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ECO-CHEMICAL STUDY OF FRESHWATER SOURCES CONTAMINATED WITH MINING WASTEWATER

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ABSTRACT

The study of environmental objects is of special importance in order to eliminate the increasing ecological imbalance in recent times. In this regard, it is important to control the eco-chemical state of freshwater resources for living creatures. For this purpose, water samples have been taken from the territory of Okchuchay to Azerbaijan and conducted their eco-chemical study. As an example, an eco-chemical study was conducted on the samples taken from the beginning, middle and lower streams, taking into account the degree of pollution and the self-regulating property of the river. Their physico-chemical parameters have been determined. At the same time, some cations and anions were investigated. In particular, the amount of iron and manganese ions, which are important in the integrity of the ecosystem, were compared with the permissible concentration limits. The effect of chemical pollutants on the ecosystem, on living organisms, on the unity of the biocenosis has been studied.

Entrance

When conducting an eco-chemical assessment in the environment, the hydrosphere should be considered first. Because pollutants can spread rapidly in the underlying hydrosphere compared to soil. A fresh water body was selected for the purpose of investigating the effect of the hydrosphere on the organisms entering the ecosystem. At this time, we took samples from three points of Okchuchay that passes through Azerbaijan, which was affected by the waste water of the mining industry. They were taken from the upper, middle and lower parts of the river, respectively (Burunlu, Shayiflı, Jahangirbeyli areas).

Experimental Part

First, water samples were taken, and their physical parameters were determined. The hydrogen indicator is determined by pH-meters for pH, oxygen for solved oxygen, conduitometers for electrical engineering, sulphate, ammonium, nitrites and nitrates ions, and metals by optical emissions spectrometer and atomic absorbsion spectrometer. Sample studies have been conducted three times for accuracy (table 1, 2, 3)

Table 1. Analysis of water samples taken from the river at 01.03.2023

№	Name of component	Unit	Amount of component			Maximum Permissible Concentration
			Okchuchay-Zengilan village			
			Jahangirbayli village	Shayifli village	Burunlu village	
1	pH	–	8.0	7.6	7.8	6.5-8.5
2	Dissolved oxygen	mqO_2/l %	6.5 67.0	4.8 58.0	5.6 61.0	≥4.0
3	Electrical transmission	μSm/sm	1386	1264	1268	–
4	Transparency	Sm	14	10	17	>30
5	Hardness	mg-ekv/l	**10.39**	**10.6**	**10.48**	7.0
6	Calcium ion, Ca^{2+}	mg/l	139.8	148.7	147.0	–
7	Magnesium ion, Mg^{2+}	mg/l	41.5	38.7	38.2	–
8	Chloride ion, Cl^-	mg/l	23.7	19.99	20.66	350
9	Hydrocarbonate ions, HCO_3^-	mg/l	256.0	241.0	259.0	-
10	Carbonate ions, CO_3^{2-}	mg/l	0	0	0	-
11	Sulphate ion, SO_4^{2-}	mg/l	321.6	372.9	348.82	500
12	Ammonium ion, NH_4^+	mg/l	**1.02**	**1.49**	**1.58**	0.5
13	Nitrogen ion, NO_2^-	mg/l	0	0.43	0.44	3.3
14	Nitrate ion, NO_3^-	mg/l	5.2	4.4	3.9	45.0
15	Zink, Zn	mkg/l	135.4	137	122	1000
16	Iron, Fe	mkg/l	**709**	**875**	**900**	300
17	Cobalt, Co	mkg/l	2.06	1.9	3.25	100
18	Lead, Pb	mkg/l	1.5	<LOD	3.76	30
19	Nickel, Ni	mkg/l	0.414	0.755	0.745	100
20	Molybdenum, Mo	mkg/l	228	234	241	250
21	Manganese, Mn	mkg/l	**398**	**427**	**439**	100
22	Copper, Cu	mkg/l	64.0	71.3	70.6	1000

As can be seen from Table 1, according to the analyzes carried out on water samples, in the sections passing through the villages of Jahangirbeyli, Shayifli and Burunlu of Okchuchay, the concentration of hardness - 1.5 times, ammonium ion - 2.0 times in the village of Jahangirbeyli, 3.0 times in the village of Shayifli, 3.2 times in the village of Burunlu, iron - 2.4

times in the village of Jahangirbeyli. , 2.9 times in Shayifli village, 3 times in Burunlu village, manganese – 4.0 times in Jahangirbeyli village, 4.3 times in Shayifli village, 4.4 times in Burunlu village.

The parameter of water, such as hardness, is influenced by the presence of magnesium and calcium ions. [10] According to literature, magnesium affects a number of plants. It is also part of the chlorophyline, which is made up of nuclides, phosphates, and pectins. Magnesium is inorganic in plant fibers. In addition to activating plant-based enzyme systems, magnesium affects the cell's metabolism. It participates in the respiratory processes of living things that enter the ecosystem. In biochemistry plants, the battery of military acid accelerates (the magnesium ion reacts with unsuspecting dienol groups of military acid, weakening or stopping oxidation processes; its effects are greatly strengthened in acidic environments). Water plants affect oxidation-reducing reactions [10].

An excess of magnesium is accompanied by an excess of sodium [8]. [9] literature states that magnesium sulfate (MgSO4) is a common contaminant in mine waters and is usually obtained from accelerated oxidation of sulfides and subsequent dissolution of magnesium minerals in exposed ore, waste rock, or tailings.

Manganese blocks phosphorus and calcium ions. Manganese is antagonistic elements with elements like Fe and Zn. That is, the amount of one should be less compared to the amount of the other elements. The excess of these two elements is related to its anthropogenic factors as well [11].

Table 2. Analysis of water samples taken from the river at 09.03.2023

№	Name of component	Unit	Amount of component			Maximum Permissible Concentration
			Okchuchay-Zengilan village			
			Jahangirbayli village	Shayifli village	Burunlu village	
1	pH	–	7.8	7.5	7.5	6.5-8.5
2	Dissolved oxygen	mq O_2/l %	6.4 71.0	4.0 41.0	4.9 54.0	≥4.0
3	Electrical transmission	μSm/sm	1220	1212	1210	–
4	Transparency	Sm	12	11	15	30
5	Hardness	mg-ekv/l	**10.43**	**10.8**	**11.2**	7.0
6	Calcium ion, Ca2+	mg/l	146.3	151.5	157.1	–
7	Magnesium ion, Mg^{2+}	mg/l	38.0	39.4	40.9	–
8	Chloride ion, Cl^-	mg/l	21.0	19.4	20.7	350
9	Hydrocarbonate ions, HCO_3^-	mg/l	254.0	250.0	263.0	-
10	Carbonate ions, CO_3^{2-}	mg/l	0	0	0	-
11	Sulphate ion, SO_4^{2-}	mg/l	350.3	381.2	411.0	500
12	Ammonium ion, NH_4^+	mg/l	**0.93**	**1.60**	**1.62**	0.5
13	Nitrogen ion, NO_2^-	mg/l	0.1	0.34	0.29	3.3
14	Nitrate ion, NO_3^-	mg/l	6.1	4.9	4.2	45.0
15	Zink, Zn	mkg/l	87.3	194	270	1000
16	Iron, Fe	mkg/l	**459**	**1040**	**1220**	300
17	Cobalt, Co	mkg/l	3.41	3.82	6.2	100
18	Lead, Pb	mkg/l	1.1	2.28	3.1	30
19	Nickel, Ni	mkg/l	<LOD	<LOD	2.27	100
20	Moibden, Mo	mkg/l	164	170	180	250
21	Manganese, Mn	mkg/l	**110**	**386**	**665**	100
22	Copper, Cu	mkg/l	46.5	57.1	93.5	1000

As it can be seen from Table 2, according to the analyzes carried out on water samples, hardness - 1.6 times in Burunlu village, 1.5 times in Shayifli and Jahangirbeyli villages, ammonium ion - 1.9 times in Jahangirbeyli village, 3.2 times in Shayifli village and Burunlu villages, iron - 1.5 times in Jahangirbeyli village, 3.5 times in Shayifli village, 4.1 times in Burunlu village, manganese – 1.1 times in Jahangirbeyli village, 3.9 times in Shayifli village, 6.7 times in Burunlu village.

The same parameters were re-analyzed at the end of March. The results were shown in table 3.

Table 3. Analysis of water samples taken from the river at 28.03.2023

№	Name of component	Unit	Amount of component			Maximum Permissible Concentration
			Okchuchay-Zengilan village			
			Jahangirbayli village	Shayifli village	Burunlu village	
1	pH	–	7.8	7.7	7.8	6.5-8.5
2	Dissolved oxygen	mqO_2/l %	6.9 75.0	5.5 59.0	5.5 60.0	≥4.0
3	Electrical transmission	µSm/sm	1228	1202	1207	–
4	Transparency	Sm	23	20	22	>30
5	Hardness	mg-ekv/l	**10.1**	**9.94**	**9.97**	7.0
6	Calcium ion, Ca^{2+}	mg/l	141.7	139.4	139.9	-
7	Magnesium ion, Mg^{2+}	mg/l	36.8	36.3	36.4	-
8	Chloride ion, Cl^-	mg/l	19.0	18.9	18.9	350
9	Hydrocarbonate ions, HCO_3^-	mg/l	299.0	267.0	261.0	-
10	Carbonate ions, CO_3^{2-}	mg/l	6.4	0	0	-
11	Sulphate ion, SO_4^{2-}	mg/l	249.0	247.0	250.4	500
12	Ammonium ion, NH_4^+	mg/l	**0.7**	**1.6**	**2.0**	0.5
13	Nitrogen ion, NO_2^-	mg/l	0.32	0.45	0.53	3.3
14	Nitrate ion, NO_3^-	mg/l	7.1	4.9	3.72	45.0
15	Zink, Zn	mkg/l	61.6	181	166	1000
16	Iron, Fe	mkg/l	**420**	**1830**	**2200**	300
17	Cobalt, Co	mkg/l	2.53	7.29	6.79	100
18	Lead, Pb	mkg/l	2.1	7.4	9.7	30
19	Nickel, Ni	mkg/l	1.47	0.147	5.22	100
20	Moibden, Mo	mkg/l	180.0	233	248	250
21	Manganese, Mn	mkg/l	**111.0**	**625**	**669**	100
22	Copper, Cu	mkg/l	36.5	143.0	147.0	1000

As it can be seen from Table 3, according to the analyzes carried out on water samples, iodine - 1.4 times in Jahangirbeyli, Shayifli and Burunlu villages, ammonium ion - 1.4 times in Jahangirbeyli village, 3.2 times in Shayifli village, 4 times in Burunlu village, iron - 1.4 times in Jahangirbeyli village, Shayifli village 6.1 times, 7.3 times in Burunlu village, manganese - 1.1 times in Jahangirbeyli village, 6.3 times in Shayifli village, 6.7 times in Burunlu village.

It should be noted that the Permissible Hardness Limits for Surface Waters are from the document "Rules for the Protection of Surface Waters from Wastewater Pollution" approved by the State Ecology and Nature Use Control Committee of the Republic of Azerbaijan by Order No. 01 of January 4, 1994. taken.

Magnesium has a chronic toxic effect on five species of ecosystems [9]. The excess amount of magnesium affects in a mutagenic way. This is due to its cumulating properties. It is associated with a sudden deterioration in the liver, kidneys and gastrointestinal tract. In

children's organism, magnesium causes excessive neurotoxicity and intellectual ability in adults.

Manganese is considered a major pollutant. Its presence in the environment creates serious environmental problems. Its excess in the hydro environment is related only to the anthropogenic factors. Manganese can bioaccumulate in the environment, so it can have ecotoxic effects. If it exposed to a high dose for a long time, the creatures of the ecosystem can be destroyed [11].

The biogeochemical and ecological status of iron in freshwater ecosystems has been extensively investigated, as various anthropogenic influences have strongly modified lentic and lotic ecosystems over recent decades. In freshwater ecosystems, iron is considered an essential element as it affects numerous ecosystem functions and organisms both directly and indirectly.

Conclusion

According to the information above, it can be concluded that pollutant ions such as sodium, ammonium, iron, manganese, which are very important in the eco-chemical assessment of the environment, were many times higher than the norm in March. These are parameters that pose a serious threat to the existence of living things in those water ecosystems.

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