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TRENDS IN THE FORMATION OF OIL AND GAS CHEMICAL CLUSTERS

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Abstract

Today, almost all industries are consumers of oil and gas chemical products. This is because the rapid growth of oil and gas chemistry is due to its high competitiveness. The determining factors here are: low prices for oil and gas chemical raw materials; convenient logistics and low costs for transportation of finished products from production sites to consumption markets, low specific level of capital costs. For the Russian Federation, oil and gas chemistry is the basic segment of Russian industrial production, but a key feature here is the lack of capacities for the production of basic monomers and a number of other reasons. At the same time, despite the presence of problems and weaknesses, Russia has the resources for the further development of oil and gas chemistry. Oil and gas companies account for about half of the total production of oil and gas chemical products, the other half - for specialized chemical companies. It is proposed to develop domestic oil and gas chemistry by forming six clusters: West Siberian, Volga, Caspian, North-West, East Siberian and Far Eastern.

Keywords: Petrochemical sector, oil and gas chemical products, pyrolysis, light hydrocarbon feedstock

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1. Introduction

In the structure of the world economy, oil and gas chemistry accounts for various estimates from 5% to 10%. Almost all the largest oil and gas companies in the world have oil and gas chemical sectors, in which oil and gas chemical products are produced on the basis of oil and gas raw materials of companies, ranging from basic semi-products, basic petrochemical chemicals to polymers, composites and products based on them. Oil and gas companies account for about half of the total production of oil and gas chemical products, the other half - for specialized chemical companies. It is proposed to develop domestic oil and gas chemistry by forming six clusters: West Siberian, Volga, Caspian, North-West, East Siberian and Far Eastern. The production core of each of them will be large pyrolysis capacities (from 0.6 to 1 million tons of ethylene and more).

2. Problem Statement

Today, almost all industries: construction, engineering, energy, agriculture, medicine, electronics, astronautics, as well as trade and many other industries are consumers of oil and gas chemical products.

3. Research Questions

According to experts, the main factor that determines the economic efficiency of the production of oil and gas chemical products in oil and gas companies is the integration of oil and gas processing and oil and gas chemistry, which generates a synergistic effect. This integration allows you to:

- Significantly reduce capital and operating costs when using common engineering and social infrastructure facilities;
- Provide "economies of scale";
- Optimize the flow of raw materials, semi-products and by-products;
- Reduce transaction expenses through the use of the so-called "transfer" (intra-corporate) prices;
- Regulate and stabilize the business cycles of oil and gas companies by changing the structure and coordination of production;
- "Smooth out" the effects of the inherent cyclicity of oil and gas chemistry by coordinating output (Bulanov, 2019).

4. Purpose of the Study

Global demand for naphtha as a raw material for petrochemicals is growing by about 2.5% per year. However, its share in the next 5 years will decrease with a gradual replacement as a raw material in the production of ethylene from oil to cheap ethane and liquefied gas. According to experts, ethane will be the main driver of the growth of pyrolysis capacities.

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5. Research Methods

The basic products of the industry include lower olefins (ethylene, propylene, butylene), aromatic hydrocarbons (benzene, toluene, xylenes), butadiene, isoprene, etc., organic synthesis products - alcohols, oxides, glycols, aldehydes, anhydrides, acids, cretones, etc. The final product of oil and gas chemistry is a variety of types of plastic, synthetic rubbers and resins, chemical fibers, detergents, surfactants, etc.

The production of lower olefins is based on the pyrolysis of hydrocarbon feedstock. Currently, about 50% of the world's ethylene volumes are produced from naphtha (other names are naphtha and petroleum alcohol).

Braginsky (2014) notes, that as seen in the schematic image, the formation of cluster formations in oil and gas chemistry is a response to the global challenges of our time. For the gas and petrochemical industry, as one of the most capital-intensive industries, the management of technological innovations, resources, concentration of competencies, the formation of conjugated territorial-industrial agglomerations of a new generation are currently becoming priorities. In accordance with the Plan for the development of gas and petrochemicals of Russia for the period until 2030, the implementation of the principles of effective use of raw materials, the development of infrastructure, the creation of competitive production and the development of demand for oil and gas chemical products can be best realized through the formation of oil and gas chemical clusters at the intersection of large industrial projects, including with international participation. The cluster approach provides an efficient solution to a number of main problems in combining oil refining and oil and gas chemistry. The integration and structuring of the maximum number of competitive competencies in a single oil and gas chemical cluster allows us to form an innovative and infrastructure platform, with several cores of large scientific, design, engineering, production and educational organizations, united by solving the priority tasks of cluster development and production of products of high limits.

Sokolov (2016) notes: as follows from the universal design of the oil and gas chemical cluster, meaning an interconnected system, in general, its balanced functioning in the industrialized region, on which the largest Russian energy companies are represented, is able to provide a long life cycle in which there is simultaneously competition and cooperation as integral components of the socio-economic development of the Republic of Belarus and the Russian Federation as a whole.

Currently, the main areas of development of oil and gas chemistry remain the production of olefins, the main raw materials for petrochemical synthesis, and the processing of gas raw materials into propylene, global demand for which will almost double in the coming decade. However, recently, modern foreign petrochemical complexes have begun to switch to the production of increasingly high-tech products (plastics, synthetic rubbers, basic organic synthesis products) with high consumer characteristics and a wide range of applications of products from them.

The rapid growth of oil and gas chemistry is due to its high competitiveness. The determining factors here are: low prices for oil and gas chemical raw materials (ethane, liquefied hydrocarbon gases and naphtha); convenient logistics and low costs for transportation of finished products from production sites to consumption markets, low specific level of capital costs.

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As Demina (2018) wrotes, today, China has the lowest capital expenditure. For example, the average unit capital costs for the construction of pyrolysis facilities ($/ton of ethylene) in this country are 1.5 times lower than in the European Union. We add that in Korea and China, the creation of an integrated oil and gas chemical capacity for the production of 500 thousand tons/year of pyrolysis and polyethylene from the moment the development of the investment idea begins to the launch of the industrial complex averages 3-4 years. As a result, in only 5 years (from 2005 to 2010), China increased its own polyvinyl chloride production capacity by almost 70%, becoming a net exporter of this product from a country experiencing acute shortages in PVC.

It should be noted that a low level of capital expenditure is achieved primarily through the introduction of advanced technologies. At the same time, operating costs (due to lower consumption rates for raw materials, materials and electricity) and environmental events costs are also reduced.

It is important that in almost all new oil and gas chemical regions (particularly the Persian Gulf region and North and South-East Asia) the above-mentioned competitiveness factors are being developed with the active support of States.

In addition to the shortage of basic capacities, Russian oil and gas chemistry is characterized by a number of other features and problems:

First, technological backwardness (more than 40% of technologies belong to the 60-70s of the last century and earlier, almost 30% of technological processes were introduced in the 70-80s of the last century) and high depreciation of fixed assets (on average 43%), the maximum level of capacity utilization of the most important types of oil and gas chemical products.

Secondly, the underdevelopment of the domestic market (at the current level of GDP per capita, the country should consume 1.5-3 times more plastics), which is due to the insignificance of the share in GDP of traditional industries-consumers of petrochemical products (construction, housing and communal services, automotive industry, packaging).

Thirdly, the imperfection of the regulatory framework in the field of technical regulation of oil and gas chemistry. According to experts, many provisions of existing legal acts on technical regulation, including industry standards, are either outdated, redundant, or agreed among themselves and contradict each other.

Fourth, infrastructure restrictions, primarily on the transportation of oil and gas chemical raw materials. There is a geographical gap between the regions of oil and gas chemical production (Western Siberia) and the regions of its processing (European part of Russia), which is not compensated by the presence of a developed network of product pipelines for the transportation of a wide fraction of light hydrocarbons and LPG. Suffice it to say that in Russia the total length of product pipelines for LPG transportation is a little more than 2 thousand km, while, for example, in the USA this figure is more than 128 thousand km. Most of the liquefied gas transportation in Russia falls on railway transport, which increases the share of the transport component in the price of LPG among its processors.

Fifth, the small size of domestic production. So, the basis of domestic oil and gas chemistry is pyrolysis plants EP-300 with a design capacity of 300 thousand tons of ethylene per year, while a significant part of these plants has never reached the declared design capacity.

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Sixth, limited opportunities to export additional volumes of oil and gas chemical raw materials to adjacent markets.

At the same time, despite the presence of problems and weaknesses, in Russia there are a number of prerequisites for the further development of oil and gas chemistry. In addition to the excess of relatively cheap and affordable oil and gas chemical raw materials noted above, as well as the high potential for developing the domestic market, there are large vertically integrated structures in the country that can independently or with the support of the state create competitive production (Rosneft, Gazprom, LUKOIL, NOVATEK, SIBUR Holding, etc.).

In addition, Russia already has quite large chemical nodes that can become the basis for the cluster development of the oil and gas chemical industry (oil and gas chemical complexes in Tatarstan, Bashkortostan, Nizhny Novgorod region, in the Tobolsk region, as well as complexes in the area of the cities of Sayansk and Angarsk in Eastern Siberia). Within the framework of these complexes, it is possible to create new capacities using the already existing infrastructure and raw material potential, thus saving on capital costs.

Thus, despite the above mentioned problems and weaknesses in the development of oil and gas chemistry in Russia, there is great potential for raw materials, markets and production base, and with the correct and coherent policy of the state and companies in the field of oil and gas chemistry, the country can successfully overcome these problems.

Today, we see how among the various forms of local production systems, the innovation and investment sectors of the regional economy take the first positions. It is important that, if possible, in each Russian mega-region, the main direction of formation of gas chemistry is an orientation towards the intensive development of both domestic and external markets for products.

This is especially relevant for the economy of the Far East. The commissioning of the Power of Siberia gas pipeline will accelerate the creation of the country's largest gas processing and gas chemical clusters in the Amur Region, the core of which will be the Amur Gas Processing Plant and the Amur Gas Chemical Plant. The project is planned on the basis of deep gas processing (up to 42 billion cubic meters. annually) produce 2 million tons of ethane, 1.5 million tons of LPG, 1.5 million tons of ethylene, 200 thousand tons of pentane-hexane fraction and 60 million cubic meters. helium, its main consumers will be China and the countries of the Asia-Pacific region. "Turn to the East" will allow connecting the richest resources of the Russian Federation with the capital and technologies of the Asia-Pacific countries, will give a powerful impetus for the sustainable development of the Far East, including by creating 5 thousand new high-performance jobs, which will partially solve the demographic problem (reduce the outflow from the region of a workable population, consolidate the labor resources of the region, ensure the influx of high-class specialists).

According to Chernikov (2012), the need to establish new gas production centers becomes an imperative challenge to energy: development of new deposits located in the Far North, on the shelf of the Arctic seas and the Caspian Sea, as well as in Eastern Siberia and the Far East, characterized by increased environmental vulnerability and difficult climatic and geological conditions, is quite comparable in complexity and cost with the development of gas wealth in Western Siberia, carried out in the 1970s and 80s. According to the forecast made during the development of the ES-2030, the new centers will provide

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production in the amount of 490-550 billion cubic meters of gas by 2030, which is slightly less than all current production in the Nadym-Pur-Tazov region.

Minenergo describes, that Eastern Siberia is the largest oil and gas province of the Russian Federation. There, oil and gas production is increasing, a large-scale gas infrastructure is being created, opening up new opportunities for the development of the economy of the Siberian mega-region. As indicated in the draft Energy Strategy of the Russian Federation -2035, the adoption of tax incentives allowed to increase oil production in Eastern Siberia and the Far East by 5 times (from 14.3 to 74.6 million tons); offshore more than 2 times (from 12.7 to 29.1 million tons); hard-to-recover reserves (TRIZ) - by 6 million tons (up to 38 million tons) (Draft energy strategy of the Russian Federation for the period up to 2035, 2019).

In addition to significant hydrocarbon reserves, the main factors for the effective development of gas chemistry are: electricity produced by the Zeya and Bureyskaya hydroelectric power stations; the growing demand for deep products in China and Asia-Pacific countries; administrative and tax regulatory support from the state through the system of regional preferences and the formation of territories of advanced development; achieving an optimal PPP balance; cluster integration of medium and large gas chemical companies.

Once again, we note the importance of introducing the Amur GPP. This is a strategically significant link in the GHG supply chain to China along the eastern route as part of the largest contract in world history. The Power of Siberia gas pipeline plant will receive multi-component gas from the Yakutsk and Irkutsk gas production centers. At the GPP, ethane, propane, butane, pentane-hexane fraction and helium will be separated from it - valuable components for gas chemical and other industries. Processed gas will be supplied to the PRC.

Also, according to experts, "the implementation of the largest investment projects in the Priamurye will lead to the influx of new technologies into the region, and will increase the quality of education. School students, university students will have the opportunity to work with the most modern solutions, companies - industry leaders. The labor market will provide young people with the opportunity to choose a wide range of professions, including those that are practically absent in the region today: related to digitalization, IT, management of large projects."

Thus, according to the plans of PJSC Gazprom, the bulk of the GHG produced in Eastern Siberia will be sent for processing to the Amur Gas Processing Plant, which will become the largest in the Russian Federation and one of the world's most important GHG processing enterprises. In turn, it will be technologically connected with the enterprise for deep processing of hydrocarbons. In fact, we are talking about a change in the strategic approach to the development of the industry - from expanding existing capacities to creating new ones. And this is extremely important.

Today we can already say that, finally, "growth points" have been found that will eliminate the accumulated problems and give a vector of progressive development of oil and gas chemistry.

The cluster model of gas and gas chemistry development in the regions of the Russian Federation is based on the implementation of the general idea of forming an industrial architecture that would integratively combine energy facilities into a complex, interconnected and waste-free system for processing hydrocarbon raw materials into high-tech products with high added value, adhering to the strategy of

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monetization of raw materials flows, a gradual but expected transition from an export-raw material to a resource-innovative model.

The competitiveness of clusters in the fuel and energy complex is characterized by their ability to achieve a synergistic economic, technological and geopolitical effect, expressed in increasing national competitiveness, attracting investment, international positioning, increasing the quality of life of the population, creating high-performance jobs, reducing dependence on foreign products, and comprehensive regional development.

Ideally, a competitive oil and gas chemical cluster should fully cover the needs of the economy for certain types of high-value products and export it outside the territory on which it is located. Practically, the level of competitiveness of the cluster can be determined on the basis of measuring the requirements of the national economy for domestic high-tech products, balances of fuel-energy and gas-chemical resources of various regions.

The main purpose of oil and gas chemical clusters is to be the basis for the formation of the competitive advantages of the country and its regions, they can become the growth point and locomotive of the regional economy only when implementing an innovative breakthrough scenario for the development of the fuel and energy complex. The formation of oil and gas chemical clusters in the fuel and energy sectors, in our opinion, will contribute to obtaining a synergistic effect, consisting in their positive impact on the state of the domestic economy, and, therefore, will contribute to increasing the competitiveness of the regions

6. Findings

For the Russian Federation, oil and gas chemistry acts as the basic segment of Russian industrial production, including more than 650 large and medium-sized industrial enterprises, which employ about 280 thousand people. About 2% of the value of fixed assets of industry and more than 5% of the value of fixed assets of manufacturing industries are concentrated in the industry. At the same time, the contribution of oil and gas chemical enterprises to the country's GDP is small - 0.5% (2017 data). Considering that in 2009 it was 0.4%, it must be admitted that the development of the oil and gas industry in Russia is extremely slow.

Neftegaz (2019) notes, key feature of oil and gas chemistry in the Russian Federation is the lack of capacities for the production of basic monomers (ethylene, propylene, butadiene), primarily pyrolysis, which limits the development of the industry.

But, despite the existing problems in the development of oil and gas chemistry, Russia has great potential in this industry, so with a successful and thoughtful policy of the state and companies in the field of oil and gas chemistry, the country can successfully rise to a new level.

Today it can be stated that the situation with the environment is improving, serious funds are allocated for its maintenance and restoration of ecosystems (10-15% of the cost of each project). This has become part of the corporate policy of companies that work closely with regional authorities on this issue.

It is proposed to develop domestic oil and gas chemistry by forming six clusters: West Siberian, Volga, Caspian, North-West, East Siberian and Far Eastern. The production core of each of them will be large pyrolysis capacities (from 0.6 to 1 million tons of ethylene and more).

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7. Conclusion

Thus, the regions of the Russian Federation must not miss resource opportunities to "overtake, without catching up" the accelerating locomotive of world oil and gas processing.

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