UDC:631.445.5:504.5
DOI: *https://doi.org/10.30546/2521-6317.2025.02.542*

THE IMPACT OF OIL CONTAMINATION ON THE MORPHOGENETIC INDICATORS AND ECOLOGICAL CHARACTERISTICS OF GRAY-BROWN SOILS IN THE ABSHERON PENINSULA

Ali IBRAHIMOV[1*], Gunay VALIYEVA[1], Azade ALIYEVA[2]

[1] *Baku Engineering University, Hasan Aliyev Street, House 120, Khirdalan city, Absheron district, AZ0102, Azerbaijan*

[2] *Sumgait State University, 43rd district, Sumgait city, AZ5008, Azerbaijan*

ARTICLE INFO

Article history:
Received:2025-07-11
Received in revised form :2025-07-19
Accepted:2025-08-17
Available online:2025-12-25

Keywords:
Soil, oil, contamination, ecological characteristics, morphological features

ABSTRACT

During the exploitation of oil fields, the fertile topsoil layer has undergone significant degradation. As a result, mechanical disturbance of the soil surface and the loss of vegetation cover on productive lands are widely observed. These soils have been contaminated to varying degrees by oil-derived wastes.

A portion of the oil mass remains on the soil surface, forming a persistent coating, while another fraction infiltrates the soil profile to different depths. Addressing the stress imposed on the soil–plant system of the Absheron Peninsula requires, first and foremost, the identification and assessment of technogenically induced disturbances, as well as the determination of the genetic characteristics and the physical, physicochemical, and sanitary–hygienic parameters of these soils.

The morphogenetic characteristics of oil-contaminated soils in the peninsula have been investigated at different times. Based on studies conducted in the territories of Binagadi, Sabunchu, Surakhani, and Azizbayov districts, a soil fertility model has been developed for heavily, moderately, and slightly contaminated soils. The proportion of oil-derived pollutants causing contamination constitutes 26.0–20.0% in heavily contaminated areas, 18.0–16.4% in moderately contaminated areas, and 13.0–10.6% in slightly contaminated soils.

The Absheron Peninsula is one of the most industrially developed and highly urbanized regions of the Republic of Azerbaijan. Over many years, waste generated from the oil industry and related sectors has led to critical levels of contamination in several areas of the peninsula. The remediation and restoration of contaminated soils and water bodies are among the urgent priorities for the Republic of Azerbaijan. These measures are essential for reducing risks to public health, supporting the sustainable development of Baku and its surrounding settlements, and reintegrating rehabilitated lands into the national economic circulation.

INTRODUCTION

The Absheron Peninsula is an oil-producing region with a history of nearly 200 years. The former lack of advanced oil extraction technologies and the failure to comply even with the most basic requirements of environmental protection led to the formation of land areas contaminated with oil and petroleum products across the peninsula.

As is well known, out of the 200 thousand hectares comprising the Absheron Peninsula, 21.3 thousand hectares are lands requiring recultivation, of which 10.1 thousand hectares are soils contaminated with oil and oil-polluted wastewater.

In the Republic of Azerbaijan, the total area of oil-contaminated lands subject to recultivation is 24,156 hectares. Of this, 13,805 hectares are located on the Absheron Peninsula (including 6,788 hectares under the jurisdiction of Azneft), while 10,351 hectares are situated in other regions. According to SOCAR regions, the distribution is as follows: Khazar district – 302 ha, Sabail district – 526 ha, Garadagh district – 1,277 ha, Surakhani district – 533 ha, Sabunchu district – 410 ha, and Binagadi district – 183 ha [2, 11].

The areas of the Absheron Peninsula located under formation waters (saline, oil-contaminated, and radioactive lakes) amount to 1,190 hectares. Approximately 6–8% of the peninsula's territory is extremely (deeply) contaminated.

The history of soil contamination by crude oil in the Absheron Peninsula is relatively long. Industrial-scale oil contamination of soils began in the late 19 th century (around 1870). During that period, oil was extracted from hand-dug wells in low-relief and gently elevated areas where oil-bearing layers were close to the surface (in locations such as Balakhani, Fatmai, Binagadi, and Sulutepe). Starting from the first quarter of the 20th century, the mechanical drilling of oil wells accelerated oil extraction, transportation, processing, as well as environmental pollution [3,7].

It should be noted that soil contamination in the Absheron Peninsula is patchy, affecting areas ranging from 2–3 ares to several hectares (5–10 hectares or more). Crude oil spilled onto soil negatively affects its morphology, as well as its water-related, physical, physicochemical, chemical, and biological properties. It destroys and alters vegetation cover, soil fauna, microorganisms, enzymes, and bacteria. The light fractions of oil infiltrate into deeper soil layers in soils with lighter granulometric composition, reach groundwater, and partially evaporate upon release. In contrast, the heavy fractions accumulate on the soil surface, blocking aeration [9,11]. As a result, the soil completely loses its fertility and ceases to function as soil. Therefore, there is a need to restore the aforementioned properties of oil-contaminated soils and, accordingly, to determine permissible limits of oil content in soils for agricultural crops.

The Absheron Peninsula is the area most exposed to environmental pollution in the Republic. Approximately 75–85% of the country's industrial potential and about one-third of its population are concentrated in this economic region. Up to 30% of the peninsula's territory has been allocated for oil fields and has been contaminated by their waste, as well as by domestic, construction, wastewater, and technical discharges. Oil and gas extraction, transportation, and processing have led to pollution and degradation of the environment, particularly soils; gas emissions have caused atmospheric contamination with various harmful substances; and water bodies and groundwater have been polluted with petroleum products, radionuclides, and heavy metals [8,9]. These factors have resulted in the formation of anthropogenic landscapes across the peninsula.

It should be particularly noted that in Azerbaijan, although reclamation measures are included in project estimates for the extraction of mineral resources, construction materials, and oil, in practice such measures have often not been implemented. Formation waters, sludges, and oil gushers discharged onto the soil surface lead to salinization and contamination [1,6].

Contamination of the soil cover, especially groundwater, by formation waters can pose serious threats not only locally but also at the regional level [4, 13]. Based on the assessment of the ecological condition of the Absheron Peninsula, the following four levels of landscape disturbance are observed:

- Satisfactory – the soil–vegetation cover is not disturbed;
- Moderate – the soil cover is slightly disturbed;
- Critical – the soil cover is destroyed and the landscape has changed;
- Catastrophic – all elements of the landscape are altered and all internal landscape relationships are disrupted.

There is a pressing need for conducting research on landscape restoration, as well as for the remediation of contaminated lakes, the recultivation of polluted soils, the leaching of saline soils, and the development of collector–drainage systems to lower groundwater levels.

The territory of the Binagadi Oil and Gas Production Department belongs to an old oil-field zone. It is located in the northwestern part of Baku city, at a distance of 8–10 km from the city center. The Binagadi Oil and Gas Production Department operates in the Binagadi, Sulutepe, Chakhnaglar, Kirmaki Shabandag, Silyanshor, Mahammadli, and Masazir fields. It has been functioning as an oil production zone since 1896. A total area of 2,759 hectares of the Absheron Peninsula is included within the company's production zone.

The primary objective of this research is to study, first of all, the impact of oil contamination on the morphogenetic indicators of gray-brown soils in the Absheron Peninsula, depending on the degree of contamination, and subsequently to develop reclamation methods for these soils under agricultural crops, taking into account their granulometric composition. In this regard, the following tasks have been set:

1) Investigation of the natural and oil-contaminated soil cover in the territories of the Binagadi and Sabunchu Oil and Gas Production Departments.
2) Assessment of the impact of oil on the morphogenetic properties of soils, depending on the degree of contamination and whether it is recent or aged.
3) Study of the effects of oil on the physical, chemical, and biological properties of soils.
4) Investigation of heavy metals and radioactivity in background and oil-contaminated soils.

Experimental Section

The 2nd oil field of the Binagadi Oil and Gas Production Department under SOCAR is located at the intersection of roads leading from Binagadi settlement to Mehtiabad settlement, on the right side of the highway, toward Balakhani settlement. From the central part of the field, a deep (more than 2 m) open drainage channel carrying wastewater flows toward the Binagadi-Boyukshor Lake. The central part of the field is a micro-depression. The soils in this depression are highly salinized and saline-alkalized due to both natural conditions and formation waters seeping from the oil wells, as well as to some extent from domestic wastewater [5,10]. These soils remain moist throughout the year and are dark in color. During the summer, they dry out relatively. Since the surrounding terrain is relatively elevated, the groundwater level in this area (central part) is very close to the surface (1.0–0.60 m).

Our studies were carried out on relatively steep slopes. For comparison, four soil profiles were established: one in uncontaminated soil (Profile N1) and three at different depths in oil-contaminated soils. These profiles were described in detail, and soil and groundwater samples were analyzed for total water extraction, granulometric composition, bulk density, exchangeable bases, pH in water suspension, carbonate content, humus, nutrient elements (NPK), heavy metals, absorption of radiation, and radioactive elements. The descriptions of these soils are presented below.

Profile No. 1. Established on a south-facing slope in the oil field area in uncontaminated gray-brown soil. Vegetation includes ephemeral plants, camel thorn, grassland species, sage, clover, etc.

AUVCa – Depth 0–10 cm; granulometric composition: light loamy; color: light gray-brown; structureless granular; consistency: soft; roots and rootlets present; moisture: dry; boundary clear; reaction in 10% HCl: vigorous effervescence.

AUV_{Ca} – Depth 10–35 cm; medium loamy; color: light gray-brown; structure: fine cloddy; consistency: firm; roots, rootlets, and new growth (small fishbone-like roots) present; moisture: dry; boundary clear; reaction in 10% HCl: vigorous.

B_{Ca} – Depth 35–67 cm; loamy; color: light gray-brown; fine cloddy; consistency: firm; roots, rootlets, white nodules (salt, gypsum) present; slightly moist; boundary gradual; reaction in 10% HCl: vigorous.

B/C_{Ca} – Depth 67–100 cm; loamy; color: light gray-brown; structure: fine cloddy; consistency: firm; very few weak roots and rootlets; numerous white nodules; compact, moist; boundary gradual; reaction in 10% HCl: vigorous.

C_1 – Depth 100–124 cm; light loamy; color: light gray-brown; structureless; consistency: firm; sparse weak rootlets; dry; boundary gradual; reaction in 10% HCl: vigorous.

C_2 – Depth 124–165 cm; light loamy; color: light gray; structureless; consistency: firm; very weak sparse rootlets; slightly moist; boundary gradual; reaction in 10% HCl: vigorous.

C_3 – Depth 165–200 cm; light loamy; color: light gray; structureless; consistency: firm; slightly moist; boundary gradual; reaction in 10% HCl: moderate.

Profile No. 2 – Located 100 m to the southeast of Profile No. 1 along the right side of the Binagadi-Balakhani highway. Microrelief is smooth, south-facing slope; soil: gray-brown; granulometric composition: upper loamy; parent material: loess, fishbone gravel, small stones, sand, various marine sediments; vegetation: ephemeral plants, camel thorn, grass, clover, sage; groundwater: absent; waterlogging: absent; erosion: absent; reaction in 10% HCl: vigorous.

X – Depth 0–25 cm; hardened oil residue (bitumen); color: black; structureless layer; consistency: firm; moisture: absent; boundary sharp; reaction in 10% HCl: none (due to oil effect).

B – Depth 25–64 cm; loamy; color: light-dark gray (oil sediment observed); structure: cloddy; consistency: firm; slightly moist; boundary gradual; roots/rootlets absent; new formation: oil deposit; reaction in 10% HCl: none.

C1 – Depth 64–100 cm; medium loamy; color: light gray-brown; structureless; consistency: firm; new formations absent; white nodules present; moisture: moist; boundary clear; reaction in 10% HCl: vigorous.

C_2 – Depth 100–150 cm; granulometric composition: sandy; color: light gray; structureless; loose; new formations absent; rootlets absent; slightly moist; boundary gradual; reaction in 10% HCl: moderate.

C_3 – Depth 150–200 cm; sandy; color: light gray; structureless; loose; new formations absent; slightly moist; reaction in 10% HCl: none.

Profile No. 3 – Located within the territory of the 2nd oil field of the Binagadi Oil and Gas Production Department, 80–100 m east of the highway, on a smooth micro-depression to the right of the drainage channel flowing toward Boyukshor Lake, near an oil well, on clayey, sandy, oil-contaminated, relatively shallow-hardened ground.

X – Depth 0–60 cm; thick layer; color: black; clayey, sandy; relatively firm; oil residues present; lower part soft; boundary clear; reaction in 10% HCl: none.

X/B – Depth 60–70 cm; sandy; color: dark ash; structureless; loose; new formation: oil-infiltrated; moisture: moist; boundary clear; reaction in 10% HCl: none.

B – Depth 70–100 cm; medium sandy; color: dark ash; structureless, layered; consistency: firm-loose; new formation: oil deposited; boundary gradual; reaction in 10% HCl: none.

C – Depth 100–200 cm; granulometric composition: sandy; color: light ash; structureless; consistency: loose; new formation: light fraction of oil filtered through; reaction in 10% HCl: none; groundwater accumulation observed. On the following morning, the oil-contaminated water level was one meter below the surface.

Table 1. Some Physicochemical Characteristics of Oil-Contaminated Gray-Brown Soils in the Territory of the Binagadi Oil and Gas Production Department

Profile No.	Depth (cm)	Hygroscopic Moisture, %	Bulk Density, g/cm³	Humus, %	Total Nitrogen, mg/kg	Phosphorus, mg/kg	Potassium, mg/kg	pH (water suspension)	$CaCO_3$, %
1	0–10	4.021	1.34	3.02	12.07	21.11	126.52	7.69	5.75
	10–35	4.019	1.56	2.38	6.04	17.78	117.47	8.25	4.61
	35–67	5.066	1.63	0.52	9.48	18.89	84.35	8.94	8.63
	67–100	3.947	1.66	0.41	5.17	32.50	78.32	9.05	7.90
	100–124	4.165	1.72	–	–	–	–	9.00	10.06
	124–165	5.905	1.73	–	–	–	–	8.59	11.49
	165–200	3.643	1.64	–	–	–	–	8.68	12.95
	0–25 Oil-contaminated	1.77	–	–	–	–	–	–	–
2	25–64	3.786	1.75	7.71	6.90	26.67	24.10	8.12	–
	64–100	4.632	1.48	0.90	5.17	27.78	102.42	8.23	0.72
	100–150	2.179	1.44	–	–	–	–	8.10	2.88
	150–200	–	1.49	–	–	–	–	8.04	1.43
	0–40 Oil-contaminated	1.80	–	–	–	–	–	–	–
3	40–59	2.296	1.73	2.38	6.04	32.50	90.37	8.20	0.43
	59–80	3.081	1.70	0.77	12.07	24.44	108.45	8.44	0.27
	80–103	3.474	1.72	–	–	–	–	8.73	4.89
	103–130	1.638	1.63	–	–	–	–	8.90	8.63

	0–60 Oil-contaminated	1.70	–	–	–	–	–	–	–
4	60–70	0.902	1.65	2.15	–	–	–	9.61	3.60
	70–100	2.451	1.62	0.96	–	–	–	9.74	4.74
	100–200	1.439	1.61	–	–	–	–	9.91	2.87
Binagadi Loamy	Experimental soil	1.763	1.40	1.74	9.48	35.00	12.05	7.52	4.75

Table 2. Results of Heavy Metals in Oil-Contaminated Gray-Brown Soils in the Territory of the Binagadi Oil and Gas Production Department, $\frac{\%}{mg/kg}$

Profile No.	Depth, cm	Cu	Pb	Zn	V	Sr	Ba
1	Background 0–10	$\frac{0,0012}{12}$	$\frac{0,0008}{8}$	$\frac{0,0094}{94}$	$\frac{0,0126}{126}$	$\frac{0,160}{1600}$	$\frac{0,0024}{24}$
3	0–40 Bitumen 40–59	$\frac{0,0017}{17}$	$\frac{0,0021}{21}$	$\frac{0,0084}{84}$	$\frac{0,0117}{117}$	$\frac{0,084}{840}$	$\frac{0,0054}{54}$
4	0–60 Bitumen	$\frac{0,0024}{24}$	$\frac{0,0011}{11}$	$\frac{0,0118}{118}$	$\frac{0,0096}{96}$	$\frac{0,192}{1920}$	$\frac{0,0086}{86}$
	60–70	$\frac{0,0011}{11}$	$\frac{0,0016}{16}$	$\frac{0,0112}{112}$	$\frac{0,0142}{142}$	$\frac{0,096}{960}$	$\frac{0,0042}{42}$
Clark values (mg/kg)		20 mg/kg	10 mg/kg	50 mg/kg	100 mg/kg	300 mg/kg	500 mg/kg.

The operational area of the Balakhani Oil and Gas Production Department (OGPD) encompasses the mining zones of oil and gas fields around the settlements of Balakhani, Zabrat, Sabunchu, and Ramana. Throughout the entire operational period of the Balakhani OGPD, primary attention was focused on oil extraction; as a result, reclamation measures were not implemented during the drilling of oil wells. Consequently, the ecological balance of the area was completely disrupted due to the discharge of formation waters into the territory and contamination of the soil with crude oil. The OGPD occupies an area of 1,510.9 hectares. The volume of formation water produced daily exceeds the oil production by 2.5 times. As a result, "Ramanagolu" Lake (with an area of 110 ha) has formed in the area. This lake was created from formation waters and the accumulation of rain and domestic waters in a micro-depression. It is oil-contaminated, saline, and radioactive.

The fifth oil field investigated in this study is located in the northern and northwestern parts of the Balakhani settlement. Topographically, it is slightly inclined to the west and east, i.e., it is situated on a gentle slope. The eastern end of the area connects to the Zabrat main road, and as a result of the discharge of formation waters along the slope, the groundwater (oil-contaminated) level is observed at approximately 1 meter.

Soil contamination with oil exerts irreversible effects on its morphological, physical, chemical, biological properties, and fertility. The direct impact of crude oil on soil morphology is evident in the genetic horizons of the soil profiles established in the oil-contaminated soils of Balakhani. Contamination of soils with oil and its products can induce significant changes in soil composition, properties, and structure. Oil contamination affects soil morphology, causing changes in the color of natural genetic horizons throughout the profile—from gray and dark shades to light brown—and also leads to deterioration of soil structure. Ultimately, this results in

the formation of a soil type modified by technogenic impact, derived from the original zonal soils [2,12].The lack of oxygen in the soil is caused by liquid oil compressing the air and covering the surface with a bituminized layer, which also prevents water infiltration and causes soil particles to adhere to each other. As a result, anaerobic conditions develop, the oxidation–reduction potential slows down, and soil alkalinity increases. Oil forms a coating around soil particles, which prevents water penetration and reduces moisture retention. The amounts of hygroscopic moisture, water infiltration, water-holding capacity, and evaporation from the upper soil layer decrease. During oil contamination, the humus content in the soil increases, but its quality changes: humic and fulvic acids decrease, and hydrolyzed residues increase Table 1 and 3. The soil's absorption capacity decreases because the oil film envelops the soil particles [14].

In addition to the strong effect of oil on the soil, saline oil formation waters cause chlorinated-sodium salinization and sodification. As a result, the soil horizon is completely altered. This type of contamination is even more hazardous than oil contamination alone [5,8].

Soil contamination with oil and its products significantly affects the number and composition of microorganisms. Bacteria that fix ammonia and nitrogen increase, whereas denitrifying bacteria, sulfate-fixing bacteria, mycromycetes, nitrifying bacteria, cellulose-degrading bacteria, and actinomycetes are completely altered. However, when the oil content in the soil is low—within permissible limits—all types of soil microorganisms remain active, positively influencing soil biota [2, 6, 13].

Profile No. 5. This profile was established on the northern side of Balakhani settlement, in the second section of Balakhani Oil Company No. 5, on a gently sloped smooth area contaminated with oil, along the roadside.

X. Depth 0–116 cm: Bitumen-contaminated sandy-loam mixture, recent oil contamination, color black with intermediate sand layers. Structure – layered, surface dry, lower part loose, moist, soft, bituminous, sandy-loam, slightly moist, transition sharp, boiling test – none .

X_1. Depth 116–124 cm: Sandy, dark brown, structureless, dense, light fraction of oil, sandy, moist, clear transition, weak to moderate boiling.

X/C. Depth 124–143 cm: Sand, sandy, whitish-gray, relatively dull, structureless, rust-colored spots, slightly moist, clear transition, moderate to high boiling.

C_{Ca}. Depth 143–200 cm: Sand, sandy, light brown, structureless, dense, rust spots, slightly moist, gradual transition, intense boiling.

Profile No. 6. Uncontaminated clean soil (background). This profile was established in the northwestern part of Balakhani settlement, on undulating gentle terrain, 25–30 m from the roadside within the area of Oil Field No. 5, on a raw, relatively elevated site. The vegetation is ephemeral, including *Qanqal*, camel thorn, willow in garden areas, and fig, which are characteristic for the entire area.

$АУV_{Ca}$. Depth 0–10 cm: Granulometric composition sandy, color light gray-brown, structureless, density loose, new formations – roots, rootlets, small stones, occasional snail shells, moisture very dry, transition gradual, boiling test intense.

АУCa. Depth 10–17 cm: Sandy, light gray-brown, weakly topsoil-like, loose, roots and rootlets present, occasional snail shells, very small stones, moisture dry, transition gradual, boiling test moderate.

AУ$_{Ca}$. Depth 17–48 cm: Granulometric composition sandy, light gray-brown, structureless, loose, smooth with occasional small stones, white snail shells, dry, occasional white rootlets, transition gradual, boiling test moderate.

B/C$_{Ca}$. Depth 48–70 cm: Sand-sandy, light gray-brown, small black-bitumen lumps, dense, clay lumps, sparse thin rootlets, sparse white nodules, transition gradual, boiling test moderate.

C$_{Ca}$. Depth 70–111 cm: Sand, whitish-gray to yellowish-brown, structureless, loose, weak rust spots, nodules present, dry, transition gradual, boiling test intense.

Depth 111–200 cm: Sand, whitish-gray, structureless, loose, no new formations, dry, transition gradual, boiling test weak.

Table 3. Selected physico-chemical properties of oil-contaminated gray-brown soils in the Balakhani section of Sabunchu Oil-Gas Production Department (OGPD)

Profile No.	Depth (cm)	Hygroscopic moisture, %	Bulk density, g/cm³	Humus, %	Total nitrogen, mg/kg	Phosphorus, mg/kg	Potassium, mg/kg	pH in water suspension	$CaCO_3$, %
5	0–116	Oil-contaminated	–	–	–	–	–	–	–
	116–124	1.006	1.63	–	–	–	–	7.00	2.02
	124–143	1.010	1.51	–	–	–	–	9.60	1.59
	143–200	1.014	1.48	–	–	–	–	9.64	6.48
6 (background)	0–10	1.010	1.32	2.17	6.04	24.44	24.10	8.00	9.05
	10–17	1.010	1.41	2.09	5.17	15.56	24.10	8.07	4.59
	17–48	1.017	1.49	0.85	4.31	15.56	24.10	7.95	6.48
	48–70	1.013	1.43	0.72	–	–	–	7.90	5.75
	70–111	1.012	1.41	Not determined	–	–	–	8.05	6.61
	111–200	1.012	1.49	–	–	–	–	8.05	2.16
7 (old contamination)	0–10	1.015	1.32	5.82	6.90	17.78	72.30	7.48	6.32
	10–40	1.031	1.30	4.96	7.76	12.22	219.31	9.39	1.60
	40–85	1.0009	1.59	2.71	3.45	23.33	24.10	9.38	5.75
	85–145	1.012	1.66	–	–	–	–	9.69	7.48
	145–210	1.012	1.63	–	–	–	–	9.50	10.80
8	0–52	–	1.71	Oil-contaminated	–	–	–	–	–
	52–70	1.018	1.53	0.62	3.45	15.56	24.10	8.50	8.33
	70–100	1.016	1.56	0.41	2.59	13.33	24.10	8.55	8.63
	100–140	1.017	1.47	–	–	–	–	8.56	8.47
	140–200	1.025	1.48	–	–	–	–	8.57	7.91
Rataxani sandy clean soil	0–25	1.018	1.03	46.56	17.78	48.20	7.73	4.75	–

Table 4. Heavy metal content in oil-contaminated soils in the Balakhani area of Sabunchu Oil-Gas Production Department (OGPD)

Profile No.	Depth (cm)	Cu	Pb	Zn	V	Sr	Ba
5	0–116 Oil-contaminated	0,0018 18	0,0009 9	0,0136 136	0,0112 112	0,0136 136	0,0114 114
	116–124	0,026 26	0,0008 8	0,0174 174	0,0136 136	0,0112 112	0,0081 81
8	Lower contamination layer	0,0014 14	0,0019 19	0,0092 92	0,0120 120	0,078 780	0,0036 36
Clarke values, mg/kg	------	20	10	50	100	300	500

In the northeastern part of the Absheron Peninsula (30 km east of Sumqayit city), the content of heavy metals in the topsoil is as follows: Ni – 75; Co – 26; Pb – 46; Mn – 3266; Cr – 127; Zn – 42; Cu – 49; Se – 36; Mo – 7.1; Ca – 4.2; V – 120; F – 31 mg/kg [9,11].

In the Sabunchu oil area, Balakhani section (near Zabrat settlement), the content of heavy metals in the oil-contaminated soils at a depth of 0–153 cm, from the upper layer downward, is as follows: Ti – 600–105; Cr – 420–160; Mn – 1200–1680–600; Ni – 3.2–3.0; Pb – 3.0–4.8–0.6; Cu – 3.4–1.0; Zn – 16.0–4.5; Co – 4.0–2.6; Sr – 200–48 mg/kg.

CONCLUSION

1. Based on the conducted comparative-geographical studies, the morphogenetic characteristics of sandy and loamy gray-brown soils in the Absheron Peninsula, in their natural-raw and oil-contaminated variants, have been determined.
2. The depth of soil contamination by oil, the physical and chemical properties of the soils, the composition of the oil, and the nutrient elements (NPK) have been studied; it was established that in contamination, the color of the morphogenetic layers' changes (deeper in sandy soils), and the water, physical, and p**hysicochemical** properties deteriorate.
3. The study shows that in soils contaminated with crude oil, the content of heavy metals and radioactive elements does not exceed the permissible limits compared to raw soil. At the same time, in natural gray-brown soils and in vegetation experiments with clover, accumulation of heavy metals and toxic elements is not observed.

REFERENCE LIST

1. Alizade V.M., Shirvani T.S., Alirzayeva E.G. Plant resistance to toxicity of metals and petroleum hydrocarbons approaches to phytoremediation. Baku: Elm, 2011, p. 276.
2. Ahmedov. V. (2011) Methods of invention and reclamation of technogenically degraded and oil-contaminated soils. // Department of Biological Sciences of ANAS. "News". Baku: Nauka Publ., volume 66, No. 2. p. 49-56
3. Aliyeva Azade, Guliyev Alovsat, Babayeva Tunzala (2024) İmpact of petroleum contamination on soil properties in Absheron Peninsula, Azerbaijan Eurasian Journal of Soil Science, Turkey Volume 13, İssue 2, p. 145-152.
4. Babyev M.P., Azizov G.Z., Mustaphayev M.G., Jafarov A.M. (2012) Natural factors that can create danger for that part of the Baku-Tbilisi-Ceyhan oil pipe-line passeng through the Azerbaijan Republic and intending measures for preservation.Baku: Elm, p. 111.
5. Babayev M. P., Nadzhafova S.I, İbrahimov A.H. (2015) Application of activated sludge to purify urban soils of Baku city from oil contamination ISSN 1064-2293.Euroasian Soil Sceince, Vol 48, pp.773-779.
6. Coulon et al. (2004) Deqradation of petroleum hydrokarbons intwosub-antarctik soils: influance of an oleophilic fertilizer. // Environ. Toxsiol. Chem, 2004, V23, № 8, p. 1893-1901.
7. Ibrahimov A.H., Gurbanova K.R., S.A.Kuliyeva S.A. (2018) Investigation of morph-ogenetic properties and reclamation methods of oil polluted soils of Absheron peninsula 10 th International Congress on "The Soil Resources and Environment Conservation" Almaty, Kazakhstan, p.251-254.
8. Ibrahimov A.H. (2013) Absorbed bases, heavy metals and radioactivity in crude and oil-contaminated soils on the territory of Binagadi Oil Company Soil Science and agrochemistry Volume 21, №3, Baku-"Science", p. 445-448.
9. Ibrahimov A.H. (2012) İnvestigation and restoration of soil polluting Soils of the Absheron Peninsula by the agromeliorative method Department of Biological Sciences of ANAS. "News". Baku: Nauka Publ., volume 67 (1), p. 128-132.
10. Mirzayev A.B., Mirzayev F.B. (2012) ecological problems of oil fields in Absheron Peninsula and Azerbaijan sector of Caspian Sea and ways of their elimination.Baku: Science, etc. 367.
11. Mozhaisky Yu.A., Tobratov S.A., Dibenok N.N., Popeochin Yu.P. Agroecology of technogenically polluted landscapes. / Magenta Publishing House, Smolensk, 2003, p. 382.
12. Oborin A.A., Ilarionov S.A., Nazarov A.V., Khmurchik V.T., Markarova M.Yu. Oil-contaminated biogeocenoses // Izvestiya RAS. Ural Branch, Perm, 2008, p. 501.
13. Orlov D.S.; Sukhanova, N.I.; Rozanova, M.S. (2001) Spectral Reflectivity of Soils and Their Components; MSU: Moscow, Russia, s.201.
14. Orlov D.S., Sadovnikova L.K.,Sukhanova N.I. Chemistry of soils, (2005) M. Higher School, p. 458.