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RESEARCH ARTICLE

Rehabilitation of Ecologically Polluted Areas in the Absheron Peninsula, use of the Area Under Greenery

Z. H. Aliyev, S. X. Shukurov

Department of Agriculture, Institute of Soil Science and Agrochemistry, National Academy of Sciences of Azerbaijan, Baku, Azerbaijan

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ANNOTATION

In the article, the development of oil fields in the Absheron Peninsula is sufficient to improve the health of the soil by conducting research on soil that has been intensively man-made as a result of the expansion of oil refining and petrochemical industry. The ecologically polluted area was mapped on the basis of geographic information system (GIS) technology and a methodology for planting new greenery was developed by conducting soil research. The ecologically polluted territory was applied to the map on the basis of GIS technology, soil research was conducted, and a methodology for planting new green plantations was developed.

Key words: Absheron peninsula, pollution, soil fertility, ecology, pollution, degradation

INTRODUCTION

Extensive production methods applied in the development of the oil industry in the former Soviet Union in violation of environmental safety norms have led to the pollution of thousands of hectares of fertile lands, aquatic, and marine ecosystems in the Absheron Peninsula with oil and oil products and their waste. The imperfection of the technology used in the production, transportation, and refining of oil has led to huge losses, accompanied by long-term pollution of the environment – land cover, groundwater, aquatic, and marine ecosystems. As a result, once fertile lands turned into man-made deserts.

One of such industries is the production of the Baku Iodine Bromine Plant, which operated in the 30s and 90s of the last century. The areas where the lay water used by this plant as a raw material is collected and polluted with post-production waste have created an environmental problem.

Address for correspondence:
Z. H. Aliyev
E-mail: volqa_5@mail.ru

The direction and methods of reclamation of the landscape disturbed by industrial activity depend on the nature of the disturbance, the development situation, and prospects of the region, the economic and social significance of reclamation for the region, and the physical and geographical features. Therefore, reclamation works in different countries, even in different regions of the same country, should be carried out in accordance with the specific features of the place.[1]

OBJECT AND METHODOLOGY OF RESEARCH

According to the technology applied at the iodine bromine plant, iodine was extracted from the Balakhani-Sabunchu-Ramani and Gala oil fields together with oil and extracted from the mineral water collected in the raw lakes. The mineral water treated at the plant was discharged to the research area.[3-7]

To date, no measures have been taken to dispose of waste or isolate it at landfills, resulting in an environmental crisis in which dust fractions spread

to the surrounding area under the influence of climatic factors such as wind and rain.

The purpose of the study is to develop a scientific basis for improving the environmental situation in the area. Recently, the ecological rehabilitation of the area, the creation of greenery on the site of the lake with waste remains has become urgent.

Scientific research requires the development of appropriate methods to achieve the following goals:

- Treatment of industrial waste accumulated on the surface of contaminated areas
- Cleaning of the contaminated area to a depth of 2 m with the application of physical and mechanical treatment technologies to reduce the initial amount of hydrocarbons in the soil
- Decontamination of contaminated soils with residual hydrocarbons using treatment technologies
- Leveling, recultivation, and landscaping of cleared areas
- Reduction of man-made impacts on the natural environment in Absheron
- Mitigation of the effects of desertification and degradation of the natural landscape
- Strengthening the potential of productive land returned to the economy
- Research has been conducted in the following areas, applying scientific methods for the full rehabilitation of the area, taking into account the requirements of future unlimited use of the farm
- Development of a plan scheme for the current state of the land cover
- Basic study of the land cover of the area, analysis of soil and water samples
- Scientific substantiation of soil rehabilitation for planting greenery
- Provide practical advice on reclamation of cleared areas
- Ensuring environmental control in the post-project period.

The following research methods have been used for this purpose.

- Comparative analysis and mapping of the area based on geographic information system (GIS) technology and space images
- Collection of soil samples based on trench and horizontal drilling methods
- Carrying out chemical-physical and other analyzes in the laboratory
- Comparative analysis by assessing the current situation in a similar area.

To study the area, a comparative analysis of space images was carried out over the years, similar scientific research works were carried out and soil research works were carried out at a depth of 120 cm in the area. It was found out that liquid wastes of the iodine production plant operating in the area and produced water mixed with oil residues extracted from oil wells in the upper areas were discharged into the area.

Although the plant was shut down in the 1990s, the lake's environmental impact has affected the city's ecological situation.

As a result of the initial survey of the area, a large number of field and local pollutants were detected in the area, which are characterized by the following differences:

1. There was a layer of bitumen covered with soil and contaminated soil in the area of 41.4 ha. Lands formed during the discharge of produced water and currently dried up in lakes and oil-contaminated soils were observed, which increased the likelihood of becoming a serious problem in the rehabilitation of the area
2. The main problem is the presence of radium isotopes in produced water. Although these

Table 1: Physical and mechanical properties of the soil samples

Indicators	Average prices
Granulometric composition, %	
Sand fractions (2.0–0.05 mm)	19.53
Dust fractions (0.05–0.005 mm)	42.51
Clay fractions (0.005 mm)	40.02
Natural humidity %	8.01
Volume mass of soil g/cm^3	3.81
Mass of oil-contaminated land g/cm^3	1.75
Porosity of oil-contaminated land, %	40.00
Soil porosity %	22.0
Porosity coefficient	0.30
Water saturation coefficient	0.60
Water-soluble salts %	1.18

Table 2: The radionuclide content of the samples taken during the soil surveys

Example No.	Specific activity, Bk				Category
	Ra-226	Ra-228	K-40	A_{eff}	
35	29.2±3.4	8.2±0.8	230.8±22.0	58.2±4.5	–
56	23.4±3.9	11.4±1.0	190.8±16.0	53.6±2.7	–
60	24.8±3.1	9.7±1.4	205.2±18.1	50.3±3.5	–

Table 3: Degree of contamination

Example No.	Çirklənməninxarakteri	Quantity of oil products (mg/kg)	Permissible concentration of oil and oil products in the soil (mg/kg)
35	Oil products	7108	100
40	Oil products	6206	100
47	Oil products	3969	100

Table 4: Laboratory analysis

The nature of pollution	Pollution parameter		Volume m^3
	Area (m^2)	Average depth (m)	
Bituminous oil residues	42,000	2	84,000
Bituminous oil residues	177,500	1.0	177,500
Bituminous oil residues	192,000	0.50	960,00
Total	441,500	–	357,500

Table 5: The amount of soil contaminated with heavy metals

Heavy and other metals	Chemical formula	Determined amount (mg/kg)	YVQH (mg/kg)
Lead	Pb2+	0.3–1.2	10
Manganese	Mn2+	10–95	1500
Nickel	Ni2+	0.3–17	40
Cobalt	Co2+	0.3–2.2	10
Sink	Zn2+	3.0–12.0	50
Mis	Cu2+	2.0–8.0	20
Mercury	Hg2+	0.003–0.5	2.0
Common chrome	Cr	0.3–5.0	200
Molybdenum	Mo6+	0.005–2.0	3.3

Table 6: Amount of radium isotopes in water-soluble form

Example No	Volume activity mBk/l	
	Ra-226	Ra-228
1	14.6±1.2	10.6±1.4
2	16.4±1.3	9.9±1.5

isotopes were insignificant and harmless in produced water, they accumulated continuously in millions of tons, increasing the likelihood that a strong concentration of radium would accumulate in a small area

3. Due to the high level of pollution in the area of the lake, even the development of primitive plants was not observed. Area assessment of pollution categories was carried out on the basis of maps and schemes based on GIS technology.

Samples from soils and various solid wastes were taken both from the surface and from the section walls. Soil and water samples taken from the area were analyzed and the results of the analysis were thoroughly analyzed.

The results on the physical and mechanical properties of the soil samples are summarized in accordance with Table 1.

The possibility of radioactive contamination in the area has also been taken into account. Radioactive and electromagnetic radiation is the most dangerous types of pollution and has a strong impact on all living things (biocenosis) along with humans.[2]

The radionuclide content of the samples taken during the soil surveys in the area was determined by gamma spectrometry and the results are summarized in accordance with Table 2. Samples were taken from the 0 to 120 cm layer of the mixture at the central points of the waste.

Oil-contaminated soil samples were taken from a depth of 120 cm from three characteristic points of the most contaminated area of 42.6 ha. The results on the degree of contamination are summarized in accordance with Table 3.

Of the sample No. Nature of pollution quantity of oil products (mg/kg) Permissible concentration of oil and oil products in the soil (mg/kg).

35 Petroleum products 7108 100

40 Petroleum products 6206 100

47 Petroleum products 3969 100

A 1.5–2 m deep area contaminated with fuel oil was found on the site of the lake. The results of laboratory analysis of the samples taken here are summarized in accordance with Table 4, the volume of contaminated soil in the contaminated area.

Heavy metals have a special place among pollutants due to the scale of pollution and their impact on biological objects. Heavy metals play an important role in the body, but their intensive distribution in the biosphere, atmosphere, and high concentration in the soil makes them toxic to biota.[2] The amount of soil contaminated with heavy metals is summarized in accordance with Table 5.

The amount of radium isotopes in water-soluble form is summarized in accordance with Table 6.

The coordinates of the sampling points (WGS-84) and the results of the analysis of the mechanical composition of the structure are summarized in accordance with Table 7.

Samples taken from characteristic locations were analyzed for total water weight (%/mg.eq) and the results are summarized in accordance with Table 8. The mass of soil to be transported to the area must have sufficient fertility.[8-11] The total water content of the soil layer to be brought to the area, some results of physical analysis are summarized in accordance with Table 9.

Table 7: Analysis of the mechanical composition of the structure

No.	X	Y	Depth Dərinlik	Granulometric composition	Volume weight g/cm
1	420,054	4,475,911	0–60	Medium clay	2.24
			60–90	Solid clay layer	3.81
			90–120	Sandy	2.59
2	419,933	4,475,917	0–60	Medium clay	2.22
			60–90	Solid clay layer	3.86
			90–120	Sandy	2.66
3	419,837	4,475,915	0–60	Medium clay	2.26
			60–90	Solid clay layer	3.66
			90	rock	3.00
4	419,656	4,475,841	0–120	Bituminous oil residues	1.69
5	419,662	4,475,808	0–120	Bituminous oil residues	1.66
6	419,592	4,475,802	0–120	Bituminous oil residues	1.71
7	419,502	4,475,763	0–120	Bituminous oil residues	1.72
8	419,592	4,475,582	0–120	Bituminous oil residues	1.78
9	419,613	4,475,503	0–120	Bituminous oil residues	1.80
10	419,835	4,475,174	0–120	Stone cast dry	2.23
11	420,149	4,475,405	0–30	Medium clay	2.56
12	419,754	4,475,494	0–120	Bituminous oil residues	1.85
13	420,036	4,474,879	0–120	Bituminous oil residues	1.79
14	419,936	4,475,776	60–90	Solid clay layer	3.85

Table 8: Total water weight according to different locations

No.	Soil name and depth	$CO_3^{"}$	HCO'_3	Cl	$SO_4^{"}$	Ca^{++}	Mg^{++}	$Na^{+}+K^{+}$	Dry residue %	Salts total%
1	Station and water	0.009	0.281	1.305	0.991	0.613	0.126	2.215	42.560	8.540
		0.30	4.60	123.00	9.36	30.60	10.35	96.31		
2	Ground juice	0.036	1.025	2.310	0.535	0.153	0.098	1.696	24.740	5.853
		1.20	16.80	66.00	5.50	7.65	8.10	73.75		
3	k-30 30	–	0.015	0.014	0.044	0.045	0.003	0.005	0.120	0.104
			0.25	0.40	0.92	2.25	0.23	0.22		
	60	–	0.015	0.028	0.233	0.090	0.004	0.024	0.410	0.394
			0.25	0.80	4.85	4.50	0.34	1.06		
4	K-53 30-40	–	0.024	0.021	0.160	0.044	0.005	0.039	0.303	0.293
			0.40	0.60	3.33	2.21	0.42	1.70		
	50–60	0.006	0.037	0.049	0.248	0.017	0.005	0.136	0.498	0.492
		0.20	0.60	1.40	5.16	0.84	0.42	5.90		
5	k-53 20–40	–	0.012	0.014	0.379	0.149	0.009	0.006	0.578	0.569
			0.20	0.40	7.89	7.43	0.78	0.28		
	40–60	–	0.015	0.014	0.102	0.047	0.003	0.004	0.210	0.185
			0.25	0.40	2.12	2.36	0.23	0.18		
	60–100	–	0.009	0.014	0.102	0.043	0.003	0.007	0.188	0.178
			0.15	0.40	2.12	2.13	0.23	0.31		

Table 9: No., name of soils, deep CO3, HCO´3, Cl, SO4", Ca ++, Mg ++, ik, dry residue%, salts total%, 1 Airport

No.	Name of lands, depth	CO3"	HCO´3	Cl	SO4"	Ca++	Mg++	ik	% of dry residue	Salts total%
1	Airport I 0–10	–	0.021	0.014	0.044	0.014	0.003	0.016	0.088	0.069
			0.35	0.40	0.85	0.68	0.22	4.70		
	10–50	–	0.012	0.014	0.058	0.018	0.003	0.016	0.128	0.121
			0.20	0.40	1.21	0.90	0.23	0.70		
2	3 m	–	0.040	0.007	0.117	0.009	0.003	0.060	0.253	0.236
			0.65	0.20	2.44	0.45	0.23	2.61		
3	5 m	–	0.015	0.014	0.029	0.016	0.004	0.003	0,100	0.081
			0.25	0.40	0.60	0.79	0.34	0.12		

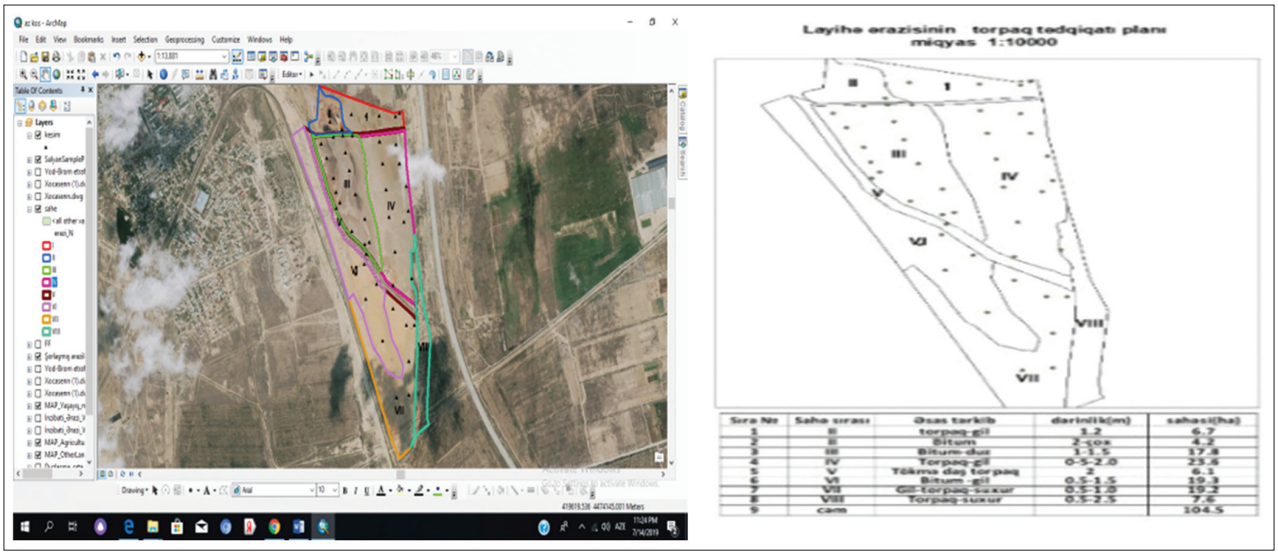

Figure 1: Plan scheme of the area

The intensity of the processes associated with the conversion, transportation, and accumulation of mineral and organic compounds in the soil depends significantly on its mechanical composition [Figure 1].

CONCLUSION

Formed water from oil production, as well as wastewater from the iodine-bromine plant, were collected in the area. Over the past period, the water has been exposed to natural evaporation and dried harmful substances.

Causes of flooding in the area, the intensity of water formed from external sources, leakage from the nearby "Hovsan Canal," the low frequency of water transmission of the "Hovsan Canal," the depression of the relief, etc., clarified. The main causes of pollution in the area are the long-term oil production in these areas, the accumulation of sludge collected at oil storage facilities and produced water treated at the iodine bromine plant.

According to the plan scheme of the area, contaminated area with oil-contaminated soil layer at the depth of 2–0.5 m was found in the 2nd, 3rd, and 6th areas. The contaminated area was 441,500 m^2. The final volume of contaminated soils was 357,500 m^3.

Various heavy meta of man-made contaminated soils. As a result of the assessment conducted to determine the degree of pollution, it was determined that the amount of these metals is much lower than the permissible price limit for the Republic of Azerbaijan, and some heavy metals (Cd and Sb) were not detected in the study environment.

According to the results of the analysis, since Aeff <370 Bk/kg, these wastes are not considered radioactive wastes.

Radioactive contamination corresponds to the permissible price limit. The volume activity of radium isotopes in water samples is very low.

When Group II elements, including radium, were present in produced water, a decrease in pressure and temperature (due to their removal to the surface) could lead to an increase in the solubility of their mixed sulfates and carbonates.

This is in the form of their sulfate and carbonate sediments in the bottom sediments of the lake and so on increases the probability of accumulation.

Some areas are slightly salinized. The carbonate content of the soil is very low. The impact of possible water flows and groundwater should be neutralized by the drainage system. There are no harmful effects of salinity and irrigation water in the area.

In general, the land cover was assessed according to the following sections. According to the plan scheme, there were oil residues at the depth of 1–1.5 m from the 2nd, 3rd, and 6th areas. At the depth of 50–90 cm in the 1st, 4th, 7th and 8th areas. There was a heavy clay layer 40–80 cm thick. This layer should be destroyed and mixed with other rocks and spread to the areas where oil residues are transported, and a layer of fertile soil should be created on it.

The topsoil of the area to be transported from the outlying areas is weak. Regular agrochemical measures are necessary to improve the soil.

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