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Research Article

Changing Ecological Status of Water Sources in the Industrialized Areas Adjoining Tashkent Region of Uzbekistan

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Abstract

This article presents the changes in the ecological state of water sources, the total number of microorganisms, quantitative indicators of chemical elements in water sources distributed around industrial areas, and the limits of pollution of water sources at a distance of 1,5 km to 23 km, depending on the location of industrial sectors. In Bekabad district, in the areas around the activities of the Metallurgical Combine , Angren oil base, Yangi Angren thermal power plant, and Almalyk Mining and Metallurgical Combine, Ammophos-Maxam, where hazardous waste was transported and recultivation measures were carried out, after the completion of the recultivation measures, an increase in the level of soil pollution and the total number of microorganisms in the composition, a decrease in the amount of chemical elements and harmful waste was observed.

Keywords: *Microorganisms, water sources, industrial contamination, chemical elements, remediation measures, heavy metals.*

INTRODUCTION

Presently a significant part of the earth's surface water is polluted, and it is becoming increasingly difficult to find drinking, clean water. The greatest harm to the state of the water environment is caused by human economic activity. Substances that pollute water bodies enter the aquatic environment from anthropogenic and natural sources. The latter include the destruction of rocks, volcanic activity, and the waste products of aquatic organisms. Anthropogenic sources are the growth of the population, the development of agricultural and industrial production. Domestic, industrial, and agricultural wastewater is discharged into the surrounding water bodies.

The problem of waste from industrial sectors is one of the most urgent problems in the world. As for example, it has been determined that there are more than 30 billion tons of waste in the industrialized regions of the Russian Federation. This has led to a change in the ecological state of soils [8]. Waste settles in the soil because of climatic factors and land irrigation, worsening its water and air environment. In addition, waste in the soil negatively affects productivity indicators by making it difficult to transfer nutrients necessary for plants [6; 10; 3; 4]. 75% of dust emitted from various industrial sectors rises into the atmosphere. As a result, dust consisting of chemical elements directly falls on the soil and plants because of climatic factors. In addition, polluting compounds have a negative effect on all properties of soils [11].

Recently a similar study conducted in the Ramensky district of Moscow [7], where man-made pollution processes were observed in the landscapes and water bodies of the region because of waste released by industrial sectors. As a result of the high amount of man-made pollution released into the environment, significant ecological changes were observed in almost all components of the natural environment [7]. In many other countries, the globalization of environmental problems is increasing due to the activities of industrial sectors. This leads to such situations as pollution of the surrounding soil, water and air, global warming, and the decline of flora and fauna. It has been found that due to the deterioration of the global ecological situation, changes in the properties of soils are observed [11;9]. It has been found that water bodies are polluted due to the influence of many industrial areas located in the Samara region of Russia [10]. According to scientific analyses conducted by several researchers, oxidation-reduction processes are observed in soil and water ecosystems due to the influence of many industrial sectors [2].

Research Methods: in determining the total number of microorganisms in the water distributed in the research area M.A. Zuparov, A.A. Khakimov, U.N. Rakhmonov, R.K. Sattarova, N.T. Khakimova, A.N. Allayarov using the information provided in the study guide "Laboratory exercises from microbiology" published in 2014 at the Institute of Microbiology of UzRFA and the National University of Uzbekistan, available in the research areas samples taken from water sources for analysis in the hydrochemistry laboratory of Uzbekhydrogeology State University Alekseev C., Reznikov A.A., Mulikovskaya E.P., Sokolov I.Yu. (12; 1-119).

A map of the areas where scientific research was conducted in the Tashkent region by district is shown in the figure below.

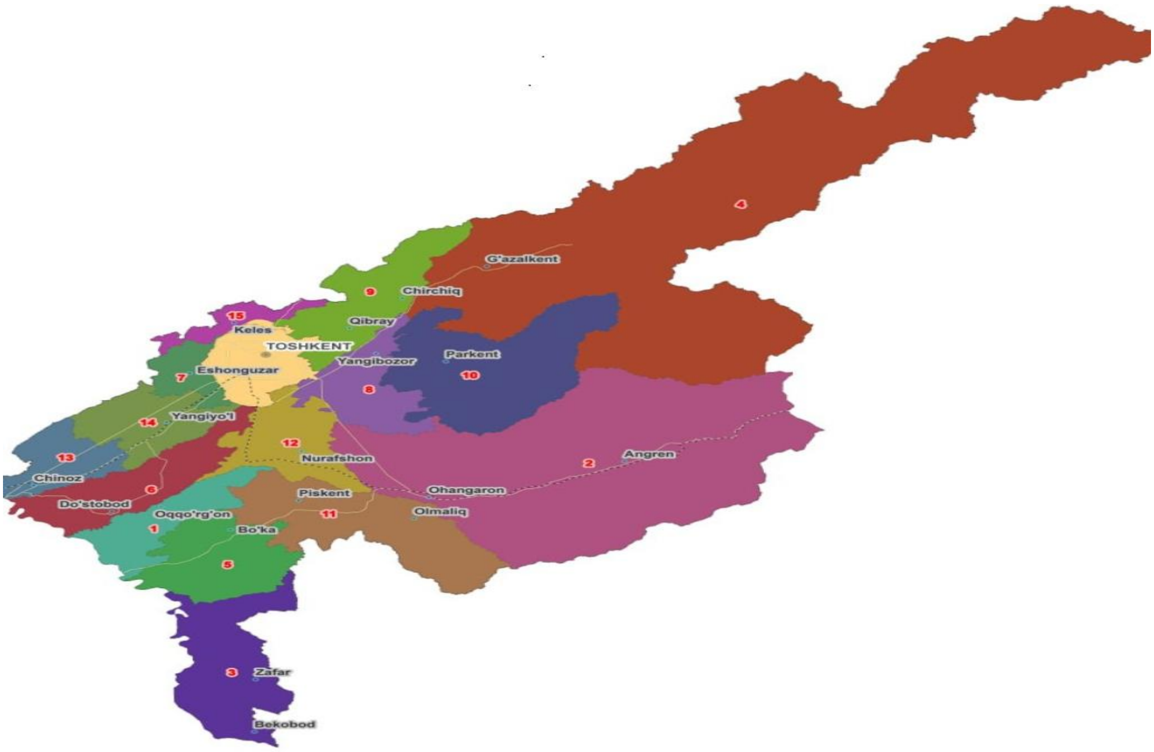

Figure_1: Geographical location map of the study area by district

As a result of the research, scientific research was conducted on the changes in the ecological state of water sources that are irrigated with natural water. Laboratory work was carried out to determine the total number of microorganisms [3] and the amount of chemical elements in water sources distributed around industrial sectors. Accordingly, the total number of microorganisms found in the composition of water sources is presented in 1-2-table and information on the number and quantities of chemical elements and the permissible limit share norm is presented below.

Table_1: Total number of microorganisms in water sources distributed around industrial sectors in Tashkent region, in mg/l

Research areas	Distance from industrial sectors km	Total microbial count (TMC)	Pollution limits km
I- territory	2 km	$7x10^3$	Strong
	8 km	$4x10^3$	Average
	23 km	$2x10^2$	Weak
II- territory	1,2 km	$3x10^4$	Strong
	3 km	$5x10^3$	Average
	5 km	$4x10^3$	Weak
III- territory	2,5 km	$5x10^5$	Strong
	9 km	$6x10^5$	Average
	23 km	$7x10^2$	Weak
IV- territory	2 km	$9x10^3$	Strong
	7 km	$7x10^3$	Average
	22 km	$3x10^2$	Weak
V- territory	1 km	$7x10^5$	Strong
	2,5 km	$2x10^3$	Average
	3,5 km	$2x10^2$	Weak
VI- territory	2,8 km	$7x10^6$	Strong
	8 km	$5x10^3$	Average
	21 km	$7x10^2$	Weak
VII- territory	1,3 km	$6x10^8$	Strong
	8 km	$4x10^5$	Average
	15 km	$2x10^2$	Weak
permissible limit share *		Up to 100 - clean water	
		Water with a level of 100-500 is moderately polluted.	
		More than 500 - dirty water	

** Permissible limit share*

Table_2: Amounts of some chemical elements in water sources distributed around industrial sectors in Tashkent region, mg/l (as of October 2021 and November 10, 2022)

Research areas	Amount, mg/l										
	F	**K**	**Na**	**Mn**	**Pb**	**Cu**	**Cr**	**Zn**	**Hi**	**As**	**Al**
As of October 2021											
I- territory	0,79	51,9	145,00	0,002	0,008	0,0035	0,0009	0,0044	0,07	0,05	<0,02
II- territory	0,76	52,7	139,00	0,004	0,007	0,0034	0,0008	0,0046	0,11	0,04	<0,01
III- territory	0,78	51,6	149,00	0,023	0,029	0,0037	0,0015	0,0064	0,04	0,03	0,03
IV- territory	0,85	53,8	146,00	0,012	0,034	0,0014	0,0009	0,0241	0,01	0,02	<0,01
V- territory	0,88	54,9	136,00	0,005	0,006	0,0027	0,0004	0,0045	0,09	0,04	<0,001
VI- territory	0,76	51,1	151,00	0,003	0,011	0,0011	0,0007	0,0054	0,06	0,07	<0,006
VII- territory	0,81	52,4	128,00	0,008	0,016	0,0054	0,001	0,0048	0,02	0,08	<0,009
As of November 10, 2022											
I- territory	0,88	54,4	141,00	0,003	0,009	0,0059	0,0008	0,0046	0,09	0,03	<0,007
II- territory	0,81	55,3	129,00	0,002	0,012	0,0064	0,0004	0,0045	0,12	0,05	<0,008
III- territory	0,83	52,5	147,00	0,014	0,018	0,0043	0,0007	0,0086	0,01	0,02	0,04
IV- territory	0,78	51,9	139,00	0,015	0,011	0,0025	0,0005	0,0056	0,07	0,04	<0,009
V- territory	0,81	53,4	146,00	0,006	0,005	0,0028	0,0006	0,0061	0,04	0,05	<0,006
VI- territory	0,84	54,3	150,00	0,01	0,026	0,0054	0,0006	0,0065	0,04	0,04	<0,004
VII- territory	0,85	52,4	128,00	0,013	0,029	0,0046	0,0009	0,0084	0,02	0,03	<0,006
permissible limit share	**0,75**	**50**	**120**	**0,1**	**0,03**	**0,001**	**0,001**	**0,01**	**0,1**	**0,05**	**0,2**

According to the results of the study, it was found that the groundwater sources used for pumping due to the activities of the Uzbek Metallurgical Combine located in Bekabad district are polluted in the following three processes. The first is polluted during the cooling process of metal processing. The second is polluted during the cleaning and washing of the metal production workshops at the combine. The third is polluted during the discharge of the combine's smokestack and other harmful chemical compounds in solid and liquid form. As a result, due to the increased concentration of harmful chemical compounds in the ecosystems of the region, a change in the number of microorganisms in the water was observed. In this area, Bacillus.idosus, Bacillus.megaterium, Bacillus.subtillus, Bacillus.cereus, Bacillus.mycoides, Bacillus. Aglomeratus: spore-free, mainly distributed in the species Microbacterium, Bacterium, pseudomonos, etc., and microorganisms in this area were found to be 7x103 at 2 km from the Uzbek Metallurgical Combine, 4x103 at 8 km, and 2x102 at 23 km using Vinogradiskiy, Giltay and Ashby acidic media. In addition, it was found that the amount of some chemical elements in the water exceeded the permissible limit share.

In addition, it was determined that the amount of some chemical elements in the water exceeded the prescribed limits.

According to the results obtained in 2021-2022, it was determined that chemical elements such as F, K, Na, Cu exceeded the defined limits. Changes in microorganisms in the water and an increase in chemical elements above the norm are interpreted as harmful chemical waste from the Uzbekistan Metallurgical Combine. Bekobodcement is unique in that it does not discharge wastewater into the area. According to laboratory results, some chemical elements in the water exceeded defined limits. According to the results obtained in 2021-2022, it was determined that chemical elements such as F, K, Na, Cu, Ni exceeded the permissible limit share. It was also observed that the total number of microorganisms in the water was 3x104 at 1.2 km from Bekobodcement, 5x103 at 3 km, and 4x103 at 5 km. According to the results obtained, in the area close to Bekobodcement, an increase in the number of microorganisms in the water was observed due to waste generated from it, and a decrease was observed with increasing distance.

This is explained as the impact of waste generated under the influence of the activities of Bekobodcement. Today, the growing population is causing an increase in the need for electricity. This requires an increase in the number of thermal power plants in our country and an increase in their operating capacity. As a result of the operation of the Angren oil base, water sources in the region have been polluted due to the emissions from it. Harmful chemical compounds that have risen to the atmosphere have returned to water bodies and the surface of the earth under the influence of climate change, that is, through rain. Since the groundwater level in the Angren oil base area is quite low, it has not had a negative impact on it. Ash and slag waste collected as a result of incomplete combustion of coal used to supply fuel to the Angren oil base are stored in ash dumps. This has had a negative impact on various components of the environment and changes in the ecological state. In addition, pollution has been observed as a result of the discharge of wastewater from the Angren oil base into other surrounding waters. The annual increase in waste around the Angren oil base has had a negative impact not only on the pollution of surrounding waters, but also on the ecology of the region.

In order to determine the total number of chemical elements and microorganisms in the waters affected by the Angren oil base, samples were taken and tested in laboratory conditions. According to the laboratory results, it was determined that the amount of several chemical elements in the water exceeded the permissible limit share. In particular, according to the results obtained in 2021-2022, the amount of chemical elements such as F, K, Na, Cu, Al exceeded the permissible limit share Also, changes in the number of microorganisms in the water were observed due to technogenic waste. In particular, it was determined that there were 5x105 microorganisms at 2.5 km from the Angren TPP, 6x105 at 9 km, and 7x102 microorganisms at 23 km. In particular, according to the results obtained in 2021-2022, the amount of chemical elements such as F, K, Na, Cu, Al exceeded the permissible limit share [11]. Also, changes in the number of microorganisms in the water were observed due to technogenic waste. In particular, it was determined that there were 5x105 microorganisms at 2.5 km from the Angren TPP, 6x105 at 9 km, and 7x102 microorganisms at 23 km.

The New Angren Thermal Power Plant had a smaller impact on the negative changes in the ecosystem of the region due to technogenic pollution of the environment compared to the Angren oil base. This is explained by the operating capacity of the New Angren Thermal Power Plant. Because the New Angren thermal power plant produces electricity at a power several times lower than the Angren thermal power plant. Samples were taken from the surface waters of the irrigated area around the New Angren thermal power plant and studied in laboratory conditions. Accordingly, it was determined that some of the chemical elements in the water samples obtained exceeded the defined limits [11]. According to the results obtained in 2021-2022, it was determined that chemical elements such as F, K, Na, Pb, Cu, Zn exceeded the defined limits [11]. It was found that the number of microorganisms in the obtained water samples changed several times compared to the number of microorganisms in water samples taken 23 km from the thermal power plant. In particular, 9x103 microorganisms were observed 2 km from the New Angren thermal power plant, 7x103 at 7 km, and 3x102 at 22 km.

Chemical elements in industrialized areas, when added to water sources, begin to show their negative impact as pollutants. Chemical elements that have entered the water under the influence of the Angren oil base have mixed with climatic factors and changed its ecological state. The impact on water sources around the Angren oil base has been observed in the processes of oil reception and distribution, causing pollution of water sources. Water samples taken from this area were tested in laboratory conditions. According to this, it was determined that some chemical elements exceeded the permissible limit share. In particular, according to the results obtained in 2021-2022, the amount of elements such as F, K, Na, Cu exceeded the defined limits [11]. At the same time, the total number of microorganisms in the water was observed to decrease due to the influence of harmful waste. Accordingly, it was determined that there were 7x105 microorganisms per 1 km from the Angren oil base, 2x103 microorganisms per 2.5 km, and 2x102 microorganisms per 3.5 km.

Due to the long-term activity of the Almalyk Mining and Metallurgical Combine JSC, the area has been subjected to technogenic pollution. Harmful chemical compounds that have entered the waters of the area near the combine have led to pollution. During the study, water samples were taken and studied in laboratory conditions in order to study the impact of the Almalyk Mining and Metallurgical Combine JSC on water sources. According to the results obtained in 2021-2022, the amount of elements such as F, K, Na, Cu exceeded the permissible limit share. The total number of microorganisms found in the water was determined to be 7x106 at 2.8 km from the Almalyk Mining and Metallurgical Combine JSC, 5x103 at 8 km, and 7x102 at 21 km.

The ecological state of water sources has changed due to the toxic substances of Ammofos-Maxam. At the same time, harmful pollutants have had a negative impact on microorganisms living in water. The toxic pollutant that has entered the water leads not only to a deterioration in the ecological state of water, but also to an increase in the acidity of its pH environment. Water sources flowing in the area near the ash landfills of Ammofos-Maxam JSC are used for the cultivation of agricultural products. According to the results of 2021-2022, in the waters around Ammophos-Maxam, it was determined that elements such as F, K, Na, Cu exceeded the permissible limit share. At the same time, when determining the number of microorganisms living in water, it was determined that they were 6x108 at 1.3 km from Ammophos-Maxam JSC, 4x105 at 8 km, and 2x102 at 15 km. This is explained by the fact that the ecological state of water sources has changed due to the negative impact of Ammophos-Maxam. After the completion of recultivation measures such as washing the soil surface, deep loosening plowing, moderate application of mineral and organic fertilizers in the areas around Angren (IES- thermal power plant), New Angren permissible limit share, Almaliq Mining and Metallurgical Combine, Ammofos-Maksam , the level of soil pollution, including the amount of heavy metals contained in it, was studied in laboratory conditions in relation to permissible limit share (3-table).

Table_3: Soil condition before and after reclamation

№	Name	Amount of chemicals before recultivation, g/kg				Amount of chemicals after recultivation, g/kg				permissible limit share *
		III- area	**IV- area**	**VI- area**	**VII- area**	**III- area**	**IV- area**	**VI- area**	**VII- area**	
1.	V	60,0	160,0	84,0	91,0	55,0	92	60,0	78,0	150
2.	Ni	112,0	145,0	57,0	48,0	94,0	110,0	51,0	35,0	85
3.	Cu	590	29,0	350	330	120,5	21,0	153	110,5	55
4.	Zn	200	105,0	310	230	69	74,0	95	89	100
5.	As	64,0	44,0	59,0	63,0	22,2	22,4	14,6	19,8	2
6.	Cd	0,550	0,200	1,10	0,880	0,470	0,690	0,6	0,660	0,7
7.	Sb	3,90	2,30	8,40	21,0	3,10	2,20	3,6	4,0	4,3
8.	Pb	80,0	34,0	160	220	25,0	19,0	29,1	28,0	30

* Permissible limit share

CONCLUSION

In conclusion, the impact of microorganisms on water sources near industrial areas was observed. After reclamation, the biological properties of soils and the quantitative and group composition of microorganisms decreased around the sources of pollution, and after the reclamation measures were carried out, their number gradually increased. Restoration indicators, the use of organic and mineral fertilizers for microorganisms and plant nutrition, deep tillage, loosening and constant moisture supply, increased the chemical elements in the soil composition, and the pollution of water sources was observed, and the amount of chemical elements and harmful waste was reduced.

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