DEVELOPMENT OF THE TECHNOLOGICAL SCHEME OF WASTEWATER TREATMENT FROM OIL

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Abstract: The article considers the problem of realization of the cognitive and communicative approach in language education. The concept of a cognitive and communicative approach in the language education of students, which is based on the integration of cognitive and communicative approaches, has been given. In linguodidactics, the emphasis was primarily on language and communication aspects, but with the development of cognitive science, the priority of the communicative approach has been replaced by a cognitive and communicative approach in recent decades. In teaching languages, the problem of revealing the connection between communicative and cognitive approaches to the organization of linguistic education became relevant because essential characteristics of the cognitive process are predetermined by the integrative study of language as a means of learning, cognition and as a means of communication. This relationship of cognitive and communicative aspects in linguodidactics is based on the integration of the two main functions of the human language: communicative and cognitive.

Keywords: cognitive and communicative approach, language education, methodology, didactics.

1 Introduction

One of the most important tasks of the fuel and energy complex is to increase the reserves of hydrocarbons and the development of new fields. During oil production, the formation of stable oil emulsions occurs, which leads to large losses of oil, and pollution of wastewater. Watering out of productive layers of oil fields causes serious complications in the extraction, gathering, and preparation of oil associated with the formation of oil-water emulsions.

In the process of extraction in many fields, the formation water, with its pressure, displaces oil from porous rock to the wells. (1-2) Depending on the properties of the layers, the rate of withdrawal of oil, its viscosity, etc., the water flow in the well with the oil may be different. Usually, in the initial extraction period, anhydrous or low-water cut oil is extracted at a new field, but over time, the water cut of the oil increases and reaches 80–90% in old production fields, forming stable oil emulsions. (3-4)

The increase in the volume of oil production is increasingly provided by the involvement in the development of fields with hard-to-recover oil reserves. Whereby, the unit weight of heavy, high-viscosity oil production in the total volume of oil extraction increases. The difficulties of developing new fields, increasing the efficiency of wells, require the development of new technologies.

The most important problem in the extraction of heavy and high-mineralized oil is its water cut, which leads to a decrease in the oil recovery factor. In this regard, the solution to the above problem is devoted to many scientists' researches.

Groundwater on the territory of the field is opened by wells at a depth of 3-8 meters and is confined to lower quaternary and recent sediments. The water-bearing materials are sand streaks with a thickness from 4-6 m to 25-30 m, poorly continuous to the strike and occurring at different depths. The depth of bedding of the sand streaks increases in the direction towards the intercupolar areas from 50-97 m to 400-500 m and more. In terms of chemical composition and dynamics, the water indices are rather monotonous: highly mineralized up to 170.2 g/l - chloride-sulphated and sodium. (5-6)

A network of observation wells was created at the studied fields, consisting of 4 monitoring wells.

In accordance with the environmental control program, sample drawings were taken for carrying out the overall chemical composition and the presence of pollutants, including the following components: pH, dry residue, phenols, ammonium ions, petroleum products, nitrites, nitrates, copper, zinc, lead, cadmium, COD, synthetic surfactant, BOD5, hydrogen sulfide.

Laboratory analysis showed that groundwater is saline, mineralized. Due to the high salinity, these waters do not belong to the sources of drinking water supply. The increased groundwater salinity is due to natural factors.

Wastewater of fields is characterized by different mineralization and chemical composition. The salinity of water reaches 3.6–29.3 g/dm3, predominantly of chlorine-calcium and sodium sulphate composition. The amount of salts reaches 200-350 g/l, the content of chlorine ion - 37.40 g/l, sulfates - 3.8 g/l. With an increase in mineralization, sodium salts increase from 58 to 72%, the number of sulfates, alkalinity, and pH of the medium decrease. (7)

It was established that the oil content in the wastewater exceeds the MPC of 0.4 mg/dm3 by 3-4 or even more times. The content of synthetic surfactants is 0.65 mg/dm3. Very weak contamination up to 0.9 mg/dm3 is noted in the wells of 3, 5, 16, 20, 21. By the remaining samples, an excess of 3-6 times with an average value of 2.8 times. Biochemical oxygen demand (BOD) is the oxygen consumption on the neutralization (oxidation-reduction) of living microorganisms. The oxygen consumption is predominantly within the norm of 3 mg O2/dm3 and only by a few samples, exceedance of statutory criteria by 3-4 times is observed.

Chemical oxygen consumption (COD) - oxygen consumption for chemical dissolution of pollutants (petroleum products, salts of heavy metals, etc.). A certain consumption was 450 mg O2/dm3, which indicates a high degree of contamination.

The study of wastewater by the method of infrared spectroscopy (IR) showed that the main pollutant component is petroleum hydrocarbons. In addition, in small quantities (up to 3-5% of the total content), the presence of oxidized compounds and oxygenated substances was noted. Experimental studies of the treatment process were carried out in a laboratory setup.

In the laboratory conditions conducted research on the selection of binding materials and found the optimal ratio and concentration of binding additives. The optimal conditions for drying the granules and their strength was determined by the known method for agglomerates.

Experimental batches of granules of sorbents of different diameters for laboratory and integrated experiments on the sorption of oil were well-established.

Work was carried out to determine the optimal technological conditions and parameters of the process of wastewater treatment from oil deposits with composite materials and the influence of various factors on the process was investigated. In the course of works carried out, the influence of size (0.8-4.0 cm), shape (in the form of a tablet and a small ball), thickness of the granules (1.0-5.0 mm) and drying temperature (70-110°C) of well-established samples of sorbents KM-1a and GKM on the process of oil sorption. Experimental data showed that KM-1a and GCM preparations made in the form of tablets have the best sorption activity. For example, by the concentration of oil in water is 250 mg/l, for 30 minutes of the process by using a sorbent of 1.0 cm in size in the form of a tablet, the degree of water treatment from oil was 80.21 and 80.73%, and in the form of a small ball - 42, 94 and 41.09%.

In this regard, further work was carried out using sorbents KM-1a and GKM of the specified form.

2 Materials and Methods

Today, oil and oil products are one of the main types of wastewater pollution. Sources of oil and its products are oil companies, the delivery of petroleum products, their storage, processing, and use. Separate water objects contain more than a hundred cubic meters of oil pollution. (8) Built in the middle of the last century, storage facilities for the oil refining industry today are sources of pollution.

UNESCO called petroleum products the most dangerous water pollutant. They are dissolved in some liquids, and on water, they most often form a surface insoluble layer.

In the protection of nature should be guided by the principles:

- the amount of non-regenerating natural resources should be used to avoid their complete exhaustion;
- waste from the oil industry must be in a safe amount and form for wildlife. (9)

Reservoirs are not only the main source of fresh water for humans but also the living environment of many living organisms. Water makes a complete cycle of the circulation, which is important for human life.

Oil is an unrestorable natural resource. Its extraction, transportation, and processing are very harmful to the environment. The problem of oil pollution today is the most important nature of the defenders.

The question should be solved from all sides: economics, politics, and law. The technical problem can be solved with the help of individual tasks for each enterprise related to oil.

A couple of years ago it was believed that oil could not be dissolved in water. Today it is known that many products of the petroleum industry under the influence of certain factors dissolve. With the direct interaction of water and oil over time, many components become part of the composition of water. For example, at 2 hours of joint storing, the concentration of oil is 0.2 mg/l, with an increase in the period of 60 times leads to a sevenfold increase. If we consider gasoline, then the methylene and methyl groups should be taken into account. So for A76, with an increase in the duration from 2 hours to 120, the content of gasoline in water will increase from 1.4 to 11.9 mg/l, and for aromatic carbons from 2.6 to 34 mg/l. (10-11)

One of the most common man-made types of water pollution, as a result of which it cannot only be drunk, but also often used for industrial needs - these are impurities of various petroleum products.

It includes fuel oil impurities, kerosene pollution, gasoline pollution, impurities of various petroleum oils. All of the above compounds are highly toxic, which is why they are extremely dangerous for the ecological state of the environment. These oil impurities are brought into the soil along with drains, and already from it are spread through natural and artificial reservoirs, on which water intakes are installed, supplying civil and industrial facilities. (11)

Oily waste is an effluent polluted with petroleum products, as well as suspended solids and in some cases specific compounds.

In wastewater, petroleum products can be in a free, bound and dissolved state. Coarse, free petroleum products are removed as a result of thickening. For the removal of finely divided and adjacent petroleum products, flotation purification methods, electrocoagulation and electroflotation methods are traditionally used. As a result of these processes, oil products up to 20 mg/l remain in the water. Deeper treatment from finely divided, especially emulsified petroleum products up to 10 mg/l is achieved in the filtration processes. Removal of dissolved impurities up to 0.5-1 mg/l occurs at the stage of sorption purification. (12-14)

For the production of oil sorbents, a variety of raw materials are used. (15-18) By structural type, the sorbents are divided into fibrous and bulk-porous (with a closed or open pore structure). Fibrous materials are a system of thin filaments chaotically laid loosely distributed in space. As a rule, they have a spatially non-oriented structure that allows contamination to come into contact with a large surface per unit of time. In the process of absorbing oil, the fibers of the sorbents are able to move apart, creating a specific structure of the sorbent-oil, which, after collecting, gradually begins to contract under the action of gravity and drain out -25% of the collected oil product. (19-20)

Among the currently existing methods of cleaning oil-contaminated water the most effective are the following: mechanical, chemical and biological methods.

The essence of the technology of mechanical purification of water from petroleum products is that wastewater passes through several stages of filtration. At the same time, it undergoes a repeated process of settling in special equipment. This type of specialized equipment includes oil separators. In such cleaning systems of a mechanical type of action, special materials with a porous structure are used. These materials are used as water treatment filters. In this case, the principle of the system is based on the passage of oil-contaminated water through the pores of the filters, through which small water molecules pass further, while large molecules of oil, fuel oil or kerosene remain in the filter. Mechanical water purification is capable of purifying water only from about 60% of chemicals containing oil, therefore in most cases, this method is considered preparatory for the subsequent purification process. (21)

The essence of the chemical method of purifying water from petroleum products is to add special chemicals to the polluted water. In the process of interaction with polluted water, the molecules of these reagents are in contact with petroleum products, as a result of which a chemical reaction is formed. (22-23) As a result, petroleum products precipitate in the form of substances that cannot be dissolved. In most cases, surfactants are used as such chemicals or in other words reagents, as well as various oil-water emulsions. In addition, special adsorbents are quite effective, among which aluminum oxide has found wide application. Thanks to the chemical method of water purification, it is possible to achieve a sufficiently high degree of removal of oil products, the rate of which can approach the mark of 98%. (24)

Physico-chemical treatment methods characterize sorption as the absorption from the purified water by the sorbent of the solid consistency of harmful impurities that are present in it, including petroleum products. (25-26) Sorbents can be a variety of materials having a porous structure: peat, ash, silicate gel, and various types of active clays. Experts consider different types of activated carbon as the most effective sorbents.

This is due to the high rate of their porosity, as well as the large value of their specific surface. The porosity of this material varies from 60 to 70 percent, and its specific surface area (depending on what technology such coal is made) ranges from five hundred to one and a half thousand square meters per gram. (27-28)

The high degree of industrialization of modern society leads to the fact that in the course of their economic activities, a person causes significant damage to the ecology of his environment. In this regard, issues of environmental safety in general, and water purification from oil and petroleum products pollution are very important and relevant. (29-30).

3 Results and Discussion

It is established that an increase in the size of sorbents from 0.8 to 1.5 cm contributes to an increase in the degree of water treatment from oil, and a further increase in the size of the sorbent to 4.0 cm leads to a certain decrease in this indicator. For example, by the concentration of oil in water of 250 mg/l, for 30 minutes of the process, when using KM-1a sorbent with a size of 0.8 cm, the degree of water treatment from oil from the Zhylankabak deposit is 76.30%, under these conditions, when used, cm - 80.21%, 1.5 cm - 82.63%, 2.0 cm - 80.00%, 2.5 cm - 74.70%; 3.0 cm - 69.60; 3.5 cm - 67.70% and 4.0 cm - 64.50%. From the analysis of the obtained data, it follows that when composite materials with a size of 1.5 cm tablets are used as sorbents, maximum water treatment from oil is observed.

Analysis of the obtained data showed (Figure 1) that the thickness of sorbent tablets influences the oil treatment process. So, by the content of oil in water is 300 mg/l, for 30 minutes of the sorption process by using tablets of the KM-1a preparation of 1.5 cm in size at a thickness of 1.0 mm tablets the degree of water treatment from oil is 67.70%, and the use of tablets with a thickness of 2.0 mm, respectively - 78.00%, 3.0 mm - 88.33%, 4 mm - 86.64% and 5.0 mm - 82.30%.

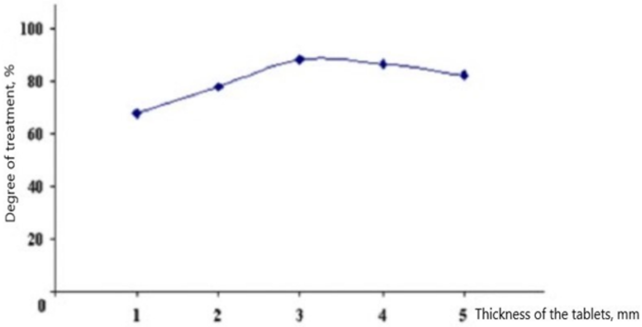

Figure 1. The Dependence of the Degree of Water Treatment on the Thickness of the Tablets of Composite Materials

The effect of the drying temperature (70-110°C) of well-established samples of sorbent KM-1a on the process of sorption of oil (Figure 2) was established. From the analysis of the data obtained, it follows that the degree of water treatment from oil decreases with an increase in the drying temperature of more than 90°C. So, the above conditions, when using a sorbent of 1.5 cm in size, dried at a temperature of 70°C, the degree of water treatment from oil is 82.63%, and at temperatures of 80, 90, 100 and 110°C, respectively, 85.30%, 87.44%, 86.25% and 84.30%. On the basis of the conducted research, the optimal conditions and parameters of the process of preparing sorbents from composite materials that are designed for cleaning wastewater from oil are determined: the form of the sorbent is a tablet, the size of the sorbent is 1.5 cm, the thickness of the tablets is 3.0 mm, the drying temperature of the sorbent is 90°C and drying time is 60 min. Experimental samples of KM-1a and GKM preparations were made in the form of tablets 1.5 cm in size and 3.0 mm thick, the drying temperature of the sorbent was 90°C, and the drying time was 60 minutes. Experimental samples of KM-1a and GKM preparations were produced in the form of tablets 1.5 cm in size and 3.0 mm thick, the made samples were dried in a drying stove at a temperature of 90°C for 60 minutes.

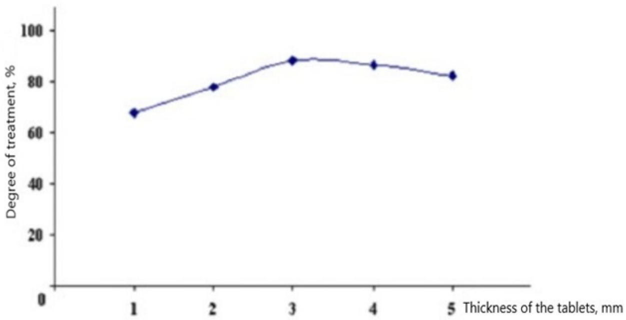

Figure 2. The Effect of Sorbent Drying Temperature on the Degree of Water Treatment From Oil With Composite Materials

The approbation of the assembled laboratory setup was carried out; during the tests, the conditions for water treatment from oil from the "Zhylankabak" field were determined. The process of sorption treatment of water was carried out in two versions: 1) using the KM-1a preparation; 2) using the GKM preparation.

According to the first variant: on the model set, there is established the influence of oil concentration (100-300 mg/l), temperature (20-60℃), time (5-60 min) and amount of sorbent (0.02-1.0 w.p.) on the wastewater treatment process of the "Zhylankabak" field (Atyrau Region).

Analysis of the data obtained (Table 1) shows that with an increase in the concentration of oil from 100 to 1000 mg/l, the degree of water treatment with KM-1a is 98.21% and 68.21%. It has been established that a further increase in the oil content does not contribute to an increase in the degree of water treatment. For example, when the concentration of oil in water is 3000 mg/l, the degree of water treatment from oil is 43.03%. The obtained results made it possible to determine the optimal ratio of the initial components of the oil from the "Zhylankabak" field and composite materials.

Table 1. The Effect of Oil Concentration on the Degree of Water Treatment (by m (KM-1a) - 0,5 w.p., t - 30 min, T- 20℃)

Oil concentrations, mg/l	Amount of a sorbed oil, g	Degree of treatment, %
100	0.0196	98.21
300	0.0568	94.64
500	0.0843	84.32

1000	0.1364	68.21
1100	0.1323	60.14
1500	0.1793	59.90
2000	0.2086	52.16
3000	0.2581	43.03

On the basis of experimental data, it was established that with an increase in the amount of sorbent KM-1a from 0.02 to 1.0 w.p. regardless of the process temperature, the degree of treatment of water from oil increases. For example, for 30 minutes of the process when the concentration of oil in water is 200 mg/l by using the KM-1a preparation in an amount of 0.02 w.p., the degree of water treatment is 27.42%, and by the amount of 1.0 w.p. - 98.03%.

Analysis of the infra-red spectrum showed that with an increase in the amount of sorbent KM-1a, the intensity of the absorption bands characteristic of oil from the "Zhylankabak" field increases. For example, the absorption bands of valence vibrations - CH2- and - CH3- groups of aliphatic molecules in the region of 2920.2855 cm-1, the deformation vibrations of the CH-groups at 1460-1455 cm-1, the deformation vibrations of the

OH-groups in the region of 1140.1100 cm-1 and valence vibrations of halogen derivatives of alkenes in the region of 670 and 600 cm-1 were found out. From the analysis of infrared spectroscopy, it follows that with an increase in the amount of the KM-1a preparation, the content of oil sorbed on the surface of the oil composite material increases.

It was established that with an increase in the duration of the sorption process from 5 to 60 min, the degree of water treatment increases from 66.10 to 95.70% (Figure 3). A further increase in the duration of the process does not lead to a noticeable increase in the efficiency of sorption; most of the oil is sorbed for 30 minutes.

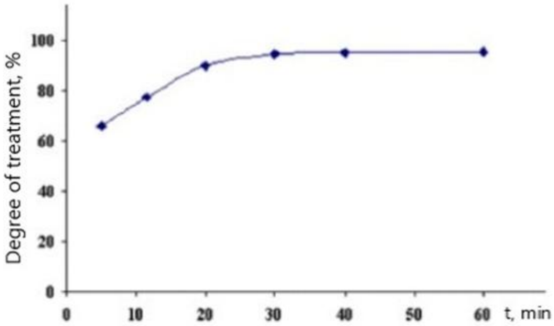

Figure 3. Dependence on the Degree of Water Treatment on time (Co- 300mg/l, m (KM-1a) – 0,5 m.p., T- 20°C)

It has been established that with an increase in the time of the sorption process, the intensity of the absorption bands of the sorbed oil from the "Zhylankabak" field increases. For example, in the infra-red spectrum of the samples obtained, absorption bands at 2924 and 2855 cm-1 were observed, which are characteristic of valence vibrations C-H- bonds in the methylene groups, absorption at 1604 cm-1 refer to planar vibrations of C=C- bonds of aromatic compounds, and in the region of 1457 and 1376 cm-1, the absorption bands of antisymmetric and symmetric deformation vibrations of C-H- bonds in the C-CH3- groups are manifested.

In the second variant, the dependence of the degree of water treatment on the concentration of oil (oil content in water 100-3000 mg/l) and the amount of sorbent (1.0-5 w.p.), temperature (20–80°C) and time (5-60 min) were established; as a sorbent, the GKM preparation was used in the form of tablets.

The obtained data showed (Figure 4) that with an increase in the concentration of oil from 100 to 3000 mg/l, the degree of water treatment decreases. So, when the content of oil in water is 100 mg/l at a process temperature of 20°C for 30 minutes, the sorption process by the amount of GKM sorbent is 1.0 w.p., the degree of treatment is 96,50%, and by oil content of 3000mg/l - 44,70%. Apparently, under these conditions, the pores of the GKM preparation are filled with oil, and its sorption capacity decreases. During the tests on the enlarged set, it was revealed that an increase in the amount of sorbent from 1.0 to 3.0 w.p. (Table 2) leads to an increase in the degree of water treatment from 93.60 to 98.60%, and with further increases in the amount of sorbent to 5.0 w.p., there is a slight increase in the degree of water treatment from oil from the "Zhylankabak" field. It follows that the optimal amount of the GKM preparation is 3.0 w.p.

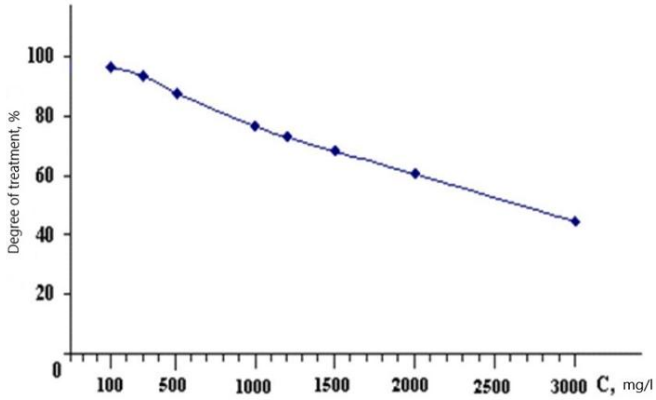

Figure 4. Dependence of the Degree of Water Treatment on the Concentration of Oil (m (GKM) - 1,0 m.p., t - 30 min, T - 20°C)

Table 2. Influence of the Amount of the GKM Preparation on the Process of Water Treatment from Oil (Co-300 mg/l, t - 30 min, T- 20°C)

Amount of GKM, m.p.	Amount of sorbed oil,g	Degree of treatment,%
1,0	0.0562	93.60
2,0	0.0576	96.03
3,0	0.0592	98.60
4,0	0.0593	98.71
5,0	0.0594	98.92

Experimental data show that increasing the temperature of the process of cleaning oil-polluted water from 20 to 80℃ leads to a slight increase in water treatment by the GKM preparation. So, at 20℃ for 30 minutes, the contact of the GKM preparation with contaminated oil (at an oil concentration in water - 200 mg/l), the degree of water treatment is 95.70%, and when the temperature rises to 80, the degree of water treatment reaches to 99.43%. From the analysis of the research results, it follows that most of the oil is sorbed at a temperature of 20-30.

Analysis of the data presented in Figure 5 shows that the degree of wastewater treatment from oil by the GKM preparation depends on the duration of the sorption process. For example, after 5 minutes of contact, the degree of water treatment from oil is 61.20%, and with a sorption duration of 10, 20, 30, 40 and 60 minutes, respectively, 73.0; 86.2; 93.6; 94.1 and 94.6%.

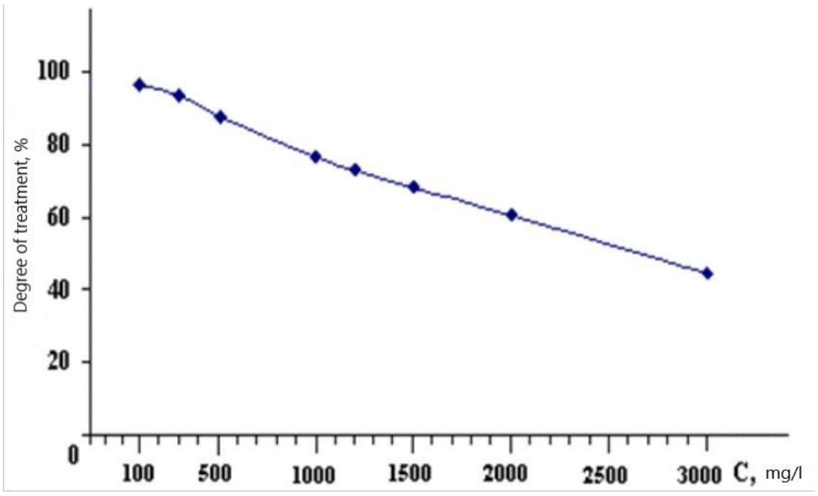

Figure 5. Dependence of the Degree of Water Treatment on Time (Co– 300mg/l, m (GKM)- 1,0 m.p., T- 20℃)

On the basis of the obtained results, it was established that the sorption process intensively proceeds within 30–40 min.

To achieve this goal were identified:

- the water cut of the productive layers of oil fields and wastewater pollution;
- viscosity, mineralization, and congelation of the extracted oil; and the following tasks are set:
- to investigate the physicochemical properties of composite materials to determine their effectiveness in the dehydration of oil and the sorption of oil-containing wastewater.
- theoretically and experimentally to develop an effective technology for the process of oil dehydration and the process of sorption of oil-containing wastewater using composite materials.

3.1 The degree of readiness of the problem
Researches from Russia, the USA, Canada, Japan, and others are engaged in research into the physicochemical and technological patterns of the processes of oil dehydration and sorption of oil-containing wastewater for oil fields. Firms that develop and supply various composite materials and other demulsifying reagents based on Organic compounds that provide effective separation of oil-water emulsions operate in many countries. However, the most effective technological solution to dehydration of oil and sorption of oily wastewater using composite materials is practically absent in practice.

3.2 Methods

The most important component of integral technology is a hypertextual representation of knowledge, intended for mastering a linguistic material, which is aimed at teaching the understanding of the text of learning, hence, conscious remembering of the information obtained. (5) We believe that this work sheds light on the subject of our research due to the fact that due to the cognitive-communicative approach, the implementation of integrated technology is possible.
In the mainstream of this approach, the theoretical basis is the position about the activity nature of language, according to which language is viewed as a cognitive process carried out in communicative activity and provided with special cognitive structures and mechanisms in the human brain. (9)

The paper presents the results of studies of changes in the degree of cleaning water from oil, depending on the amount of KM-1a; infra-red spectrum of wastewater samples obtained after cleaning with the KM-1a preparation; water characteristics after cleaning with KM-1a preparation; the effect of the concentration of oil on the degree of treatment of water (at m (KM-1a) - 0.5 w.p.); technological scheme of water treatment from oil at the "Zhilankabak" field with composite materials.

At the industrial site of the oil terminal "Zhamansor" (Atyrau Region). Enlarged tests of the wastewater treatment process from the oil of composite materials based on brown coal were carried out.

Table 3. The Change in the Degree of Water Treatment from Oil Depending on the Amount of the KM-1a Preparation (C - 300 mg/l)

Amount of KM-1a, w.p.	Amount of sorbed oil, g	Degree of treatment, %
0.02	0.0540	89.93
0.05	0.0548	91.27
0.10	0.0553	92.15
0.50	0.0567	94.52
1.00	0.0575	95.06
1.50	0.0575	95.90
2.00	0.0576	96.04

During the tests, the KM-1a preparation was used in the form of a tablet with a size of 1.5 cm and a thickness of 3.0 mm of the following composition m. %: W - 11.2; A - 13.8; C, 73.70; H - 5.34; O - 19.84; N - 1.12.

In the course of the tests carried out, the effect of the amount of the KM-1a preparation (0.02-2.0 w.p.) and the oil content (100–3000 mg/l) on the degree of water treatment from oil from the "Zhilankabak" field was determined. The sorption process was carried out at a temperature of 20°C for 30 minutes. The results of the work are shown in table 4. The data obtained show that increasing the amount of sorbent from 0.02 to 2.0 w.p. contributes to an increase in the degree of water treatment from oil.

Table 4. The Effect of Oil Concentration on the Degree of Water Treatment (at m (KM-1a) - 0,5 w.p.)

Oil concentrations, mg/l	Amount of sorbed oil, g	Degree of treatment, %
100	0.0196	98.17
300	0.0567	94.52
500	0.0842	84.20
1000	0.1340	67.02
1500	0.1792	59.73
2000	0.2080	52.00
3000	0.2565	42.74

It was established that the maximum degree of water treatment from oil is achieved when the amount of the KM-1a preparation is 0.5 w.p., and the degree of treatment is 94.52%. A further increase in the amount of sorbent leads to a slight increase in the degree of water treatment from oil.

From the data of table 4 it can be seen that when using the KM-1a preparation in the amount of 0.5 w.p. when the oil content in water is 100 mg/l, the degree of water treatment is 98.17%, and with further increase in the amount of oil to 3000 mg/l, the degree of treatment drops to 42.74%.

Table 5. Characteristics of the Water, after Cleaning by the KM-1a Preparation

Denomination of pollutants, mg/l						
Petroleum products	Suspended matters	SO^{2-4}	I^{-}	Dissolved oxygen	H	BOD
2-3	till 6	500	00	1.5	-8.5	2-3

Table 2. Effect of Fertilizers on the Content of Nutrient Elements in the Soil, mg/kg

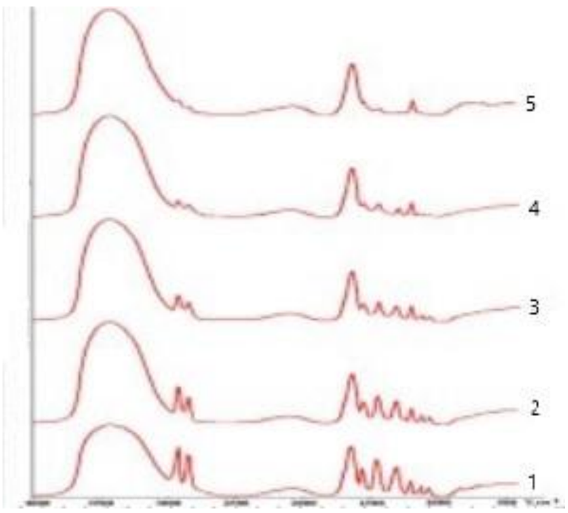

Figure 6. Infra-red Spectrum of Wastewater Samples Obtained after Cleaning with the KM-1a Preparation

1 - oil polluted wastewater; water samples with different oil content obtained after cleaning with the KM-1a preparation, mg/l: 2 - 3000; 3 - 2000; 4 - 1000; 5 - 200

It should be noted that when the oil content in water is 200 mg/l in the studied samples (Figure 6 - curve 5), the absorption bands of oil after water treatment with the KM-1a preparation are practically absent. The data obtained indicate the effectiveness of the use of composite materials for water treatment from oil.

As noted earlier in the infra-red spectrum of the samples under study, as the number of sorbent increases, the intensity of the absorption bands characteristic of oil increases.

Comparison of the spectrum shows the high efficiency of the process of sorption water treatment from oil with composite materials based on brown coal. On the basis of the conducted research, a technological scheme of the process of treatment of wastewater from oil with composite materials is proposed (Figure 7). This scheme has enclave nature; the spent sorbent can be used as a solid fuel.

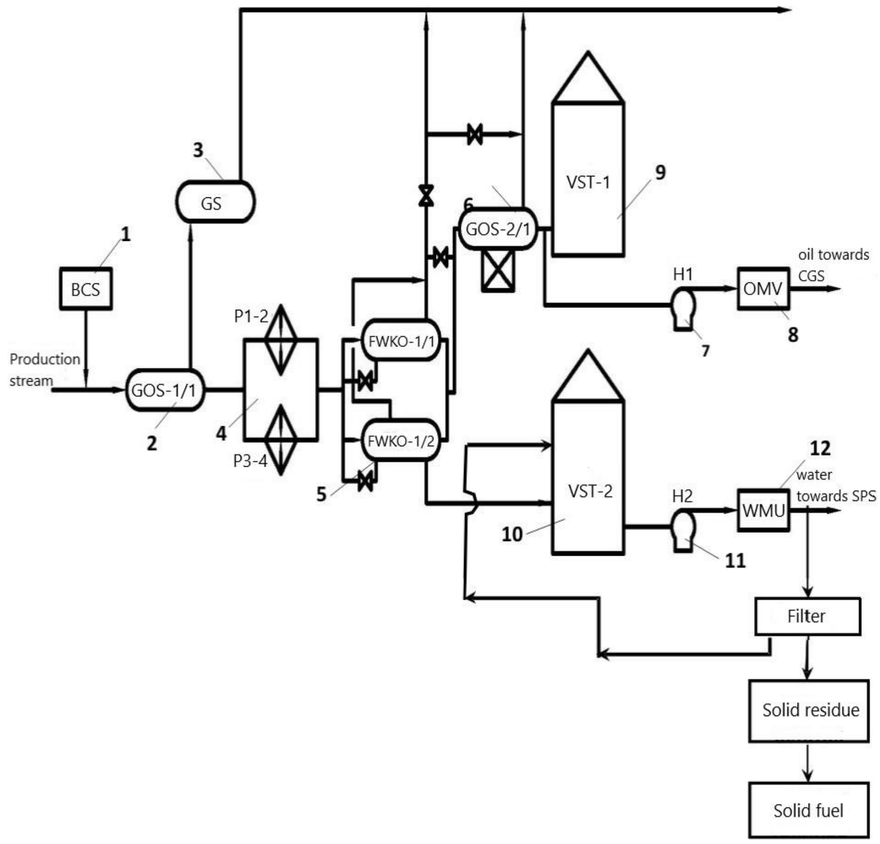

Figure 7. Technological Scheme of Water Treatment from Oil Field "Zhylankabak" by Composite Materials

1 - BCS - demulsifier dosing skid; 2 - GOS 1/1-2 - first stage separator; 3 - GS – gas separator; 4 - P-1-4 - reboiler (PP-1,6); 5 - FWKO 1/1-2 - three-phase separator; 6 - GOS-2/1 – second stage separator; 7 - H1 - oil pumping transfer; 8 - OMU - oil metering unit; 9 - VST-1 – oil vessel; 10 - VST-2 – sump tank for water treatment; 11 - H2 - pumping water transfer; 12 - WMU - water metering unit

4 Conclusion

Thus, the conducted tests have shown the possibility of using composite materials based on brown coal of Kazakhstan for the treatment of wastewater from oil by the composite materials. A flowchart of the process of cleaning wastewater from oil with composite materials has been developed. It should be noted that when the oil content in water is 200 mg/l in the studied samples (Figure 6 - curve 5), the absorption bands of oil after water treatment with the KM-1a preparation are practically absent. The data obtained indicate the effectiveness of the use of composite materials for water treatment from oil.

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