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EXPORT ROUTES AND TECHNICAL CHARACTERISTICS OF KAZAKHSTAN'S MAIN OIL PIPELINES

Kazakhstan in terms of geological oil reserves ranks second in the CIS after Russia and ninth in the world. Pipeline transportation is the main one for export oil transportation outside the Republic of Kazakhstan. The article provides the diagrams of the main oil export routes and technical characteristics (throughput, length and diameter) of the main oil pipelines of Kazakhstan: Uzen-Atyrau-Samara, Omsk-Pavlodar-Shymkent-Turkmenabad, Tengiz-Atyrau-Novorossiysk (CPC), Atyrau-Kenkiyak–Kumkol-Karakoin-Atasu-Alashankou (Kazakhstan-China).

Keywords: oil main pipelines, route schemes, technical characteristics of oil pipelines, Kazakhstan.

INTRODUCTION

The most popular product on the world market is energy resources, especially oil, gas, coal, uranium. **Oil** is called the **blood of the earth,** which feeds the economy of the entire planet. Kazakhstan in terms of geological reserves ranks second in the CIS after Russia and ninth in the world. The presence of colossal hydrocarbon reserves (more than 2.2 billion tons of oil and more than 2.0 trillion) give Kazakhstan global significance. The largest reserves of Kazakhstani oil are concentrated in the zone of the Caspian region – the zone of interests of the United States, which considers the Caspian Sea as a strategic reserve field. Under the presidency of George W. Bush, the Caspian began to be called the «Inland Sea» of the United States or the «Sixth Great Lake» [1]. A feature of the Caspian

region is its remoteness from the main sales markets, the lack of direct access to the sea, and the need for transit through territories with unstable political and interethnic conditions (Georgia, Nagorno-Karabakh, Afghanistan, Kurdistan, XUAR, etc.). Therefore, the key issues of the Caspian region were the issues of oil transportation to world markets – it is they that determine the economic prospects for the development of the Caspian countries, and they act as the main factors in the formation of a new geopolitical balance of power in the region.

The success of our country's economic development depends not only on the availability of oil and gas reserves, but, above all, on ensuring the republic's transport independence when exporting hydrocarbons. Pipeline transport, which is called the transport **of black gold** and **blue fire,** is the main one for export oil transportation outside the Republic of Kazakhstan. Any pipeline must meet at least two conditions: have a guaranteed load at the beginning of the pipe in the long run and a stable market at the end of the pipe also in the long run. In addition, the selected pipe should ensure reliable delivery and have an affordable price (tariff) for delivering oil to world markets. Those **who control the production and transportation of oil** also **control the economies** of all the countries that depend on it. Namely, for the sake of control over oil in the Caspian region and in the countries of the possible laying of oil pipelines, the United States deploy its military bases [2].

To ensure the stability of supplies, it is necessary to have several alternative routes that balance the risks of each of them individually.

MAIN PART

The oil pipeline system of Kazakhstan, inherited from the USSR, consisted of two independent subsystems – Western and Eastern, between which there was a gap between the Atyrau-Kumkol section. The **western subsystem** of oil pipelines, starting at the Kalamkas field, provides oil transportation to the terminals of the port of Aktau, the Atyrau refinery and to the oil pipeline system of the Russian Federation (Samara). This system also includes the CPC, Kenkiyak-Atyrau and Kenkiyak-Orsk pipelines (Figure 1).

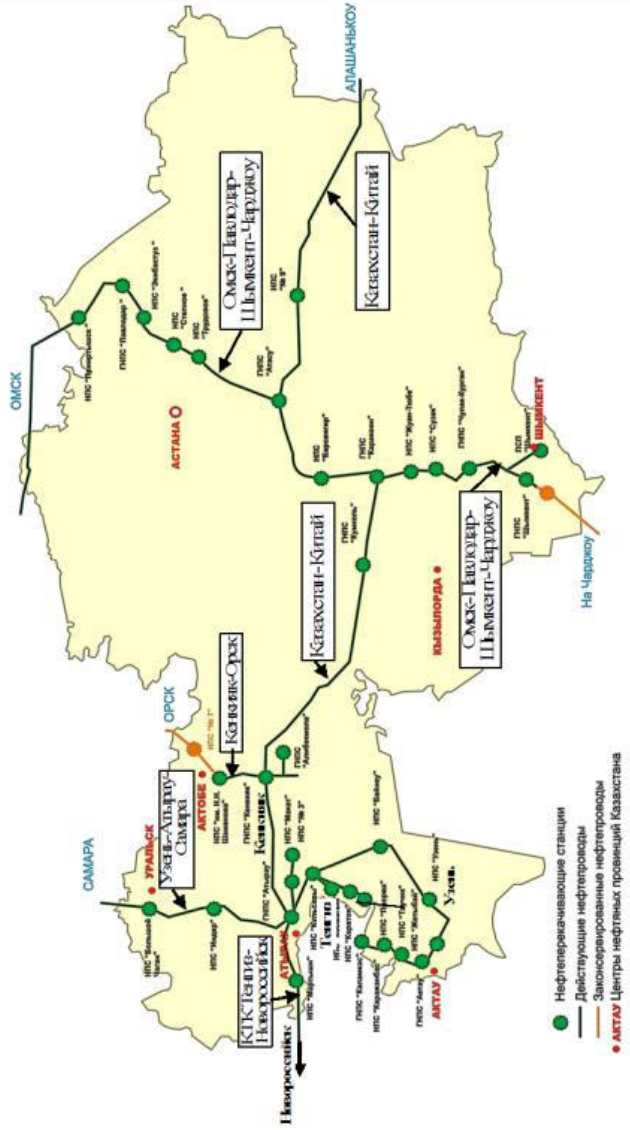

Figure 1 - Scheme of the main pipelines of the Republic of Kazakhstan

The Kenkiyak-Orsk oil pipeline (400 km, two lines with a diameter of 325 and 530 mm, 6,7 million tons / year) is intended for the supply of oil to the Orsk Refinery of the Russian Federation. After the Kenkiyak-Atyrau oil pipeline was launched in 2004, deliveries on this route were reduced to 2 million tons / year.

The eastern subsystem of oil pipelines includes the Kazakhstan part of the trans-Asian Omsk-Pavlodar-Shymkent-Chardzhou (Turkmenabad) oil pipeline, built in Soviet times to supply West Siberian oil to the refineries of Kazakhstan, Uzbekistan and Turkmenistan. West Siberian oil is supplied via the Omsk-Pavlodar pipeline to the Pavlodar refinery and the Atasu railway platform, mainly using the scheme for its replacement with Kazakhstani oil in Samara.

Transport routes of early oil. The first oil pipeline in the Republic of Kazakhstan was laid in 1911–1913. from the Dossor field to the port of B. Rakush for pumping Emba oil to the shore of the Caspian Sea with a length of 60 km, of which 16 km lay along the bottom of the Caspian Sea [3].

At the time of independence, 6300 km of oil pipelines passed through Kazakhstan (some of them are given in table 1).

Table 1 – Oil pipelines of Kazakhstan, built before 1991

Pipeline, year put into operation	Length, km (total / RK)	Diameter, mm	Throughput, mln t / year
Uzen-Zhetybai-Aktau (1966)	150		9
Uzen-Atyrau-Samara (1970)	1480/1237	710/1020	17/40
Omsk-Pavlodar-Shymkent-Chardjou (1977 to 1983	1636/1127	820/635	17/40 (40 – проект)
Каламкас-Каражанбас-Актау (1979–1986)	290	530/720	8,04/15
Zhanazhol-Kenkiyak-Orsk (1986)	810/450	377/530	7,7
Prorva-Kulsary (1986)	103		5
Kumkol-Karakoin (1990)	230 (2 линии)	530/710	2/15
Tengiz-Atyrau-Astrakhan-Grozny (1991)	678		30

The longest pipelines are Uzen-Atyrau-Samara and Omsk-Pavlodar-Shymkent-Chardzhou (see Figure 1).

The Uzen-Atyrau-Samara oil pipeline is a unique heated main oil pipeline, built in 1970, has a length of 1380 km (1237 km in Kazakhstan), and a pipeline diameter of 1020/720 mm. It starts from the Uzen field and passes through the territory of Kazakhstan and the Samara region of Russia (see Figure 1), then oil is transported via the Transneft system to the ports of Odessa, Primorsk, Novorossiysk and through the Druzhba system to the markets of North-West, Central and Eastern Europe.

The oil of the fields adjacent to this pipeline has a density of 771 to 963 kg/m^3, kinematic viscosity at 20 °C from 1.14 to 920 mm^2/c paraffin content

from 0.06 to 23,4 %, resins from 1,0 to 20,9 %, asphaltenes from 0,08 to 6,5 %. Due to the high content of paraffin, such oil has a very uncomfortable property – to freeze in the heat of thirty degrees. Oil leaving the well has a temperature of 65 °C and, moving along the pipe at a speed of approximately 3 km/h, cools through 145 km of the route. Therefore, fifteen heating stations were built along the entire length of the pipe, of which seven stations were combined with oil pumping stations. In addition to the use of furnaces, it is necessary to pass a scraper through the pipes every month, removing a 20 mm layer of sticky paraffin deposited on the walls in a month. But, despite this, the production of Mangyshlak oil is cost-effective and in demand on the market. At the end of 2011, the volume of oil transportation amounted to 15,75 million tons. The maximum throughput of the pipeline is 30 million tons /year [4].

The Omsk-Pavlodar-Shymkent-Chardzhou (Turkmenabad) oil main pipeline was built in stages from 1977 to 1983 with the goal of transporting West Siberian oil to the Pavlodar, Shymkent and Chardzhou oil refineries. The length of the Omsk-Pavlodar oil pipeline is 438 km, its diameter 1020 mm, throughput 45/42 million tons / year. The section of the Pavlodar-Shymkent pipeline is 1636 km, the diameter of the pipeline is 820 mm, the throughput capacity is 22 / 16,5 million tons / year. A section of the Shymkent oil pipeline – the border of Uzbekistan – 294 km, a section of the pipeline across Uzbekistan – 370 km, and a section from the Uzbekistan – Turkmenistan border to the Seydi oil refinery – 35 km, a pipeline diameter of 220 mm, and a throughput of 8/7 million tons / year.

After the collapse of the USSR and the cessation of supplies of West Siberian oil, the Shymkent-Chardzhou (Turkmenabad) oil pipeline was not operated on a section from 11 km to 294.5 km. In 1999, KazTransOil CJSC displaced oil at this section of the pipeline and preserved it.

With the commissioning of the Atasu-Alashankou section of the Kazakhstan-China oil pipeline, it became possible to export Russian oil to China from Omsk, and the construction of a two-strand pipeline on the Atasu-Karakoin section in 1990 allowed entering the markets of neighboring Afghanistan or Iran. The annual throughput of the pipeline in the Omsk-Pavlodar sections is up to 30 million tons, Pavlodar-Shymkent – 22 million tons and Shymkent-Turkmenabad – 7 million tons.

Late oil routes. The system of pipelines that has developed within the USSR did not meet the interests of an independent republic – the geographical disconnect between the places of production, processing, consumption and the full orientation of oil pipelines to Russia created big problems in the formation of energy independence. The only existing oil pipeline connecting Kazakhstan with the outside world (with Europe) passed through Russia (the Atyrau-Samara oil pipeline).

Over the years of independence, about 6000 km of oil pipelines were built: Tengiz-Atyrau-Novorossiysk (CPC), Kenkiyak-Atyrau, Kenkiyak-Kumkol,

Atasu-Alashankou (table 2). Currently, the main existing export directions of Kazakhstani oil are pipelines: Uzen-Atyrau-Samara, Tengiz-Atyrau-Novorossiysk, Atasu-Alashankou, Aktau seaport (see Figure 1).

The oil pipeline system of the **Caspian Pipeline Consortium** (CPC). The CPC oil pipeline **(Tengiz-Atyrau-Komsomolskaya-Kropotkin-Novorossiysk)** with a diameter of 1020 mm was put into operation in experimental production mode in 2002.

Table 2 – The main oil pipelines of Kazakhstan, built after 1991

Initial, intermediate and final points	Year of commissioning	Length, km (total / RK)	Bandwidth million tons / year / diameter mm
CPC (Tengiz-Atyrau-Novorossiysk)	2001	1580/695	28-67/ 1020
Karachaganak-B. Shagan-Kalmykovo-Atyrau	2003	650	7/610
Kenkiyak-Atyrau	2004	449	6-12/610
Kazakhstan-China – site Atasu Alashankou (China)	2006	965,2 (988)	10-20/813
Kazakhstan-China – site Kenkiyak-Kumkol (KAK)	2010	761 (786)	10-20/813

The CPC oil pipeline with a total length of 1580 km (of which the length of the new pipeline is 748 km, including 695 km through the territory of the Republic of Kazakhstan) connects the Kazakhstan Tengiz oil field and the Yuzhnaya Ozereyevka oil terminal on the Russian Black Sea coast near the port of Novorossiysk (see figure) one). The number of oil pumping stations is 15: 4 in Kazakhstan, 11 in Russia. The CPC system receives oil mainly from fields in Western Kazakhstan (Kenkiyak, Zhanazhol, Karachaganak), as well as raw materials from Russian producers. CPC, unlike the Atyrau-Samara-Druzhba pipeline, allows Tengiz oil to enter the world market with its Tengiz brand.

CPC pumps over a third of Kazakhstan's total export oil annually. Since the start of the pipeline's operation (2002), 266 million tons have been transported, including 224 million tons of Kazakhstani oil, 36 million tons in 2010, of which 29,9 million tons of Kazakhstani oil. At the end of 2011, CPC tariff revenue amounted to 1,12 billion dollars.

In connection with the increase in oil production at the Tengiz and Karachaganak fields and the commissioning of the Kashagan field, the question arose of increasing the capacity of the pipeline to 67 million tons per year due to the construction of 10 additional oil pumping stations. The project will require $ 5,4 billion.

Kazakhstan-China oil pipeline. In September 1997, an agreement was signed on a project for the transportation of Aktobe, and in the future, Caspian oil, via

the Western Kazakhstan-Western China pipeline. Around the same time, the pipeline route was agreed: Atyrau-Kenkiyak-Kumkol-Karakoin-Atasu-Aktogay-Alashankou (Figure 2). As already noted, West Siberian oil can be connected to the highway via the Omsk-Pavlodar-Atasu oil pipeline.

Figure 2 – Kazakhstan-China Oil Pipeline

In May 2002, with the participation of the Chinese side, the construction of the Kenkiyak-Atyrau pipeline began, and in 2004 it was commissioned. The capacity of this pipeline is 6 million tons / year, the length is 449 km. The immediate task of the new route is to deliver oil from Central Kazakhstan to the KKT system (Kazakhstan-China pipeline), the long-term task is to deliver Kazakhstan oil to China by reversing it and building the Kenkiyak-Aralsk-Kumkol and Atasu-Alashankou sections (Kumkol-Karakoin-Atasu section 623 km long came from the USSR).

December 15, 2005, President of Kazakhstan N. A. Nazarbayev solemnly launched the Atasu-Alashankou oil pipeline [6]. The first launch complex was put into operation in July 2006, construction was fully completed in 2008. At the end of 2011, the volume of oil transshipment to the Atasu-Alashankou oil pipeline reached 10 million 894 thousand tons of oil, including 200 thousand tons of Russian oil.

The first stage of the second stage of the Kazakhstan-China oil pipeline construction project was the implementation of the Kenkiyak-Kumkol oil pipeline project with a length of 794 km and a diameter of 813 mm. In October 2009, the launch complex was commissioned, and in December 2010, the project for the construction of the first phase of the Kenkiyak-Kumkol oil pipeline was fully completed. The capacity of the first stage of the pipeline is 5 million tons / year. In 2017, 5 million 210 thousand tons of oil was transported through the Kenkiyak-Kumkol pipeline.

The implementation of the Kenkiyak-Atyrau oil pipeline reverse project with a capacity of up to 6 million tons per year was launched in order to ensure oil supplies to the Shymkent oil refinery and Pavlodar petrochemical plants. And the expansion of the Kazakhstan-China oil pipeline will ensure oil export to China up to 20 million tons per year at the Alashankou point, completion is planned before the end of 2020.

The increase in oil production in Kazakhstan (from 90 million tons in 2020 to 100 million tons in 2024) will be provided by projects for the future expansion of the Tengiz, Karachaganak, Kashagan fields, as well as the commissioning of offshore fields [8].

CONCLUSIONS

The main pipelines currently operating for Kazakhstani oil are the following pipelines: Caspian Pipeline Consortium (CPC), Atyrau-Samara, Atasu-Alashankou and the port of Aktau. According to the results of 2018, crude oil production amounted to 77.5 million tons in physical terms and 12.2 trillion tg in monetary terms. [9].

CPC pumps over a third of Kazakhstan's total export oil annually. In 2018, more than 61 million tons of oil was shipped through the pipeline. At the end of 2018, the volume of oil transportation through the Atyrau-Samara section of the Uzen-Atyrau-Samara trunk oil pipeline amounted to 14 million 757 thousand tons of oil. In 2018, the volume of oil transportation through the pipeline system of Kazakhstan-China Pipeline LLP amounted to 16 million tons. Oil loading into tankers in the port of Aktau using the capacities of KazTransOil JSC amounted to 2 million 2 thousand tons (an increase of 810 thousand tons). 2019 is a jubilee year for the entire oil and gas industry and the country – the 120-th anniversary of Kazakhstani oil.

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Қазақстанның магистральдық мұнай құбырларының экспорттық маршруттары мен техникалық сипаттамалары

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Экспортные маршруты и технические характеристики магистральных нефтепроводов Казахстана

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Қазақстан мұнайдың геологиялық қорлары бойынша Ресей мен әлемде тоғызыншы орында тұр. Құбыр көлігі Қазақстан Республикасынан тысқары жерлерге мұнайды экспорттық тасымалдау үшін негізгі болып табылады. Мақалада мұнайдың негізгі экспорттық бағыттарының схемалары және Қазақстанның магистральдық мұнай құбырларының техникалық сипаттамалары (өткізу қабілеті, ұзындығы және диаметрі) келтірілген: Өзен-Атырау-Самара, Омбы-Павлодар-Шымкент-Түркменабад, теңіз-Атырау-Новороссийск (КТК), Атырау-Кеңқияқ-Құмкөл-Қарақойын-Атасу-Алашанькоу (Қазақстан-Қытай).

Казахстан по геологическим запасам нефти занимает второе место в СНГ вслед за Россией и девятое в мире. Трубопроводный транспорт является основным для экспортной транспортировки нефти за пределы Республики Казахстан. В статье приведены схемы основных экспортных маршрутов нефти и технические характеристики (пропускная способность, длина и диаметр) магистральных нефтепроводов Казахстана: Узень-Атырау-Самара, Омск-Павлодар-Шымкент-Туркменабад, Тенгиз-Атырау-Новороссийск (КТК), Атырау-Кенкияк-Кумколь-Каракоин-Атасу-Алашанькоу (Казахстан-Китай).

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