



Chapter 05

Advanced Materials, Artificial Intelligence, and Sustainable Technologies for Energy and Environmental Engineering

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Environmental problems arising from oil extraction

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ABSTRACT

The increase in air pollution and wastewater problems has recently been considered one of the serious factors in the pollution of the water ecosystem and the environment. These factors are related to anthropogenic factors rather than natural factors. In this regard, it is important to study the issue of wastewater and air pollution. In general, people's attitude towards waste, combating waste and treating it correctly, waste technology, general knowledge about waste and such educational information has been increasing recently. It is very significant to educate people in this direction. It is known that industrial wastewater contains a sufficient amount of oil products. Since Azerbaijan is an oil country, industrial wastewater collected in the technological facilities and commodity parks of the Oil Refinery is necessarily subjected to mechanical treatment. These waters are then fed into chemical and biological treatment plants. Finally, industrial wastewater is treated in biological treatment plants (50 thousand m³/day). Treatment is carried out in several stages. Thus, wastewater is fed into the first and second stage aeration tanks. Here, wastewater is treated close to the established standards and is subjected to biological treatment. Oil extraction on land and at sea leads to additional environmental problems. In particular, the ecosystem of the Caspian Sea is severely damaged: its flora and fauna are seriously polluted. For this purpose, the analysis composition was determined based on the extraction of crude oil from the largest oil fields, 28 May and Oil Rocks (Neft Dashlari).

Keywords: 28 May; Oil Rocks; Ecosystem; Waste Issue; Environment; Petrochemical Industry.

INTRODUCTION

As mentioned, during the operation of the chemical and petrochemical industries, quite a variety of gases enter the air. At this time, hydrocarbon mixtures of various compositions – C_xH_y , and then CO_2 , N_xO_y , SO_2 , etc., are released into the air, which causes serious problems.^(1,2) The gases released from the process are fed to an incinerator for combustion at a temperature of 800-850°C, and then (after combustion) the gases are discharged into the atmosphere through a smokestack at a temperature of 280°C.⁽³⁾ As a result of the processes that occur, not only the water layer but also the air layer is polluted. Oil products form an emulsion with water (oil sludge), seriously polluting water bodies. Phenolic compounds remaining in wastewater are a real source of danger for the living layer of the aquatic ecosystem. As a result, industrial wastewater generally creates serious problems in the environment.⁽⁴⁾ During the generation, storage, and processing of oil sludge, harmful substances are released into the atmosphere, and deep purification of industrial wastewater becomes difficult. Such waters cause serious environmental issues in all ecosystems: the atmosphere, hydrosphere, and lithosphere.

Due to the corrosion of steel technological equipment in the oil and gas and oil refining

industries, serious fires and explosions occur, which pollute the air, water, and soil ecosystems in those areas. It is precisely because of these environmental problems that the emergence of dangerous problems in oil and gas, oil refining, and petrochemical industries has been prevented as a result of the commissioning of new technological facilities over the past 50 years. In some cases, such issues cannot be avoided. In our modern era, important measures are constantly being taken to ensure safety in these industries in accordance with known environmental standards. In addition, measures are also being taken in the main directions of scientific and technical development to prevent processes that cause air pollution in oil production and oil refining enterprises. Improving and implementing automation is very important for conducting such processes and organizing environmental control.

Automatic control, which plays an important role in production management, environmental control, implementation of technological processes and preparation of economic reports, is currently gaining wide popularity. In such systems, the following requirements are mainly implemented:

1. Automation of technological operations in the process.
2. Regulation of energy carriers.
3. Automation of control over the release of harmful substances into the environment.
4. Automatic elimination of emergency situations.
5. Providing emergency warning in the event of a fire in production, as well as in the event of a dangerous or stressful situation.
6. Ensuring that technological equipment meets environmental and technical standards.

In our modern era, in connection with the development of scientific and technical progress, there are six main functions of automatic production control:

1. Regulation and regulation of processes.
2. Transmission and delivery of information.
3. Full organization of the protection system.
4. Regulation and improvement of the parameters of all technological processes.
5. Optimization of flexible modes, if necessary.
6. Organization of a system for obtaining and managing information that fully meets the production characteristics of the oil refining industry and meets the requirements.

The use of automation systems in the oil production and refining process, as well as the implementation of new facilities in accordance with modern technologies and, above all, the selection of environmentally optimal options, leads to a several-fold reduction in environmental problems arising in the oil refining process.

METHOD

The physical and chemical parameters of crude oil were carried out in the central laboratory of the Oil Refinery named H.Aliyev. Part of the analyses were carried out in the Caspian Ecological Laboratory. So compositional analysis of crude oils taken from 28 May and Oil Rocks was carried out on an Agilent 6890N GC-MSD gas chromatograph device.

RESULTS AND DISCUSSION

Recently, the oil refining industry has been highly valued economically in the world. During the extraction of oil as a raw material, gaseous hydrocarbons, in some cases hydrogen sulfide, SO₂ and other gases, as well as produced water are produced along with it. Mechanical impurities

contained in the oil: sand, clay, soil, salts, and then oily waters in the form of emulsions are also formed in the process. The produced water formed during the extraction of oil, as well as the presence of emulsions and mechanical impurities in the oil, cause environmental problems.

The process of cleaning oil from water is not easy. The cleaning process is complicated due to the fact that oil forms an emulsion with water. Despite the use of various adsorbents for this purpose, complete cleaning is not possible. There is a sufficient amount of scientific work on cleaning oil layers from water using industrially important adsorbents. We have also studied the sorption of oil collected on the water surface using bio-absorbents - oils of natural origin in laboratory conditions.⁽⁵⁾ However, the treatment of high-tonnage industrial wastewater by sorption is not efficient in terms of time and economic aspects.

During the purification of oil from water and mechanical impurities, the amount of oil in industrial wastewater containing a large amount of oil products is 1000-1500 mg/l. This leads to the formation of highly emulsified mixtures in the wastewater obtained during the initial purification of oil. Their separation and purification from water become major environmental problems.

When oil and oil products are cleaned of mechanical impurities, a large amount of impurities settles and accumulates at the bottom of oil storage tanks. Also, during the purification of oil from water, oil-sludge waste contained in industrial wastewater accumulates in the sewage system, at the bottom of treatment facilities and tanks. These substances are classified as class III hazardous substances. Since industrial waste is a third type of pollutant, it is considered moderately hazardous, but it is a source of serious danger to the living world.

Oil-sludge mixture is one of the main causes of environmental problems during the storage, purification, and transportation of oil as raw material. Thus, during the cleaning, storage, and processing of oil-sludge waste, a large amount of harmful substances are released into the atmosphere. At the same time, they become sources that create conditions for the pollution of water bodies and soil. Also, during the production of oil, its purification from water and mechanical impurities is carried out using special devices. A large amount of various hydrocarbons enters the atmosphere from the tanks where oil is stored during the day. Therefore, the use of special devices, furnaces, tanks, and separator devices for separation from gas is one of the main conditions during the production, storage, and purification processes of oil.

During the primary processing, extraction, purification, storage, and transportation of oil, harmful substances are continuously released into the environment. The release of gaseous substances C_xH_y (C_1-C_4) and liquid petroleum hydrocarbons into the atmosphere causes pollution of the air, water, and soil environment and the emergence of ecological problems. In particular, the problem of pollution of aquatic ecosystems occurs, the cleaning of which takes a long time.⁽⁶⁾

Even when the industrial wastewater obtained during the production, refining, and storage of oil is treated at the required level: in accordance with environmental standards, many harmful substances are contained in the water. The air is polluted when petroleum hydrocarbons, other organic compounds, hydrogen sulfide (H_2S) and substances harmful to the air layer are released into the atmosphere. In addition, water bodies are polluted as a result of the incomplete deep cleaning of other harmful substances contained in the water - oil emulsions, phenol and its derivatives, small-sized mechanical mixtures, oil sludge and other substances.

When oil and oil products prepared as commodity raw materials are loaded onto railway

platforms, seaports, and special ships, petroleum hydrocarbons evaporate and pollute the atmosphere. In many cases, during the transportation of oil and oil products under high pressure, large-diameter steel pipelines fail due to corrosion, which leads to long-term environmental problems as a result of their leakage into the soil and spillage into water bodies. Depending on the composition and properties of the soil, pollution occurs at depths of tens of meters. This, in turn, penetrates the upper and deeper layers of the soil, along with groundwater and surface rainwater, depending on the relief, causing its pollution. As a result, excessive damage and toxic effects occur to living organisms in water bodies and soil. These situations lead to the emergence of ecological issues, and the cleaning of ecosystems requires a long time. Classical methods are usually used for cleaning. Also, as a result of accidents during the transportation of oil products by water transport, railways, pipelines and special tankers, pollution of water bodies, soil and air occurs, and ecological problems arise from time to time.

As a result of the conducted research, it was determined that 5-10 % of harmful substances released into the atmosphere in tanks where oil is stored as raw material occur at oil filling platforms. For the shipment of oil products as export commodities in tanks by water, by rail and by auto-sterns, a large amount of volatile hydrocarbons enter the atmosphere at filling points. That is why, in the oil and oil refining industry, one of the main conditions is that the technological temperature is normal when filling raw materials and oil products from tanks to platforms. Since filling raw materials and oil products at very high temperatures is environmentally dangerous, it is normalized to carry out it at low temperatures. In addition, since it is very difficult to reduce the viscosity of products that require special heating, that is, transport at temperatures close to freezing point, additional heating is required when filling these oil products or high-paraffin oils. Only after this, their filling is carried out on platforms. Also, due to changes in meteorological conditions, the operating mode of production in oil product filling areas is changed. This is mainly applied in these areas to prevent the additional release of harmful substances and gaseous hydrocarbons into the atmosphere, that is, the creation of additional environmental problems. Regardless of the type, oil-contaminated waste is generated during the cleaning of areas contaminated with these products at oil and oil product filling points. Waste is usually in liquid form. After purification, waste mixtures of oil and oil products are returned to production. At this time, pollution of water, air, and soil is undeniable. That is why, as in other production areas, there should be an acceptable concentration limit (ACL) for harmful substances emitted into the air from filling platforms where oil and oil products are stored and transported as export commodities. For this, a regulatory and ecological technical document is being prepared. Reducing environmental issues during the primary and subsequent oil refining processes mainly depends on the improvement of technological equipment and processes. In the oil industry, the use of liquid fuels, which are the main energy carriers: fuel oil, solar oil, and natural gas, is important, as well as the organization of the efficient use of electricity.

Over the past 30-40 years, as in developed countries of the world, the volume of industrial wastewater of various compositions in oil production and petrochemical production areas has been reduced by millions of cubic meters per year and its discharge into the sea has been prevented, based on the operation of new technological facilities and the implementation of reconstruction and installation works in the oil industry of the Republic of Azerbaijan, as well as in the fields of oil production and petrochemical production. The amount of carbon and sulfur gases and nitrogen-containing compounds emitted into the atmosphere has been reduced tenfold. The processing of liquid and solid wastes, alkaline wastes, oil sludge, and the purification and neutralization of wastes of used slag (synthetic fertilizers made from oil waste) received in the oil and oil refining industry have been carried out.⁽⁷⁾

It is estimated that the productivity of vacuum distillate is two million tons/year. The following products are obtained during the processing of vacuum distillate according to the adopted technology:

- Obtaining high-octane components for gasoline fuel.
- Obtaining a catalytic cracking fraction purified with hydrogen (at 195-3500C).
- Obtaining a high-boiling fraction of the coking unit (above 4200C).
- Obtaining dry gas.

During the implementation of the mentioned technological processes, environmental problems arise depending on the course of the reactions. During the distillation of oil, depending on the boiling point, the oil is separated into fractions, and the oil refining products consist of the following:

- Liquid and gaseous fuels.
- Solvents.
- Lubricating oils.
- Solid and semi-solid mixtures of hydrocarbons (paraffin, petroleum jelly, etc.).
- Naphthenic or petroleum acids, their derivatives (sulfonic acids, fatty acids).
- Various hydrocarbons (ethylene, propylene, benzene, toluene).

Before being refined, oil undergoes a preparation stage. The preparation process ends with the separation and dehydration of gases. Gas separation occurs by reducing the pressure and oil movement speed in the devices. At this time, gases are separated from the oil by desorption. Dehydration is carried out through long-term clarification. Fuel oil is considered an important raw material during the process. It plays the role of raw material in boiler fuels and recycling processes. Gas oil, oil fraction and tar are obtained from the vacuum distillation of fuel oil. The oil fraction serves as a raw material for obtaining lubricating oils, coke, and bitumen. The tar remaining on the ground is used in the production of asphalt mixtures and bitumen production. The distillation process takes place in two main stages:

1. Heating to a high temperature (boiling).
2. Separation of the products from each other.

The main equipment for heating is furnaces used to heat raw materials and intermediate products, as well as various heat exchangers. The separation of products by distillation of oil is carried out in rectification columns. At temperatures above 4500C, destructive changes occur in hydrocarbon molecules. Hydrocarbons with a large molecular mass are broken down into molecules with a smaller mass. This process is called cracking. During cracking, the following processes occur:

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The main equipment for heating is furnaces used to heat raw materials and intermediate

products, as well as various heat exchangers. The separation of products by distillation of oil is carried out in rectification columns. At temperatures above 450°C, destructive changes occur in hydrocarbon molecules. Hydrocarbons with a large molecular mass are broken down into molecules with a smaller mass. This process is called cracking. During cracking, the following processes occur:

1. Decompositions involving the cleavage of the C-C bond.
2. Dehydrogenation processes involving the cleavage of the C-H bond.
3. Isomerization processes.
4. Polymerization, cyclization, and other reactions.

The first two types of reactions are endothermic. The subsequent reactions are exothermic, and the starting materials for them are the products of the first two reactions. The decomposition of paraffin hydrocarbons occurs by a radical mechanism. The mechanism of their decomposition is determined by the bond energy between the carbon and hydrogen atoms in the primary hydrocarbons. Based on the bond energies, it can be noted that paraffin hydrocarbons are less thermally stable. These substances decompose at temperatures above 425-450°C, and the reactions under consideration occur by a chain mechanism.

Naphthenic hydrocarbons are more stable than paraffinic hydrocarbons. Therefore, they are destroyed at higher temperatures and dehydrogenated at temperatures above 500°C to form aromatic hydrocarbons. The unsaturated hydrocarbons formed during the initial reactions have a higher reactivity and easily undergo various transformations. The final product of the decomposition consists of low molecular weight saturated and unsaturated hydrocarbons. Naphthenic acids give crude oil its acidity. This quantity is measured in milligrams (mg) of potassium hydroxide required to neutralize one gram of oil. The acidity of crude oil is neutralized by adding NaOH.

Phenol and its compounds are observed in water only as a result of industrial effluents. The toxicity of phenol is due to the formation of stable chlorine-containing phenols during chlorination. These substances give water a special taste. Phenol and its compounds are found in high quantities in the spent solution after alkaline cleaning of oil. Since phenol is highly soluble in water, its purification is also very difficult. Therefore, it is more expedient to carry out the decomposition of phenol biologically. The speed and completeness of the process depends on the composition of the wastewater. When processing technological water containing 2,5 g/l of phenol, 95 % of phenol can be removed.

As we know, hydrocarbons constitute the main part of gas emissions in terms of quantity. The main method for cleaning gas emissions from organic substances is the combustion of the mixture at a temperature of 800-1000°C. The disadvantage of this method is associated with a large amount of fuel consumption and high material cost, which is economically disadvantageous. Recently, catalytic cleaning methods carried out at lower temperatures (600-700°C) have become widespread. These methods are based on the oxidation or reduction of organic substances in the gas mixture in the presence of a catalyst (e.g., platinum (Pt)). In this case, the catalysts should not be poisoned by sulfur compounds. These requirements are met by platinum catalysts, which accelerate various transformation reactions of organic substances in oxidizing and reducing environments. Therefore, platinum (Pt) is widely used. However, Pt is a very valuable metal. In this regard, other metal and non-metal oxides (Ni, Cu, Cr, Mn), which are cheaper than platinum metal, are also used.

A large amount of wastewater with various compositions is generated from the catalytic cracking process at the H. Aliyev Oil Refinery.^(8,9,10) The oil desalination unit provides its distillation. During the oil refining process, 0,3-0,5 % water containing 150-300 mg/l of salt enters the plants, the norm is 20-40 mg-eq/l of salt and 0,1-0,2 %. Therefore, before oil is refined, water and inorganic substances (salts) contained in it must be removed. In the desalination process, the oil is initially washed with soft water, as a result of which the salt content in the oil decreases from 300 to 10-20 mg/l, and the water content from 0,4 to 0,15-0,2 %. The wastewater is black due to the presence of colloidal particles and corrosion products. The volume of water used for desalination is 5-6 % of the total volume of refined oil.

Environmental problems also arise during the catalytic reforming process. Many reactions take place during this process:

- Conversion of olefins to alkanes.
- Desulfurization.
- Oxygen removal.
- Denitration-nitrogen removal.
- Separation of halogenated compounds.
- Metal separation.

Methods of neutralizing waste generated as a result of the processes taking place in the plant are one of the most important environmental issues. Light-colored gasoline, kerosene and diesel fractions (distillates) obtained during the primary processing of oil are subsequently subjected to many technological processes. When the gasoline fraction is obtained in the technological plant, it is passed through a NaOH solution. This method removes RSH, HCl, SO₂, H₂S, etc. substances from the gasoline composition, while free hydrogen sulfide and other harmful gases in its composition react with NaOH and turn into salts of NaCl, Na₂S, Na₂SO₃, etc. The salts obtained are generally discharged into the sewage system, where industrial wastewater is discharged. Na₂S is considered one of the most harmful substances in the composition of these salts. The salts formed in the production wastewater obtained during the initial cleaning and washing of the gasoline fraction from the alkaline solution are constantly discharged into water bodies, causing pollution with harmful Na₂S salt, which has a negative ecological impact on the fauna and flora of water bodies. Finally, the gasoline fraction undergoes technological processes to increase the octane number in accordance with the required standards and prepare a commodity product.

Since the late 1960s, alkaline wastes obtained as a result of production processes have been treated with sulfuric acid, during which naphthenic acids are obtained.



The obtained naphthenic acids are separated into fractions. These acids are used in the preparation of additives of particular importance in the petrochemical industry and other important chemical preparations for the national economy. During the purification of kerosene and diesel fractions with alkaline solutions, the organic compounds contained in these fractions are released into the atmosphere. At the same time, during technological processes, large volumes of oil waste and mixtures in the form of emulsions are obtained. As a result, environmental problems arise in the process of purification of industrial wastewater, which cause pollution of other water bodies.⁽¹¹⁾

Thus, during the technological processes carried out to obtain commodity products of

gasoline, kerosene and diesel fuels, in addition to the organic and other inorganic compounds contained in those fractions, during the combustion of fuels in technological processes, a large amount of C_xH_y , CO_2 , N_xO_y , H_2S , sulfur gases and other harmful compounds are also released into the atmosphere, these gases directly and indirectly participate in the greenhouse effect.⁽¹²⁾

Naphthenic acids account for 60-70 % of industrial waste. They contain phenolic compounds, RSH , H_2S , polycyclic aromatic hydrocarbons, Zn , Cd and other heavy metals. These compounds also cause serious problems from an ecological point of view.

In the oil refining industry, lubricating oils are obtained from fuel oil. The fuel oil fraction obtained from the primary processing of oil is heated again in technological furnaces and distilled in vacuum columns, and finally lubricating oils are obtained. Based on lubricating oils, primary oil distillates are subjected to technological operations and various branded commercial products are prepared. The fuel oil obtained in AVT units is distilled again in vacuum. In Azerbaijan, the production of various oil distillates by distillation of fuel oil in vacuum is carried out in special units. This process, in turn, causes extreme environmental problems. During these technological processes, a barometer-condenser system is used to create a vacuum in the columns. This requires a large amount of seawater. At this time, emulsion production wastewater containing a significant amount of a mixture of petroleum products is obtained. The purification of these waters is extremely difficult, and although some of these purified industrial wastewaters are reused in systems, they cause pollution of water sources and the air environment. One of the main reasons for the emergence of environmental problems during the production of oils in AVT facilities is the use of large amounts of liquid fuel oil in technological furnaces. During the combustion of fuel oil, harmful gases of various organic and inorganic origin are released into the atmosphere. These gases are of particular importance in the formation of greenhouse gases.

In AVT units, the fuel oil fraction is vacuum distilled. At this time, various brands of oil distillates are obtained - light, medium and heavy oil distillates. For the preparation of these oils as a full-fledged commodity product, the acid-alkali method, contact method and hydrogenation of oils are used. As a result, petroleum oils of various properties and qualities are obtained. Various wastes are obtained in the process, for example; acid tar, mineral oils. Acid tar is dark black, has a soft, sharp smell similar to sulfuric acid. Mineral oils contain toxic heavy metals and mainly polycyclic aromatic hydrocarbons.

Thus, the neutralization of industrial wastes such as acid tar and “processed gum,” which are formed during the aforementioned technological processes and cause significant environmental pollution, is carried out.⁽¹³⁾ Since 1970, the production of petroleum oils has been carried out. For this, the organic compounds contained in oil distillates and which negatively affect the quality of oils are cleaned, which also causes environmental problems.⁽¹⁴⁾

Since the early 1980s, the use of new technological facilities has prevented the discharge of acidic production waters obtained during the production of petroleum oils into the Caspian Sea. The amount of harmful substances emitted into the atmosphere has also been reduced by thousands of tons.

Currently, the process of hydrogen purification of oils is being carried out. In these facilities, mainly many petroleum oils are passed through technological furnaces and, using special reactor devices, catalysts and a hydrogen gas flow, the harmful substances contained in the oils, mainly sulfur compounds, are cleaned. The quality of the oils is brought to the required level. Certain

environmental problems also arise in these facilities. Thus, the formation of waste gases, mainly hydrogen sulfide, from the separation of harmful substances contained in oil distillates during the technological process leads to negative impacts on the environment.

In order to minimize environmental problems, waste gases are captured with ethanolamine in special devices, which prevents the direct release of hydrogen sulfide and other inorganic compounds into the air. Finally, these gas mixtures are burned in a production flare farm and completely neutralized. Using this method, the release of hydrogen sulfide and other harmful substances into the air during technological processes is prevented.

Since 2000, as a result of the commissioning of the new facility, the amount of both wastewater and gaseous harmful substances obtained during the production process has decreased tenfold compared to the old bitumen production. Due to the high amount of harmful substances obtained during bitumen production and the presence of some of them in the form of aerosols in the air, harmful substances cause pollution of the atmosphere, water, and soil ecosystem. The new bitumen facility is installed in accordance with European standards, and the waste obtained in gaseous form during the operation of the facility is neutralized in special furnaces and released into the atmosphere. Such gases are burned in special technological furnaces at a temperature of 800°C for neutralization. At the same time, gases that cannot be neutralized into the atmosphere are also released into the atmosphere.⁽¹⁵⁾ Based on the studies, the amount of harmful substances released into the atmosphere from the smoke pipe of that furnace was calculated (table 1).

Table 1. Annual TLV limit for harmful substances		
Name of the harmful substance	Amount of harmful substances produced t/year	LVD of the harmful substance in the working area (mg/m ³)
C _x H _y	28,032	300
H ₂ S	0,223	10
SO ₂	30,850	10
CO	17,291	20
NO ₂	0,257	2
NO	2,138	30
Toz	0,285	10
RSH	0109	-
C ₆ H ₅ OH	0,006	0,3

Even today, the bitumen production facility in Azerbaijan, despite meeting the most modern international standards, is one of the sources of environmental pollution. The accumulation of oil sludge (a mixture of oil, sand, clay, and soil) obtained during the treatment of industrial wastewater at the bottom of the treatment facilities and its subsequent treatment causes environmental problems. Thus, serious pollution of the soil and water ecosystem occurs during oil extraction.⁽¹⁶⁾ In particular, during oil extraction on land, soil degradation occurs. Unlike the less dynamic aquatic ecosystem, the soil is a slow-recovering system, requiring hundreds of years to recover. The organisms living in the aquatic ecosystem suffer serious damage. Despite the existence of various methods for wastewater treatment,⁽¹⁷⁾ these situations have serious consequences for flora and fauna, as global treatment is not implemented.

Table 2 shows some physicochemical parameters of crude oil taken from the two areas.

Table 2. Some physicochemical parameters of crude oil taken from different areas					
Types of oil	Chlorinated salts (mg/l)	Sulfur(%)	Tar(%)	Ash(%)	Paraffin(%)
Oil Rocks	39,2	0,21	13,40	0,0126	1,65
28 May	31,7	0,27	12,80	0,0207	1,27

We conducted chemical analysis of crude oil taken from some areas (table 3).^(18,19,20,21,22) Chromatographic analyses were performed to determine which organic hydrocarbons were present in the crude oil (figure 1, figure 2).

Table 3. Analysis of crude oil taken from two locations in the Oil Rocks				
Alkanes	Oil Rocks (I station)		Oil Rocks (II station)	
	Area	Ratio %	Area	Ratio %
nC 10	28518	1,02	27851	0,99
nC 11	27630	0,99	27647	0,98
nC 12	28438	1,02	28369	1,00
nC 13	27575	0,99	26380	0,93
nC 14	21991	0,79	21159	0,75
nC 15	17601	0,63	12477	0,44
nC 16	6091	0,22	5972	0,21
nC 17	5078	0,18	5190	0,18
Pristan	19617	0,70	18677	0,66
nC 18	2705	0,10	2673	0,09
Phytane	15656	0,56	15243	0,54
Total amount of hydrocarbons	2799090	100	2826610	100
Area ratio of isoprenoid hydrocarbons				
17/pristan	0,259		0,278	
18/phytane	0,173		0,175	
Pr/F	1,253		1,225	

Although crude oil is richer in alkanes and naphthenes (C_{10} - C_{18} alkanes), a certain amount of aromatic hydrocarbons is formed as a result of chemical transformations in the oil.^(22,23,24,25,26) Therefore, various processes in the Oil Refinery (OR) cause serious pollution of the environment: air and water.

Car engines running on petroleum fractions emit sulfur dioxide into the environment, polluting the atmosphere and thereby increasing greenhouse gases in the air. During the extraction of crude oil, as well as its combustion in chemical processes, some of the substances such as CO_2 , SO_2 , HCl , Cl_2 , H_2S , C_xH_y , NO_x are released into the air in the form of aerosols and spread widely in the air up to 100 km away, which ultimately leads to long-term environmental problems in

water, air and soil ecosystems.

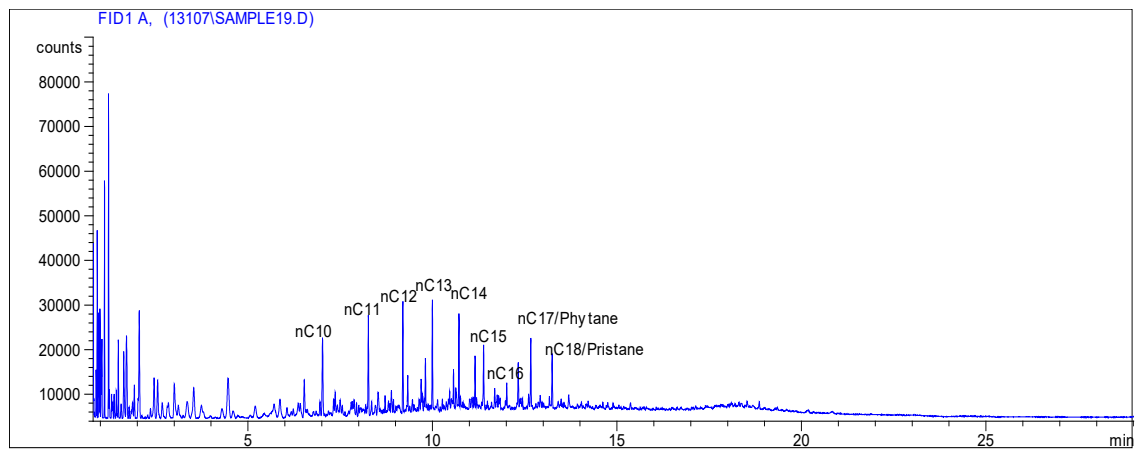


Figure 1. General view of the chromatogram of crude oil taken from Oil Rocks (Station I)

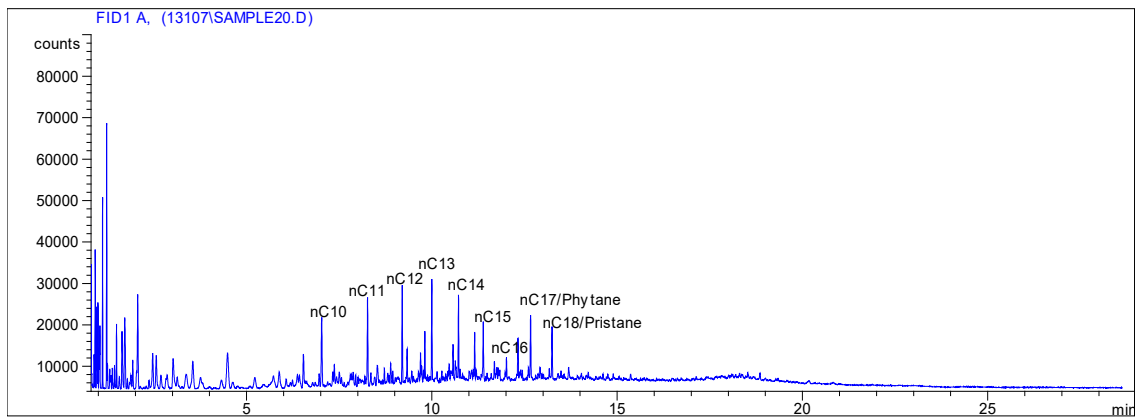


Figure 2. General view of the chromatogram of crude oil taken from Oil Rocks (Station II)

Table 4. Composition of crude oils taken from the 28 May area				
Substances	28 May (I)		28 May (II)	
Alkanes	Area	Ratio %	Area	Ratio %
nC 10	50149	0,92	0,00	0,00
nC 11	48948	0,90	0,00	0,00
nC 12	51185	0,94	9939	0,22
nC 13	49362	0,91	10915	0,25
nC 14	40799	0,75	13746	0,31
nC 15	32639	0,60	19227	0,44
nC 16	10899	0,20	18128	0,41
nC 17	5133	0,09	669	0,02
Pristan	33157	0,61	31041	0,70
nC 18	3848	0,07	678	0,02

Phytane	31326	0,58	22586	0,51
Total amount of hydrocarbons	5430940	100	4417970	100
17/pristan(Pr)	0,259	0,155		0,022
18/phytane(F)	0,173	0,123		0,030
Pr/F	1,253	1,058		1,374

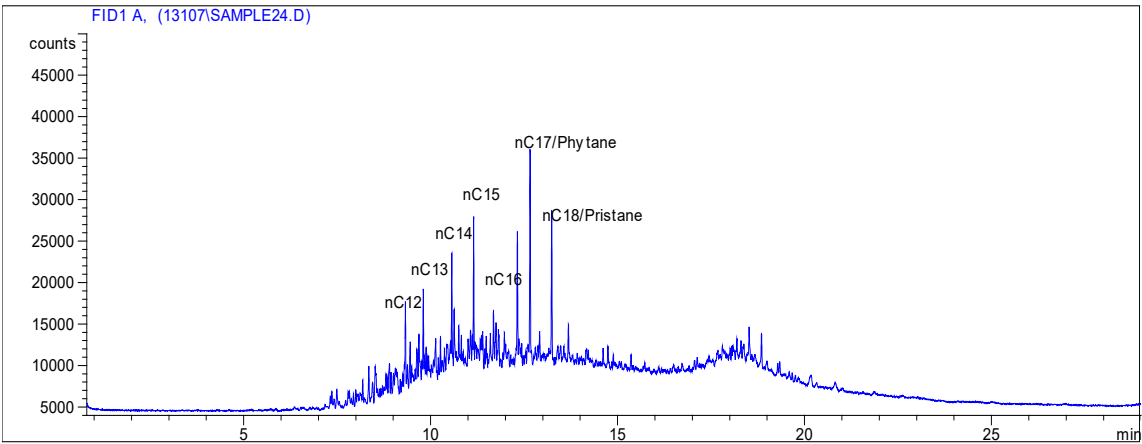


Figure 3. General view of the chromatogram of crude oil taken from the 28 May area (Station I)

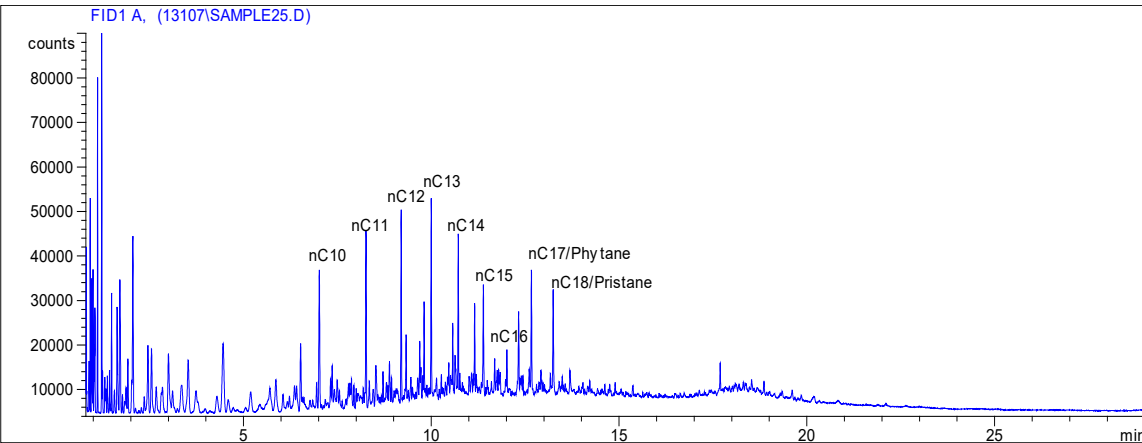


Figure 4. General view of the chromatogram of crude oil taken from the 28 May area (Station II)

CONCLUSIONS

Currently, in connection with the development of industry and technical progress, the problem of pollution of the atmosphere and hydrosphere is one of the global environmental problems. In this regard, based on the conducted research, new perspective directions in solving the problem of environmental pollution have been analyzed. The processes taking place in various areas of the Oil Refinery, production processes taking place in the catalytic cracking area cause pollution of the environment, especially with organic toxic substances - polycyclic aromatic hydrocarbons. Crude oil was taken from certain areas of the Caspian Sea, in our case from Neft Dashlari and 28 May, determined, and its impact on the environment was ecologically assessed.

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FINANCING

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CONFLICT OF INTEREST

None.

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