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CHANGES IN THE NUMBER OF MICROORGANISMS IN LIGHT GRAY SOILS CONTAMINATED WITH INDUSTRIAL WASTE

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Abstract
This article presents the results of studying changes in the number of certain soil microorganisms under the influence of industrial waste contamination of light gray soils distributed in the Guzar district of Kashkadarya region.

Keywords: Actinomycetes, micromycetes, oligonitrophils, ammonifiers, humus, carbon monoxide, nitrogen dioxide, nitrogen oxide, hydrocarbons, sulfur dioxide.

Introduction

Soil is a complex natural-historical body, a source of life that determines the socio-economic potential of humanity with its origin, formation, structure, physical and mechanical properties, chemical composition, level of fertility, and most importantly, directly participates in the biosphere with its ecological function[1].

As is known, the main part of the natural gas produced in the republic falls on the Kashkadarya region. Therefore, in 2001, the Shurtan Gas Chemical Complex was built and commissioned in the Guzar district of Kashkadarya region. As a result of the processing of 3.5 billion m^3 of natural gas per year, various wastes and chemical compounds are released into the environment. These compounds have a certain impact on the ecological state of the region, including soil biological activity. Studies have shown that the microflora of Uzbekistan's soils is very diverse in composition. Depending on the soil type, degree of cultivation, applied agrotechnical measures, and others, the type of microbes in the soil and microbiological processes change in a certain order. The activity of soil microflora also varies depending on the time of year. It has been established that there is a significant difference between the life and activity of microbes in irrigated and non-irrigated lands. In irrigated soils, microbiological processes are active in spring, summer, and autumn, and only slightly decrease in winter. On irrigated fallow and virgin lands, especially in the desert zone, microflora is characterized by a weak microbiological activity. In these areas, microbiological activity increases only slightly in spring.

Gray soils are characterized by low organic matter content and rapid mineralization. This characteristic of gray soils arose as a result of the active activity of the microflora. This property of gray soils has attracted the attention of many researchers. Researchers S.P. Kostichev, O.G. Shulgina, M.P. Korsakova, V.N. Bilinkina, E.N. Nikitina, and others, as early as the 1920s, identified the intensive development of nitrogen-fixing aerobic bacteria, namely azotobacter, cellulose-decomposing bacteria, salt-to-nitrate bacteria, and other microorganisms, in the irrigated

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lands of Central Asia.

In scientific research, it is possible to increase the microbiological activity of soils from year to year and improve the agronomic properties of soils by systematically applying organic and mineral fertilizers in the region of sierozem soils of our republic. It is also important to reduce the annual rates of mineral fertilizers and increase the percentage of fertilizer absorption by plants. Thus, by increasing the microbiological activity of the soil, it is possible to optimize the agrophysical and agrochemical properties of the soil. In this case, the combined application of mineral and organic fertilizers is of great practical importance. [3].

MAIN PART

In recent years, a lot of scientific research has been conducted on the suppression of microbiological processes in the soil as a result of pollution with industrial waste, oil products, heavy metals, and the elimination of its harmful consequences. The Shurtanneftegaz Unitary Subsidiary Enterprise and the Shurtan Gas Chemical Complex, built in the Kashkadarya region, are among the largest industrial enterprises in our republic, which for many years have been releasing a large amount of aerosols, solid and liquid technogenic substances into the environment, which have a harmful effect on the soil microflora of the region. The processing of 3.5 billion m3 of natural gas per year at the complex releases various wastes into the environment, namely nitrogen, carbon, sulfur oxides, hydrogen sulfide, hydrocarbons, and other various chemical compounds.

Table 1. The amount of pollutants released into the atmosphere in 2019 and 2020 is presented in

No	Ingredients	According to the project documentation, tons	In fact, tons	
			2019	2020
1.	Carbon monoxide	1016,569	106.99	105.48
2.	Nitrogen dioxide	448,229	202.21	155.123
3.	Nitrogen oxide	742,814	48.635	39,414
4.	Hydrocarbons	73,870	8.42	8.535
5.	Sulfur dioxide	2,930	1.666	2.41
6.	Saja	41,596	0.542	0.556

As can be seen from the table, due to the fact that alkaline distillation is not carried out in the sulfur production unit, the amount of sulfur dioxide is several times higher than the norm established by current legislation.

Scientific research on the influence of waste from the Shurtan Gas Chemical Complex on soil microflora, conducted on the basis of stationary field experiments, showed that the microbiological properties of light gray soils are directly related to its type and the degree of cultivation.

15 kmWhen technogenic substances released during hydrocarbon processing enter the soil in the form of acid rain or dust, their harmful effects are directly related to the distance from the enterprise [5]. That is, the harmful effects of these wastes are clearly felt inside the enterprise and up to the nearest distance. Acidic waste in the form of sulfur oxide (SO2) and hydrogen sulfide (H2S) reacts with alkalis in the soil, forming water-soluble salts such as sodium sulfate

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(Na2SO4), potassium sulfate (K2SO4), calcium sulfate (CaSO4), magnesium sulfate (MgSO4) [6].

While observing the microbiological activity of the soil as a result of soil contamination in the territory of the Shurtan Chemical Complex of Kashkadarya region, we were also convinced based on the analysis of our experiments.

Object: Our field experiments were conducted using generally accepted methods on light gray and irrigated soils of the territory of the Shurtan Gas Chemical Complex in the Guzar district of Kashkadarya region.

15 kmWhen technogenic substances released during hydrocarbon processing enter the soil in the form of acid rain or dust, their harmful effects are directly related to the distance from the enterprise [5]. That is, the harmful effects of these wastes are clearly felt inside the enterprise and up to the nearest distance. Acidic waste in the form of sulfur oxide (SO2) and hydrogen sulfide (H2S) reacts with alkalis in the soil, forming water-soluble salts such as sodium sulfate (Na2SO4), potassium sulfate (K2SO4), calcium sulfate $_{(CaSO4),}$ magnesium sulfate $_{(MgSO4)}$ [6].

As we monitored the microbiological activity of the soil as a result of soil contamination in the territory of the Shurtan Chemical Complex of Kashkadarya region, we were also convinced based on the analysis of our experiments.

Object: Our field experiments were conducted using generally accepted methods on light gray and irrigated soils of the territory of the Shurtan Gas Chemical Complex in the Guzar district of Kashkadarya region.

Methods: For the microbiological analysis of soil samples, generally accepted methods of soil microbiology were used;

To study the quantity of the main physiological groups in the soil, soil samples were taken from a depth of 0-30 cm. Microorganisms in the studied soils and water were studied, including: ammonifying bacteria - on GPA nutrient medium, oligonitrophiles - on Eshby nutrient medium, and micromycetes and actinomycetes - on Chapeka solid nutrient medium.

Procedure: A suspension was prepared from the soil sample taken for microbiological analysis. For this, 10 grams of soil sample were mixed with 90 ml of sterilized water and shaken for 5 minutes, then 1 ml of suspension was taken using a pipette and placed in 9 ml of sterilized water in a test tube. This process was continued sequentially, diluted to 1:1,000,000, and repeated. 1 ml of the liquid in the test tube was inoculated into special solid elective nutrient media on a Petri dish in three repetitions, i.e., ammonifiers were inoculated into meat peptone medium, oligonitrophils into Eshbi medium, actinomycetes and micromycetes into Chapeka medium based on "dilution" and were examined.

The results of the microbiological analyses are presented in Table 2.

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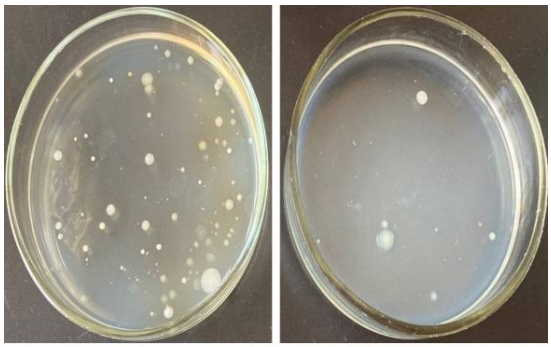
Table 2 **The number of microorganisms of the main physiological group in soils, CFU/g of soil**

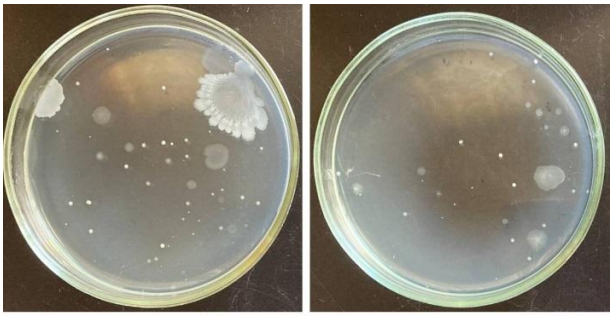
No Samples	Types of microorganisms					
	Ammonifiers	Phosphorus-degrading bacteria	Oligonitrophils	Free-living nitrogen fixing bacteria	Micromycetes	Actinomycetes
1.	$3x10^6$	not encountered	$2.1x10^5$	not encountered	not encountered	not encountered
2.	not encountered	not encountered	not encountered	not encountered	not encountered	not encountered
3.	not encountered	not encountered	not encountered	not encountered	not encountered	not found
4.	$6x10^6$	not encountered	$3.3x10^5$	not encountered	not encountered	not encountered
5.	$10x10^7$	not encountered	$1.6x10^5$	not encountered	not encountered	not encountered
6.	$1.5x10^5$	not encountered	not encountered	not encountered	not encountered	not encountered
7.	$3x10^6$	not encountered	$9x10^4$	not encountered	not encountered	not encountered
8.	$1.2x10^7$	not encountered	$4.0x10^5$	not encountered	not encountered	not encountered
9.	$9x10^6$	not encountered	$9x10^4$	not encountered	not encountered	not encountered
10.	$3x10^6$	not encountered	$1.2x10^5$	not encountered	not encountered	not encountered
11.	$5.1x10^7$	not encountered	$1.7x10^6$	not encountered	not encountered	not encountered
12.	$4.5x10^6$	not encountered	$3.0x10^5$	not encountered	not encountered	not encountered
13.	$3.0x10^7$	not encountered	$5.5x10^5$	not encountered	not encountered	not encountered
14.	$6x10^6$	not encountered	$1.0x10^5$	not encountered	not encountered	not encountered
15.	$1.5x10^6$	not encountered	$2.4x10^5$	not encountered	not encountered	not encountered
16.	$9x10^6$	not encountered	$7.5x10^4$	not encountered	not encountered	not encountered
17.	$1.2x10^7$	not encountered	$2.4x10^5$	not encountered	not encountered	not encountered
18.	$1.0x10^7$	not encountered	$5.8x10^5$	not encountered	not encountered	not encountered
19.	$4.2x10^7$	not encountered	$1.2x10^6$	not encountered	$1.5x10^4$	not encountered
20.	$1.2x10^7$	not encountered	$1.5x10^5$	not encountered	not encountered	not encountered
21.	$1.5x10^6$	not encountered	$7.5x10^5$	not encountered	not encountered	not encountered
22.	$3x10^6$	not encountered	$1.2x10^5$	not encountered	not encountered	not encountered
23.	$9x10^6$	not encountered	$4.6x10^5$	not encountered	not encountered	not encountered
24.	$5.8x10^7$	$1.5x10^5$	$1.3x10^6$	not encountered	$1.5x10^4$	not encountered

As a result of microbiological analyses, it was established that the number of ammonifying bacteria in the studied soil samples ranges from 10^5 to 10^7 CFU cells per 1 gram of soil. Ammonifying bacteria in samples 5, 8, 11, 13, 17, 18, 19, 20, and 24 were found one or two orders of magnitude more often than in other samples and amounted to 1.0-5.8x10^7 CFU/g. In samples 2 and 3, ammonifying bacteria were not found at all. (Fig. 1).

In the analyzed soil samples, phosphorus-decomposing bacteria were found only in sample 24, in all other samples they were not found at all (Fig. 2).



А 0-10 см А 20-40 см



А-1 0-10 см А-1 31-40 см

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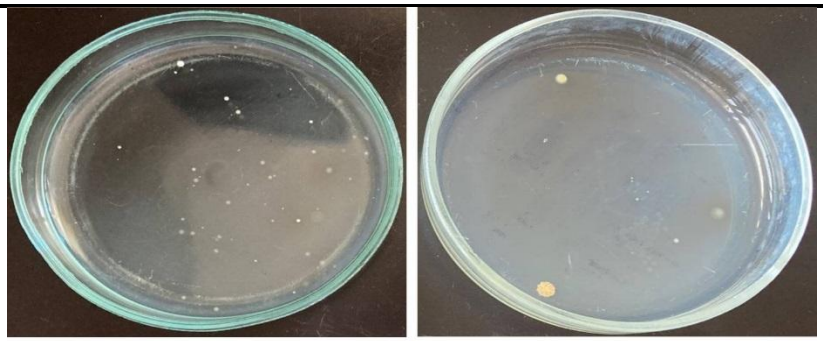

Figure 1. Total amount of ammonifying bacteria in various soil layers in the GPA nutrient medium

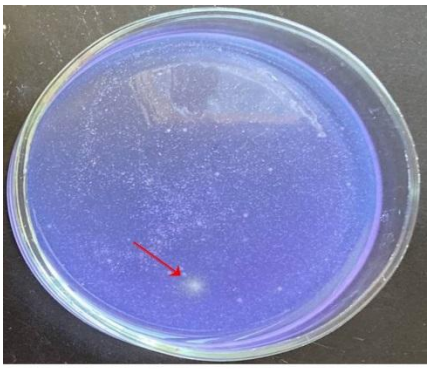

Figure 2. Total amount of phosphorus-decomposing bacteria in the Pikovskaya nutrient medium

In all analyzed soil samples, potassium-decomposing bacteria and free-living nitrogen-fixing bacteria were not found at all.

As a result of microbiological analyses, it was established that the number of oligonitrophilic microorganisms in the studied soil samples ranges from 10^4 to 10^6 CFU cells per 1 gram of soil. Oligonitrophilic microorganisms in samples 11, 19, and 24 were found one or two orders of magnitude more often than in other samples and amounted to 1.2-1.7x10^6 KHB cells/g. The number of these microorganisms in samples 7, 9, and 16 was 7.5-9x10^4 KHB cells/g, while in samples 2, 3, and 6 they were absent. In the remaining samples, their content was 1.0-7.5x10^5 CFU cells/g (Fig. 3, 4).

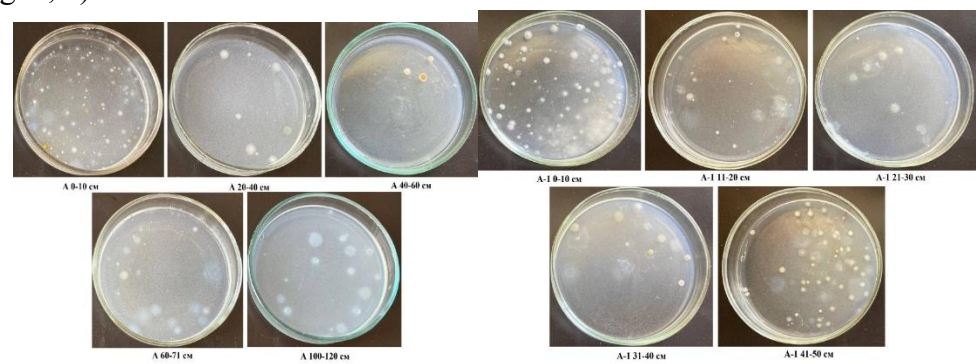

Figure 3. Total number of oligonitrophilic microorganisms in various soil layers (A, A-1) in the Eshbi nutrient medium

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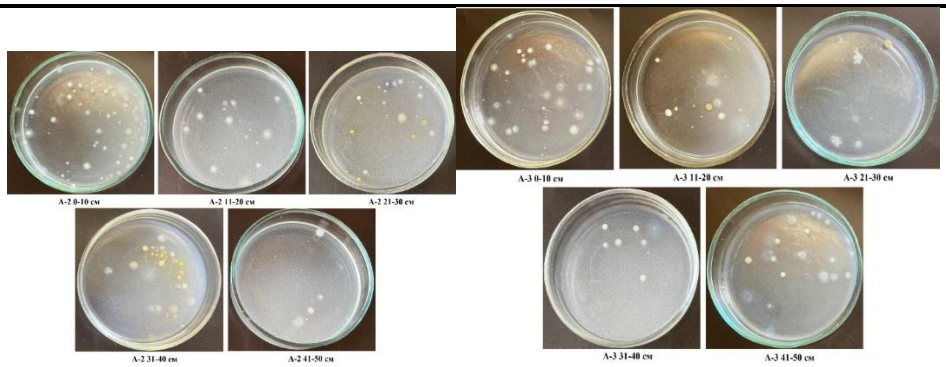

Figure 4. The total number of oligonitrophilic microorganisms in various soil layers (A-2, A-3) in the Eshbi nutrient medium

In the studied soil samples, micromycetes were found only in samples 19 and 24, and 1.5x104 CFU cells were observed in 1 gram of soil. In the remaining samples, they were not found at all (Fig. 5).

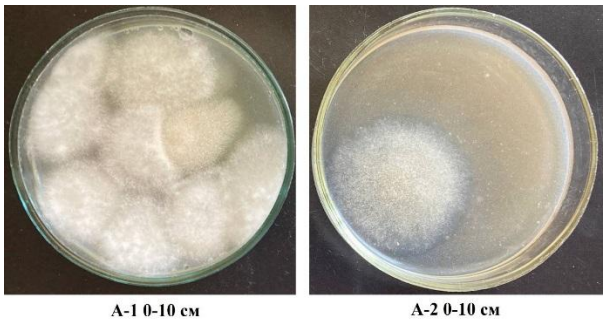

Figure 5. Total number of micromycetes in the Chapeka nutrient medium

Actinomycetes were not found at all in any soil sample under microbiological analysis.

CONCLUSION.

In conclusion, as a result of studying the microflora of these microbiologically analyzed soil samples, it was noted that the number of ammonifying bacteria from the main physiological group of microorganisms in all samples ranged from 10^5 to 10^7 CFU cells, i.e., it was 1, 2 and 3 orders less than the norm, the number of oligonitrophilic microorganisms was also 1, 2 and 3 orders less than the norm, phosphorus and potassium-decomposing bacteria, as well as free-living nitrogen-fixing bacteria and actinomycetes were not found at all. It was established that micromycetes were found only in 2 samples (A-1 and A-2), that is, only in the 0-10 cm soil layer and exceeded the norm by one order, and these microscopic fungi belong to the genera *Mucor* and*Fusarium*. In the remaining samples, that is, in the lower soil layers, micromycetes were not found at all.

References

1. Musayev M.N. Fundamentals of industrial waste treatment technology. // National Philosophers of Uzbekistan Publishing House. - Тошкент, 2021. - P. 14.
2. Bagryanseva E.P., Baybardina T.N., Burseva O.A. Anisimov M.V., Smagina N.S. Utilization of production waste on the example of beer production in Tomsk. // X International Scientific

Web of Agriculture: Journal of Agriculture and Biological Sciences
webofjournals.com/index.php/8

Volume 3, Issue 9, September - 2025
ISSN (E): 2938-3781

and Technical Conference "Science, Education, Production in Solving Environmental Problems" (Ecology - 2013). - Ufa. 2013. - P. 283-288.

3. Mirsodikov M.M. "Actions of Microorganisms on Soil Fertility" Current Problems of Soil Fertility Restoration, Increase and Melioration in the Desertification Process of the Aral Sea Basin Collection of Scientific-Practical Conference Reports Tashkent-2002.282-284 pages
4. Kholikova S., Diyorova M., Mamadiyorov F., Ergasheva O. Soil and climatic conditions of the Guzar massif with light loamy soils. // Materials of the international scientific-practical conference on the topic "Sustainable Development Goals: foreign experience and the practice of Uzbekistan." Tashkent - 2024. P. 437-444.

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