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ENSURING RELIABLE AND SAFE OIL STORAGE IN THE REPUBLIC OF KAZAKHSTAN

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The article highlights the issue of possible construction of the first large oil storage facility in the history of Kazakhstan. Construction of large oil storage facilities in Kazakhstan is an important step to ensure efficient storage and management of oil products in the country, solving the problem of redistribution and storage of oil products, given the dynamics of production and consumption growth in the country. Construction of a large oil storage facility in Atyrau region, as well as oil depots in the west of Kazakhstan, will optimize the processes of transportation and storage of oil products, reduce the cost of renting other people's storage facilities and ensure the sustainability and reliability of oil products supplies to both domestic and foreign markets. The article considers such important aspects as the need for storage of oil products, technical and environmental aspects of construction, as well as economic and social feasibility. In addition, the article presents a system analysis and study of the potential for construction of a large oil storage facility in Kazakhstan, which makes it significant and relevant in the context of the development of the country's oil and gas industry. Given the current global challenges, such as oil production limitations and volatility of oil and oil products markets, the strategic reserve becomes even more relevant.

Keywords: hydrocarbon feedstock, storage of petroleum products, strategic reserve, provision of domestic needs.

ҚАЗАҚСТАН РЕСПУБЛИКАСЫНДА МҰНАЙДЫҢ СЕНІМДІ ЖӘНЕ ҚАУІПСІЗ САҚТАЛУЫН ҚАМТАМАСЫЗ ЕТУ

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Мақалада Қазақстан тарихындағы алғашқы ірі мұнай қоймасын салу мүмкіндігі туралы мәселе көтерілген. Қазақстанда ірі мұнай қоймаларының құрылысы республикада мұнай өнімдерін тиімді сақтау мен басқаруды қамтамасыз ету, мұнай өнімдерін қайта бөлу және сақтау мәселесін шешу, мұнай өнімдерін өндіру мен тұтынудың өсу динамикасын ескере отырып, маңызды қадам болып табылады. Атырау облысында ірі мұнай сақтау қоймасының, сондай-ақ Қазақстанның батысындағы мұнай базаларының құрылысы мұнай өнімдерін тасымалдау және сақтау процестерін оңтайландыруға, шетелдік қоймаларды жалға алу құнын төмендетуге және жеткізілімдердің тұрақтылығы мен сенімділігін қамтамасыз етуге мүмкіндік береді және мұнай өнімдерін ішкі және сыртқы нарыққа шығару. Мақалада мұнай өнімдерін сақтау қажеттілігі, құрылыстың техникалық және экологиялық аспектілері, сондай-ақ экономикалық және әлеуметтік орындылығы сияқты маңызды аспектілер қарастырылады. Сонымен қатар, мақалада Қазақстандағы ірі мұнай қоймасын салу әлеуетін жүйелі талдау және зерделеу ұсынылған, бұл оны еліміздің мұнай-газ саласын дамыту контекстінде маңызды

және өзекті етеді. Мұнай өндіруді шектеу және мұнай мен мұнай өнімдері нарығындағы құбылмалылық сияқты ағымдағы жаһандық сын-қатерлерді ескере отырып, стратегиялық резерв бұрынғыдан да өзекті бола түседі.

Түйін сөздер: көмірсутегі шикізаты, мұнай өнімдерін сақтау, стратегиялық резерв, ішкі қажеттіліктерді қамтамасыз ету.

ОБЕСПЕЧЕНИЕ НАДЕЖНОГО И БЕЗОПАСНОГО ХРАНЕНИЯ НЕФТИ В РЕСПУБЛИКЕ КАЗАХСТАН

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В статье освещается вопрос возможного строительства первого в истории Казахстана крупного нефтехранилища. Строительство крупных нефтехранилищ в Казахстане представляет собой важный шаг для обеспечения эффективного хранения и управления нефтепродуктами в стране, решение проблемы перераспределения и хранения нефтепродуктов, учитывая динамику роста производства и потребления в стране. Строительство крупного нефтехранилища в Атырауской области, а также нефтебаз на западе Казахстана, позволит оптимизировать процессы транспортировки и хранения нефтепродуктов, снизить затраты на аренду чужих хранилищ и обеспечить устойчивость и надежность поставок нефтепродуктов как на внутренний, так и на внешний рынки. В статье рассматриваются такие важные аспекты, как потребность в хранении нефтепродуктов, технические и экологические аспекты строительства, а также экономическая и социальная целесообразность. Кроме того, в статье представлен системный анализ и исследование потенциала строительства крупного нефтехранилища в Казахстане, что делает ее значимой и актуальной в контексте развития нефтегазовой отрасли страны. Учитывая текущие глобальные вызовы, такие как ограничения добычи нефти и волатильность рынков нефти и нефтепродуктов, стратегический резерв становится еще более актуальным.

Ключевые слова: углеводородное сырье, хранение нефтепродуктов, стратегический резерв, обеспечение внутренних потребностей.

Introduction. Kasym-Jomart Tokayev called one of the most urgent tasks to increase the capacity of oil storage facilities, as producers are forced to immediately send raw materials for export, as it is required by technology. In this regard, the President instructed to consider the construction of a large oil storage facility taking into account environmental requirements. [1]

The oil and gas sector deals with all aspects of the extraction, production, transportation and use of oil. This sector plays a key role in the world economy as oil is a potential source of energy used in various industries. [2]

Kazakhstan exports oil in unrefined form and then imports petroleum products, this results in loss of value added and reduced economic efficiency.

To address this problem, a number of factors need to be considered:

- Production structure:

Determining the optimal oil transportation and refining scheme depends on the specifics of the fields and infrastructure in the production regions. Some fields may be more favorable for direct on-site refining and storage, while for others it may make more sense to export crude oil.

- Technological Capabilities:

Assess technological opportunities for domestic crude oil storage and refining. The feasibility of oil storage facilities, the capacity of refineries, and the potential for modernization and expansion of these refineries should be explored.

- Economic aspects:

Conduct a cost-benefit analysis of the construction of oil storage facilities and various oil transportation and refining schemes. This includes the cost of investment in the construction of oil storage facilities, refinery upgrades, and the cost of transporting petroleum products.

Feasibility of large underground storage facilities. Kazakhstan's President Kassym-Jomart Tokayev's raising of the issue of large oil storage facilities indicates the importance of providing the country with a reliable infrastructure for storage and management of oil products, strengthening the security of oil supplies, ensuring stability in the domestic market and increasing independence from external factors such as transportation constraints or geopolitical tensions.

The construction of oil storage facilities will ensure the development of infrastructure and economic potential of the region, as the construction of oil storage facilities can create jobs and contribute to the development of the local economy.

Underground oil storage facilities allow for the creation of significant reserves of crude oil and petroleum products in a small footprint. Compared to above-ground oil storage facilities, they are safer, characterized by lower evaporation losses, lower heat consumption to maintain the required temperature in the storage facility and lower specific costs of construction and operation. Underground oil storage facilities include underground tanks (tank workings, auxiliary mine workings, wells, etc.), surface buildings and structures. Due to floods that began in March 2024, oil wells in western Kazakhstan were flooded, especially in the Atyrau region, where most of the country's oil reserves are located. Three of the flooded wells are located in the East Uaz field - #101, #106, #116 (JSC Embamunaigas oil and gas production department Kainarmunaigas). Another well is located at Zhana Makat field - No. E7 (5A Oil LLP). Faced with such a problem, having an underground oil storage facility is one of the strategies to minimize the risks associated with floods and other natural disasters. Unlike above-ground oil storage facilities, underground storage facilities can be more protected from natural disasters: floods, earthquakes or fires.

This is a serious problem for oil producers in Aktobe and Atyrau regions due to the flood situation. The suspension of 634 wells and the loss of 16 thousand tons of oil has a significant impact on production and on the economy of the country as a whole. It will also lead to negative consequences for the environment and the health of the local population.

Large underground storage facilities play an important role in ensuring the reliability and sustainability of the upstream and downstream industry, as well as protecting strategic reserves. Here are some of the tasks they accomplish:

- Stockpiling reserves to cover peak fluctuations, underground storage facilities allow oil and petroleum products to be stockpiled during periods of low demand or excess production to provide coverage for peak demand fluctuations or supply problems.

- Protecting strategic reserves, large underground storage facilities provide a safe and secure place to store strategically important hydrocarbon reserves to ensure preparedness to deal with emergencies or crises.

- Ensuring uninterrupted operations of production, refining and transportation facilities, underground storage facilities help to ensure a stable supply of oil and petroleum products to production, refining and transportation facilities, preventing downtime and reducing the risk of interruption to operations.

- Ensuring the reliability of the storage system, large underground storage facilities have high capacity and reliability, making them an important link in the hydrocarbon storage system, helping to ensure the stability of the industry and the sustainability of the country's energy system.

Figure 1 - Location of the planned underground oil storage facility located in Inder district of Atyrau region

Materials and methods. The underground oil storage project will help stabilize Kazakhstan's oil production, transportation and storage. The discovery of an old abandoned underground salt mine, presents significant prospects and a number of advantages of using the space of this mine for the construction of underground oil storage. [3]

It is proposed to create with relatively low investment underground storage in salt deposits, in the depleted salt mines of Inder. Inder is located in Atyrau region, and on the way of main oil pipelines Karachaganak-KTK, Atyrau-Samara. The technology of CCS has been tested worldwide, i.e. storage in salt domes is cheaper, safer, less negative impact on the environment, and there are practically no operating costs compared to ground equipment.

The cost of storage is several times cheaper than above-ground storage tanks. And due to the fact that oil will be stored at a depth of 300 meters (in the Caspian region 200 meters below sea level), it will preserve the temperature regime and pressure for oil, and as a consequence of preserving the quality of oil for a long time. [4]

Geographical location:

The mine's location between major oil and gas fields and its proximity to major transportation routes make it an ideal location for a storage facility. This will reduce transportation costs and provide easy access to the storage facility.

Safety and sustainability:

The underground location of the storage facility provides it with protection from external influences such as weather or human factors, which increases the safety and sustainability of the storage facility.

Unique geotechnical properties:

An underground salt mine has unique geotechnical characteristics that can be ideally adapted to create an oil storage facility. For example, salt is a stable and strong material, making it ideal for creating secure walls and ceilings.

Cost-effectiveness:

Utilizing existing infrastructure reduces the cost of building a storage facility and shortens the project timeline. This makes the project more cost effective and competitive.

Reduced environmental impact: Underground storage minimizes negative environmental impacts because it does not require a large land area and does not create significant visual or environmental changes.

Based on the above factors, the use of an old salt mine for the construction of an underground oil storage facility appears promising and promises

to bring significant benefits in terms of both economics and the safety and sustainability of the oil infrastructure.

The estimated time and financial framework for converting the salt mine to an oil storage facility is very important to understand the scope of the project and its implementation. A timeframe of 3.5 years to convert the mine and construct the infrastructure is realistic given the complexity of the work and the amount of engineering involved.

Including the acquisition of geological information, study of the mine condition, reanimation of its shafts, cleaning and repair works, construction of infrastructure and facilities, laying of oil pipelines and railroad tracks will ensure safe and efficient operation of the oil storage facility.

The total cost of the project, estimated at $370 million, also looks realistic given the complexity and scale of the work. This is an important investment decision that could bring significant benefits to the oil and gas industry and the wider economy of the region. The expected payback period of 6-7 years is reasonable and in line with generally accepted investment standards.

Results and discussion. Applying similar concepts and experience to the project in Kazakhstan can ensure its successful implementation. Applying successful practices and experience of other countries to the project in Kazakhstan will reduce risks and increase the chances of successful implementation of this innovative project.

This will help to balance the oil market, provide reserves in case of crisis or temporary disruptions in production. Such storage facilities can also reduce dependence on imports of oil products and ensure stable functioning of the domestic market.

On the other hand, proponents of redirecting funds to the construction of new export routes see this as a way to increase oil exports, which could lead to higher oil revenues. However, it could also increase dependence on foreign markets and increase risks in case of changes in global oil demand or geopolitical tensions.

Large oil producers operating in Kazakhstan typically have their own tank farms that are designed to meet the operational needs and manage the flow of oil within their production operations. These tanks are typically designed to store oil for short periods of time, such as a few days, and do not provide long-term reserves or strategic stockpiles.

However, large oil storage facilities, as proposed by the President of Kazakhstan, may have a more strategic function. They can be designed to store significant volumes of oil for longer periods of time, allowing the country to respond more flexibly to changes in supply and demand on the world market, as well as to possible crisis situations, such as temporary restrictions on oil exports or transportation.

The situation with the suspension of oil pumping through the CPC's main export route does highlight Kazakhstan's vulnerability to dependence on certain transportation routes and markets. It also emphasizes the need to develop alternative routes and infrastructure to diversify oil export flows.

The repair pit contains slopes with specified slopes on both sides of the main pipeline, while the pipeline is located in the ground with a minimum wall thickness of at least 200-300 mm, and a flat bottom is formed on both sides of the pipeline located in the ground to the width of the excavator bucket. The technical result is that it is possible to simplify the work by reducing manual labor as much as possible with minimal environmental impact. The repair pit along the main pipeline 1 contains on both sides of the main pipeline 1 slopes 2 with specified slopes (steepness). The main pipeline 1 is located in the ground 3 with a minimum thickness of the soil wall of at least 200 – 300 mm, and on both sides of the main pipeline 1 located in the ground 3, a flat bottom 4 is formed for the width of the excavator bucket 5. The soil extracted from the pit 6 is located at least 500 – 700 mm from the edge of the slopes 2 of the pit on both sides.

The method of developing a repair pit along the main pipeline 1, in particular the oil pipeline, is that the repair pit is formed in the form of a trench, and the fertile soil layer is previously removed, which is formed in the form of a separate dump 7, the drainage strip is cleared of shrubs and vegetation,

the axis of the trench is broken down and fixed on the terrain, which is made by end face when moving a single-bucket excavator 5 along the axis of the newly laid oil pipeline instead of the repaired one, while the soil 6 removed from the trench, they are placed in the dump no closer than 0.5 – 0.7 m from the edge of the trench. When developing a trench with a single–bucket excavator 5, hangers are placed along the axis of the trench (not shown in the drawing) in front of it along the course of its movement and behind along the already dug trench, and in rectilinear sections, along the course of its movement, landmarks (hangers) with a height of 1 – 3 m are set every 30 - 50 m, to increase the accuracy of movement excavators on curved sections relative to the trench within the curve along the width of the tracks or along the width of the trench on both sides set landmarks every 1-2 m. [5-6]

During the work carried out, it was found that the described method ensures the precise movement of the excavator 5 along the underground main pipeline 1 laid in the ground, and no strengthening of the slopes is required, the ingress of soil from the dumps into the trench is completely prevented and the fertile soil layer is preserved, which fully allows restoring the environment after repair work on the main pipeline and at the same time, minimize the use of manual labor to clean the main pipeline under repair from the ground.

The construction of an oil storage facility can face various risks that can affect the project. The main risks to be considered are:

Technical Risks:

Technical Problems: Unforeseen technical problems during construction or operation can lead to delays and additional costs.

Process Disruption: Errors in design or construction could lead to disruption of the oil storage process and jeopardize the safety of the facility.

Environmental Risks:

Environmental Pollution: The need to comply with environmental standards and prevent soil, water and air pollution during construction and operation of an oil storage facility.

Oil Spill Risks: [7]

The possibility of oil spillage from tanks or pipelines can cause serious environmental and health consequences.

Financial risks:

Oil price volatility: Changes in world oil prices may affect the oil storage tank lease revenues and the overall profitability of the project.

Credit Risk Risks: The need for project financing and possible delays or non-repayment of loans may affect the financial position of the project.

Economic risks:

Oil market price risk: Since oil storage facility lease revenues may depend on oil prices, changes in the oil market may significantly affect the financial performance of the project.

The construction of large oil storage facilities may be one step towards mitigating such crisis situations. Storing oil in strategic reserves will help mitigate temporary disruptions in transportation and ensure stability of supply in both domestic and foreign markets. It can also help minimize revenue losses in case of suspension or restriction of export supplies.

Consideration of alternative export routes is equally important. Development of additional transportation corridors can reduce dependence on one main route and reduce risks for the country's economy in case of such crises in the future.

Thus, a comprehensive analysis of the construction of oil storage facilities and the development of alternative export routes will make it possible to take into account all factors and peculiarities.

Construction of storage facilities for raw materials and fuel is a necessary measure, because storage facilities provide coverage of seasonal and daily fluctuations and consumption, technological needs and export supplies. In order to mitigate crisis situations, oil-producing countries primarily seek to build strategic reserves.

In the world the practice of construction of underground storage facilities for hydrocarbon raw materials and fuels has been applied since the Second World War. They store crude oil, gasoline,

jet and diesel fuel, natural gas, helium concentrate, marginal and unsaturated hydrocarbons.

Underground oil storage facilities are the safest and most environmentally friendly option for storing hydrocarbons. Since, very often accidents occur during their operation of aboveground reservoirs.

Underground storages can be constructed in natural or artificial cavities, depending on the purpose. Natural cavities are mainly used for storing natural gas, while artificial cavities formed by geotechnological methods, for example, in rock salt deposits, are used for storing oil products.

Compared to above-ground tanks, underground storage facilities are characterized by higher economic efficiency, reduced losses from evaporation of light fractions of the product, low fire and explosion hazards, absence of product leakage and low probability of groundwater contamination, high resistance to earthquakes. Last but not least, they have an undeniable environmental advantage.[8]

Reduced global demand for oil amid the coronavirus pandemic, as well as Kazakhstan's plans to redirect a significant share of its oil exports to routes via the Caspian Sea, actualize the importance of storage systems. The country needs storage facilities to respond flexibly and efficiently to possible changes in domestic demand, to price increases that may occur as a result of liberalization or the creation of a single EAEU market. [9].

Conclusions. Providing safe and secure oil storage is an important challenge for any country with oil resources or dependent on oil imports.

The country's needs for oil storage facilities are determined by the following factors: economic growth, development of transportation infrastructure, energy security, and seasonal fluctuations in demand. The studied experience of countries in building and using large oil storage facilities with developed oil and gas industry - China, USA and South Korea is of practical value for the development of strategy and plans in the field of oil and gas infrastructure in Kazakhstan. The ability to adapt best practices and technologies to local conditions and needs will create a more efficient and sustainable infrastructure. Despite the obstacles and risks that may arise during the construction and operation of an oil storage facility - accidents, equipment downtime and leaks of oil products from the storage facility, as well as market risks (changes in oil prices, demand for storage services and other factors), it can be concluded that the construction of an oil storage facility for Kazakhstan is a relevant and important issue. Due to the fact that Kazakhstan is a major oil producer and has significant export volumes, ensuring reliable and efficient storage of oil products becomes a priority.

A comprehensive analysis and consideration of various factors, including economic, technical, geopolitical and environmental aspects, will allow us to decide whether to build oil storage facilities or direct resources to the development of alternative export routes.

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