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ANALYSIS OF TECHNOGENIC IMPACT (GAS-INDUSTRIAL COMPLEX) ON THE STATE OF SOIL AND GROUNDWATER

R. Slichenko, Student
N. Senenko, PhD in Physics and Mathematics, Associate Prof. in Chemistry, Academic Advisor
D. Storozhenko, PhD in Chemistry, Associate Prof. in Chemistry, Academic Advisor
Poltava National Technical Yuri Kondratyuk University, Ukraine
A. Senenko, PhD in Physics and Mathematics, Senior Researcher of the Department of Physical Electronics
Institute of Physics of the National Academy of Science of Ukraine, Ukraine

Conference participants

The results of experimental studies of soil properties in area that was contaminated following the disaster at drilling of the gas-bearing-well at oil and gas production facility are represented. The local population uses this soil for agricultural purposes. Conclusions on the impact of emergency on the state of soil, natural and drinking water of decentralized water supply to nearby settlements are made.

Keywords: *soil, decentralized water supply, gas-bearing-well, macrocomponent composition*

The Kharkiv region, like Poltava region, is one of the leading oil and gas producing regions of Ukraine. The Kharkiv region annually produces up to 8-10 billion cubic meters of natural gas. This represents over 41% of total production in the country [1]. Oil and gas complex is one of the main sources of anthropogenic pollutants which are toxic to the environment. Emergency situations, which are accompanied by significant emissions of pollutants, are the most dangerous. After an elimination of obvious factors of accidental releases a significant amount of impurities are remains in the soil, groundwater and water bodies. They change the basic physical and chemical properties of the soil. Pollutions fall through a water-soluble component into aquifers and negatively affect a human body through drinking water and agricultural products. The majority of Ukrainian rural settlements use the water of first aquifers [2], which in most cases does not comply with norms due to soil contamination [3].

In 1963 during the drilling of wells nearby v. Antonivka of Kegichevska district accident situation has occurred. The depth of the well had to be 3000 m. Gas discharge has occurred during the passage of salt crusts. A formation pressure had the value 300 atmospheres. Attempts to extinguish the flow of gas did not succeed. 20-meter torch was burning for almost a year. The information was classified. The method of liquidation of the disaster remained unknown. We have received the information from eyewitnesses and former employees. Therefore, there is assumption about the using of an underground nuclear explosion. At the site of the accident the crater with in diameter about 60 m was formed. It was filled with formation water. Drilling rig and the tractor disappeared under the ground. The water of technogenic lake has not been investigated, and the local population uses it for cultural purposes.

We carried out the qualitative and quantitative analysis of the technogenic and natural lakes water samples and drinking water of v. Antonivka and v. Chapaeve of Kegichivka district of Kharkiv region. The basic physical and chemical properties of water samples from lakes and v. Chapaeve were investigated. The results of our experimental studies are presented in [4].

At the same time, the problem of soil and water pollution (especially near populated areas) has remained unknown to the local population, which uses it for agricultural purposes.

Therefore, the aim of our work was to experimentally investigate the main physical and chemical properties of soil samples in the vicinity of the technogenic lake and natural lake, as well as the soil samples of lands v. Antonivka and v. Chapaeve of Kegichivka district of Kharkiv region; to perform the correlative analysis of the macrocomponent composition of the water extracts of the soil with the macrocomponent composition of the water samples representated in [4] and draw conclusions about the state of the soil, and natural water and drinking water of decentralized water supply to nearby settlements.

5 samples of soil in the vicinity of the technogenic lake were selected and experimentally investigated by us. Also 5 samples of soil in the vicinity of the natural lake were selected and experimentally investigated by us. Natural lake is located about 1.5 km from the technogenic lake. We also selected 5 samples of homestead plots and 5 samples of the water of decentralized drinking water

supply in the village of Antonivka and 5 samples of household plots in the village of Chapaeve and investigated them. The averaged results of experimental studies are presented in tables 1-3.

The results of the study of the basic physical and chemical parameters of soil samples are presented in Table 1

Tab. 1.

Basic physical and chemical parameters of soil samples near technogenic lake, natural lake, v. Antonivka and v. Chapaeve

№	Indicator	Technogenic lake	Natural lake	v. Antonivka	v. Chapaeve
1	Density, g/cm^3	2.57	2,17	2,02	1,91
2	Hygroscopic moisture, %	3.50	2,85	2,14	1.9
3	Water capacity of soil, %	57.4	48	38.2	27,8
4	Organic matter content, %	0.95	1,60	1,37	1,50
5	Humus content, %	0.86	1,44	1,23	1,35
6	pH of water extraction of soil	8,55	8,2	7,90	7,6
7	Exchange acidity, mmole-eqv/100 g soil	2.1	2.3	3.2	3,8
8	Mass loss of soil on calcination, %	7,34	6,52	8,22	9,60
9	Content of water-soluble salts of water extraction of soil, mg/100 g soil	1245,00	930,00	544,00	273,90
10	Bicarbonate-ions content in water extraction of soil, mg/100 g soil and mmole-eqv/100 g soil	452,44; 7,41	298,12 4,89	112,78; 1.85	42,05; 0,69
11	Chloride-ions content in water extraction of soil, mg/100 g soil and mmole-eqv/100 g soil	150,55; 4,25	110,23 3,11	73,90 2,08	8,77 0,25
12	Calcium-ions content in water extraction of soil, mg/100 g soil and mmole-eqv/100 g soil	242,13; 12.08	118,54 5,92	38,10 1,90	26,00; 1,3
13	Magnesium -ions content in water extraction of soil, mg/100 g soil and mmole-eqv/100 g soil	67.12; 5,52	48,88 4,02	36,19 2,98	5,126; 0,42
14	Sulfate-ions content in water extraction of soil, mg/100 g soil and mmole-eqv/100 g soil	317,36 6,61	269,76 5,62	205,92 4,29	142,08 2,96
15	Sodium -ions content in water extraction of soil, mg/100 g soil and mmole-eqv/100 g soil	15,4 0,67	84,55 3,68	76,88 3,34	50,03 2,18

Source: Author's experimental research

The same soil samples were taken to determine the presence of radioactive contamination. The experimental results are presented in the table 2.

Tab. 2.

The results of research on the presence of radioactive contamination the soil samples

Sample	β-radiation	The background value γ-radiation, (mcR/hr)	γ-radiation, (mcR/hr)
Technogenic lake	not revealed	24	17
Natural lake	not revealed	24	16
v. Antonivka	not revealed	24	15
v. Chapaeve	not revealed	24	15

Source: Author's experimental research

The results of experimental studies of the water of decentralized drinking water supply v. Antonivka are presented in the table 3.

Tab. 3.

Basic physical and chemical parameters of the water of decentralized drinking water supply v. Antonivka

Indicators	Standard	v. Antonivka
Colour, degrees	≤20(35)	8
The intensity of flavor, points	≤2(3)	1
The intensity of the odor, points	≤2(3)	1
pH	6,5-8,5	7,8
Total hardness, mEq/dm^3	≤7,0(10)	4,78
Ca hardness, mEq/dm^3	-	1,50
Mg hardness, mEq/dm^3	-	3,28

Aluminium-ions,mg/dm^3; mEq/dm^3	≤0,2(0,5)	0,50; 0,038
Total Fe-ions, mg/dm^3, mEq/dm^3	≤0,3(1,0)	10,12; 0,67
Alkalinity, mq/dm^3; mEq/dm^3	-	323,40; 5,30
Chloride-ions,mg/dm^3; mEq/dm^3	≤250(350)	50.92; 1,44
Nitrate-ions, mg/dm^3, mEq/dm^3	≤50	1,25; 0,02
WSS, mg/dm^3	≤1000(1500)	674,00 мг/л

Source: Author's experimental research

Comparison with the results of soil samples research with the results of experimental studies of the state of technodenic lake, natural lakes and drinking water of decentralized supply v. Antonivka and v. Chapaeve [4] allows us to draw the following conclusions. There are strong differences between the values of the basic physical and chemical indicators of quality of both soil and water from technodenic lake. The fact of changes in the properties of soil and water after the technogenic disaster is obvious. There is a correlation between soil and water quality changes. The increased value of water-soluble salts in the soil and in the water of technogenic lake are particularly significant. Since both components of the environment affect to each other, the recovery of soil after emergency emissions is extremely slow.

Conclusion:

1. All soil samples contain a low content of organic substances and have a weakly alkaline reaction. This characterizes the state of soils as degraded.
2. The investigated soil samples need urgent addition of organic fertilizers to restore their qualitative composition. But the using of fertilizers with humus content requires experimental control over the effect on the basic physical and chemical parameters of the soil
3. We have determined a significant excess of water-soluble salts in the soil water-extract and water-samples of the technogenic lake in comparison with the soil and water of the natural lake and both villages.
4. There is a correlation between pH of soil water-extract and its macrocomponent composition.
5. There is a big difference between the macro-component composition of the water-soluble constituent of the soil. This also indicates the technogenic pathway for ion emissions to the environment.
6. Positive is the lack of significant influence of technogenic pollution on the soil of nearby settlements v. Antonivka and v. Chapaeve. But the significant impact of technogenic pollution on the drinking water of decentralized water supply exists.
7. All indicators of drinking water supplies, except the content of iron ions and ions of aluminum, correspond to the norm.
8. It is necessary to implement measures to reduce the concentration of ions of aluminum and iron in the drinking water.
9. The obtained results presented the negative impact of the emergency situation of the oil and gas complex on the main components of environment. These effects have a significant impact on the main components of the environment - soil and water.

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