 11.05.2018). [in Russian]
13. Akbayeva L. Izuchenie sposobnosti k samoochishcheniyu vodoemov i vodoemov Arshalynskogo rajona Akmolinskoj oblasti, Ekologicheskij menedzhment i turizm [Studying the ability to self-purify reservoirs and reservoirs of the Arshalyn district of the Akmola region, Environmental management and tourism]. 11(5). 1095-1104 (2020). [in Russian]

Information about the authors:

Mamytova N.S. – Ph.D., Senior Lecturer of the Department of Chemistry, Chemical Technology and Ecology of the Kazakh University of Technology and Business, 37 A Kayym Mukhamedkhanov str., Nur-Sultan, Kazakhstan.

Akbayeva L.Kh. – Candidate of Biological Sciences, Associate Professor of the Department "Management and Engineering in the Field of Environmental Protection" of L.N. Gumilyov Eurasian National University, 13 Kazhimukan str., Nur-Sultan, Kazakhstan.

Kobetayeva N.K. – Candidate of Biological Sciences, Associate Professor of the Department "Management and Engineering in the Field of Environmental Protection" of L.N. Gumilyov Eurasian National University, 13 Kazhimukan str., Nur-Sultan, Kazakhstan.

Tulegenov Y.A. – Ph.D., Senior Lecturer of the Department of Geography, Kazakh National Women's Pedagogical University, 99 Aiteke bi str., Almaty, Kazakhstan.

Makazhanov Y.J. – Researcher, Bashkir State Pedagogical University named after M. Akmulla, 3A Oktyabrskaya Revolution str., Ufa, Republic of Bashkortostan, Russia.

Мамытова Н.С. – PhD философия докторы, Қазақ технология және бизнес университеті Химия, химиялық технология және экология кафедрасының аға оқытушысы, Қайым Мұхамедханов көшесі, 37 А, Нұр-Сұлтан, Қазақстан.

Ақбаева Л.Х. – биология ғылымдарының кандидаты, Л.Н. Гумилев атындағы Еуразия ұлттық университеті «Қоршаған ортаны қорғау саласындағы басқару және инжиниринг» кафедрасының қауым.профессоры, Қажымұқан көшесі, 13, Нұр-Сұлтан, Қазақстан.

Кобетаева Н.К. – биология ғылымдарының кандидаты, Л.Н. Гумилев атындағы Еуразия ұлттық университеті «Қоршаған ортаны қорғау саласындағы басқару және инжиниринг» кафедрасының қауым.профессоры, Қажымұқан көшесі, 13, Нұр-Сұлтан, Қазақстан.

Түлегенов Е.А. – PhD философия докторы, Қазақ ұлттық қыздар педагогикалық университеті география кафедрасының аға оқытушысы, Әйтеке би көшесі, 99, Алматы, Қазақстан.

Макажанов Е.Ж. – ізденуші, М. Акмулла атындағы Башқұрт мемлекеттік педагогикалық университеті, Октябрь революциясы көшесі, 3 А, Уфа, Башқұртстан.