Destruction of organic matter in the Varvarinsky reservoir

Abstract

Although the assimilation processes are similar in the Mingechaur and Varvarinsky reservoirs, which are fed from the same source and do not differ in geographical climatic conditions, there are also differences in the processes of dissimilation and destruction. So, if the same amount of organic matter is oxidized in an environment with a large water capacity, such as Mingechaur and with a small water capacity like Varvara, then the rate of oxygen consumption and regeneration in each water is not the same. Because it is very easy to "melt and caress" the metabolites formed due to its large capacity in the Mingechaur reservoir. Therefore, 25-30 percent of the area in the Varvarinsky reservoir is created in summer by hypoxia and anaerobiosis.

Comment [U1]: of

Keywords: anaerobiosis, saprophytes, coliform bacteria, saprobicity, biogenic elements.

Introduction

In reservoirs where the thickness of the water column above the muddy ground is high, metabolites formed due to hypoxia during anaerobiosis, such as H2S, rarely destroy hydrobionts in the upper layers. But in shallow water, this toxic hydrogen sulfide gas is not late, it spreads into the environment and causes massive destruction. In addition, phytoplankton developing at the flowering stage ends the vegetation in a shorter time, compared with higher aquatic plants, is massively mineralized, and poisons the waters with phytoncides, making them unsuitable and dangerous for use.

Materials and methods

Samples of water and soil were selected in compliance with asepsis by Yu.I.Sorokin bottle bathometer, GOIN-a small tube. The total number of microorganisms was determined by the method of A.S.Razumov, saprophytic, coliform and physiological groups of bacteria were taken into account by sowing on elective media, the compositions of which are indicated in the laboratory manuals of V.I.Romanenko, S.I.Kuznetsov and A.G.Rodina. The amount of destruction of organic matter, as one of the reliable indicators of the degree of self-purification, is taken into account, according to G.G.Vinberg. To establish the quantitative and qualitative composition of the organic matter present in the water, the depth of its decay and the degree of saprobity of the water in the Araz River, calculations of the ratio of the number of saprophytic bacteria with a total number of direct counts were applied.

Results and discussion

In the Varvarinsky reservoir, the destruction process proceeds relatively "calmly, a decrease is observed only in the winter months, although in other seasons environmental factors are different, the destruction of organic substances is at a high level (Table 1).

Table 1 : Seasonal changes in the destruction of organic matter

in the water of the Varvarinsky reservoir in 2015

Region	Winter	Spring	summer	Autumn
Upper	0,30 ± 0,01	0,70 ± 0,02	1,60 ± 0,07	0,90 ± 0,04
Average	0,60 ± 0,02	1,20 ± 0,04	2,10 ± 0,09	2,00 ± 0,08
Lower	1,10 ± 0,04	2,80 ± 0,12	3,70 ± 0,16	2,40 ± 0,11
Left Bank	1,40 ± 0,06	3,20 ± 0,14	4,80 ± 0,18	3,40 ± 0,14
On average	0,85	2,00	3,00	2,20

The table shows that in the spring, summer and autumn seasons, the destruction of organic substances in the water of the Varvarinsky reservoir continues almost at the same level, even when the water temperature changes. In addition, as well as in terms of phytoplankton productivity, destructive indicators are not the same in the areas-sections – of the Varvarinsky reservoir. The table shows that the seasonal index of destruction in the upper and middle sections-districts – of the Varvarinsky reservoir is 2-3 times less than in the middle and left-bank districts. Interestingly, if the massive development of phyto-bacterioplankton in reservoirs created in the upper reaches is associated with allochthonous substances brought by rivers, then anthropogenic eutrophication occurs in the Varvarinsky reservoir with wastewater discharged from the city of Mingechaur and neighboring settlements. The intensification of destructive processes by seasons shows that the enrichment of reservoir water with organic substances of allochthonous origin continues continuously. It is noteworthy that over the past 33 years, an increase in the composition of organic matter has been observed in the Varvarinsky reservoir. Comparative indicators are presented in Table 2

Table 2

Change in the destruction of organic matter in the water of the Varvarinsky reservoir by year

Indicator	Winter		Spring		Summer		Autumn	
	1982	2015	1982	2015	1982	2015	1982	2015
Average daily product with/l	0,42	0,85	0,90	2,00	1,46	3,00	1,70	2,20
G S/m2	3,80	76,0	82,0	180,0	134,0	270,0	156,0	198,0
On the entire territory of the reservoir thousand tons / s	809	1637	1755	3852	2874	5778	3346	4237

Note; All results are statistically processed p ≤ 0.048.

The table shows that in 1982 878 tons were destroyed in the Varvarinsky reservoir, and in 2015 15504 tons of organic matter. During this period, 6720 tons of additional organic matter (or 1.7 times more) were mineralized in the Varvarinsky reservoir.

The bottom sediments of the Varvarinsky reservoir vary dramatically depending on the area. So the sediments in the actively flowing part of the water in the channel on the right bank consist of sand. Firstly, due to the fact that there are very few terrigenous particles in the water, as well as due to the rapid flow, sedimentation-subsidence - does not occur and silt-ground sediments are

not formed as on the left bank. Thus, the indicators of destruction of organic substances in the upper and middle regions of the Varvarinsky reservoir are 2.5-3 times less than the results obtained in the lower and left-bank water areas (Table 3.).

Table 3

Destruction in silt-soil in Varvarinsky reservoir (2015 mg/m2)

Region	Property or-ground	Seasons			
		Winter	Spring	Summer	Autumn
Upper	dark-colored sand	96,0 ± 4,2	110,0 ± 5,2	130,0 ± 5,8	120,0 ± 4,8
Average	weak and left sand	115,0 ± 5,4	133,0 ± 6,4	150,0 ± 6,6	140,0 ± 6,3
Lower	dark brown or	200,0 ± 8,6	410,0 ± 18,4	570,0 ± 25,6	490,0 ± 22,5
Left Bank	or-a mixture with detritus-vegetable residue	310,0 ± 12,4	520,0 ± 22,6	680,0 ± 31,8	630,0 ± 24,6
On average		188,0	298	375	337

Naturally, these deposits of the Varvarinsky reservoir have different indicators of destruction depending on the mechanical – granulometric composition. Because numerous studies have proved that destructive processes occur more intensively in soft, loose mud-soil. Interestingly, over the past 33 years, the amount of degradable organic substances in the silt, as well as in water, has increased.

So, if in 1982 2,431 tons of organic substances were mineralized in the bottom sediments of the Varvarinsky reservoir, then in 2015 this figure was 4,490 tons. Depending on the nature of silty-ground deposits in the Varvarinsky reservoir, the intensity of destruction of organic matter sharply differs.

From the figures given in Table 3, it can be seen that the average annual amount of degraded organic matter in the upper and middle parts of the reservoir was 4.5 times less than the amount of organic matter that was mineralized in the middle and lower parts of the reservoir reservoir. In other words, only 24% of the organic matter mineralized in the silt of the basin was assimilated in the water area of its right bank.

According to the results of the performed studies by seasons, the calculation of the total amount of organic substances mineralized in the silt of the Varvarinsky reservoir is presented in Table 4.

Table 4

Calculation of the degraded organic matter during the year in the silt of the Varvarinsky reservoir

Indicator	Winter	Spring	Summer	Autumn
Average daily destruction mg S/m2	90,0	110,0	169,0	130,0
All bottom sediments of the reservoir on the site, with/thin	810,0	990,0	1520,0	1770,0

Note: in just a year – 5090 tons

Thus, it can be seen that 5,090 tons of organic matter are absorbed by the microbiota of the bottom sediments of the Varvarinsky reservoir during the year. The destruction of organic substances in the bottom sediments of the reservoir is equivalent to 30 percent of the primary product synthesized by phytoplankton in the basin of the Varvarinsky reservoir.

Interestingly, in 1982, the amount of mineralized organic matter in the left-soil of the Varvarinsky reservoir, according to A.Manafova, was 2,431 tons. Thus, it was revealed that over the last period the total mass of the degraded organic matter in the silt in the reservoir was more than 2000 tons. It should be noted that the degraded organic substances in the silt-soil in the Mingechaur and Varvarinsky reservoirs account for 30 percent of the primary product, which indicates an intensive process of self-purification and organic substances in the environment are easily digestible substrates. In addition, the shorter the column of water on the muddy ground, the less complex organic matter in the bottom sediments in composition.

Our research has calculated for the first time the balance of organic substances in both the Mingechaur reservoir and the Varvarinsky reservoir (Table 5).

Table 5

The balance of organic matter in Varvarinsky reservoir (2015)

Sources of income	thousand tons/year	%	Expenditure	thousand tons/s	%
Allochthonous organic substances	**2,00 ± 0,1**	**14,0**	**Destruction in water**	**15,5 ± 0,7**	**77,5**
Primary source product	**14,4 ± 0,5**	**86,0**	**Destruction in silt-soil**	**4,5 ± 0,2**	**22,5**
Total	**16,4**	**100**	**in total**	**20,0**	**100**

From the figures given in Table 5, it can be seen that 16.4 thousand tons of organic matter are created in the Varvarinsky reservoir during the year, and 20,000 tons of organic matter are mineralized. If we divide the organic substances formed and consumed both in water and on the left-ground, the area of the reservoir per square meter is 673 and 218 g/s, respectively. Of course, these indicators are 1.5-2 times higher than those obtained from eutrophied other reservoirs, such as on the Volga, on the Dnieper. Therefore, we can admit with absolute certainty that the Mingechaur and Varvarinsky reservoirs are reservoirs of the eutrophic type!

References

1. Aliyev S.N. Microflora of the Kura river and its role in the processes of self-purification. Autoref. diss. K.B.N., Kiev, 1980, 22 p.

2. Vinberg G.G. On the issue of the balance of organic matter in reservoirs. Tr. Limnologist. stations in Kosin, 1934, issue 18, pp. 5-24
3. Gorbenko Yu.A. On the most favorable amount of "dry nutrient agar >> B" for culturing heterotrophic microorganisms. Microbiology, 1961, vol. 30, issue 1, pp. 168-172
4. Mansurov A. E., Salmanov M. A. Ecology of the Kura River and reservoirs of the Oka basin. Baku, 1996, 160 p.
5. Razumov A.S. Direct method of accounting for bacteria in water, comparing it with the Koch method. Microbiology, 1932, vol. 1, pp. 131-146
6. Rodina O.G. Methods of aquatic microbiology. L., Nauka, 1965, 354 p.
7. Romanenko V.I. Microbiological processes of production and destruction of organic matter in inland waters. 1985, "Science", 295 p.
8. Romanenko V.I., Kuznetsov S.I. Ecology of microorganisms of freshwater reservoirs (Lab. manual). 1974, 194 p.
9. Rustamov S.G., Kashkai R.M. Water balance of the Azerbaijan SSR. Baku, "Elm", 1978, 110 p.
10. Salmanov M.A. Issues of environmental safety of transboundary water sources of Azerbaijan. Mat. III conf. REC of the Caucasus. Tbilisi, 2003, pp. 210-216
11. Sorokin Yu.I. A bathometer for sampling water for bacteriological analysis. Byull. In-ta BV of the USSR Academy of Sciences, 1060, 6, pp. 53-54
12. Ansarova A.H. Ecological problems of biological productivity in reservoirs created in the Middle Kura. Materials of the conference of Environmental Problems of the republic. Geographical problems of the Republic of Azerbaijan. BSU, Baku, 2016, pp. 38-41
13. Salmanov M.A., Ansarova A.H. Anthropogenic eutrophication, the primary product of phytoplankton and the destruction of organic substances in the Nakhichevan reservoir. Proceedings of the Institute of Zoology of ANAS, 2017, vol. XXXIII, No. 1, pp. 65-73
14. Salmanov M.A.,Ansarova A.H., Huseynov A.T. Hydrological characteristics of the Akstafachai river and the Akstafachai reservoir. Proceedings of the Society of Zoologists ON. 2014, volume VI, pp. 124-131