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Analysis of the Development of Gas Processing and Gas Chemistry in Russia: Possibilities and Prospects

The main trend in the development of the gas sector in Russia is that in the nearest future the companies will have to develop complex natural gas condensate reservoirs and multicomponent deposits. Gas producers will have to perform deep gas exploration and production (Cenomanian gas deposits are being exploited mainly at a depth of 9,000 to 12,000 m). Dry natural gas that is relatively easy to extract and ship to consumers is obviously coming to an end in the country. So, for instance, natural gas from East Siberian gas fields is substantially different from that of Cenomanian gas fields, which has been long exploited by the Russian gas sector. Its features are as follows:

- it contains large amounts of a broad fraction of light hydrocarbons, condensate, and therefore, is a valuable raw material for the gas industry;
- it contains large amounts of helium (its concentration in the gas reaches 0.2–0.6%), which makes special demands on its processing technology.

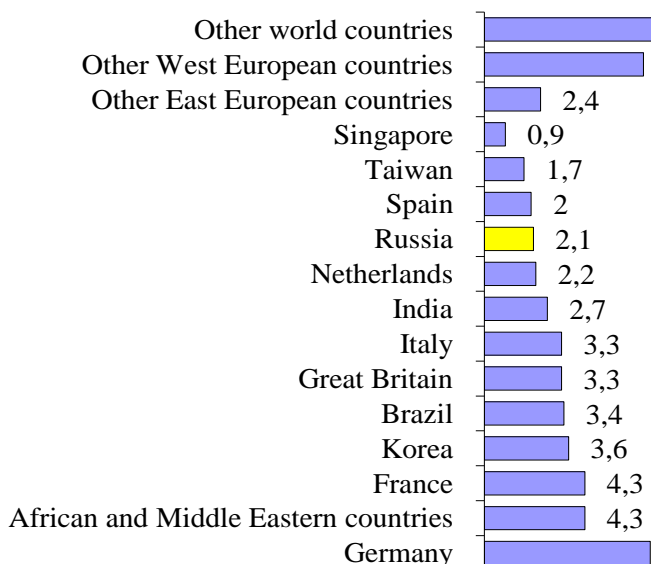
The product extracted from natural gas condensate fields differs from pure natural gas by the presence of impurities (including liquid hydrocarbon fractions), which complicates the technological production of this gas. If Cenomanian gas requires only drying and removal of mechanical impurities, then it is necessary to construct a whole complex of devices, including those for the separation, deethanization, fractionalization, and stabilization of condensate, to process multicomponent natural gas.

Gas-bearing beds of a multicomponent composition have lower reservoir properties as compared to Cenomanian deposits (lower porosity and permeability), therefore it is more difficult to exploit them. In order to produce gas from natural gas condensate mixture, we need to simultaneously solve the problem of the produced gas

condensate that is a valuable petrochemical raw material. Thus, the rational use of the raw material requires additional facilities to process it.

A principal feature of the current situation, associated with the problems of the rational use of gas, consists in that their solution insists on the implementation of a series of new investment projects such as the construction of natural gas processing plants, new gas collection and treatment systems at the fields, the expansion and development of new natural gas underground storages. The investment character of the solution of the problem largely determines the nature of the approaches to the problem solving. Under current conditions, one of these approaches is the implementation of a complex strategy for using natural gas resources, aimed at the development of the raw material component in the gas industry.

Even though our country has a giant resource potential, it lags behind other developed countries in the development of gas chemistry by several decades (not only in the overall production, but also in technical and technological aspects). The country with the world's largest resources of hydrocarbon raw materials, the world leader in the production volume and export of hydrocarbons in fact takes a back seat to the world chemical industry. Russia's share in the world's chemical production is presently 1–2%, according to different estimations (Fig. 1).



Source: American Chemistry Council (<http://www.americanchemistry.com>)

Fig. 1. Country's contributions to the world chemical production in 2008, %

The development of the chemical industry is currently facing a number of serious system problems because of the following factors:

- specific features of capital assets. Most part of enterprises were built during the Soviet period; production facilities were oriented on the internal needs of the basic chemical production (the product line structure of most Russian chemical enterprises was formed at the end of the 1980's, so it corresponds less and less to the present demand structure of both domestic and foreign markets). It should be added that a considerable part of the chemical equipment left from the Soviet times of the USSR initially manufactured the products not meeting world standards;

- high depreciation of fixed assets; as a whole, depreciation of fixed production assets is 43% in the industry and the useful life of its major part is 20 years and more (for comparison, the useful life of the

equipment of American chemical enterprises is on average about 6 years);

- mismatch between the technical level of the industry and modern demands (the use of obsolete technologies characterized by high unit costs of raw materials and energy along with a narrow product line and low quality products).

Hence, the current industrial structure of the domestic chemical complex does not meet the Russian economy demands. So, Russian producers cannot satisfy the domestic market in both absolute volume and product mix of many products (e.g., polyethylene, polypropylene, PET). Therefore Russian market needs, which are more and more shifting towards high technology chemical products (plastic products, synthetic fibers and threads, paint materials, chemical plant-protecting agents, plasticisers), are mainly met by import. Thus, the system problem of the Russian chemical complex consists in a gap between the development of the chemical production market and the development of the Russian chemical industry [1].

The Russian chemical industry is currently being in the system technological crisis. The country does not have own technologies applicable for the bulk production of almost all types of chemical products that can be manufactured based on the gas raw material. This refers not only to complex polymer products, but also the most common basic products such as methanol, ammonia, polyolefins. All large chemical plants working in Russia (e.g., Tolyattiazot Corporation, Tobolsk Petrochemical Company, in Tomsk and Gubakh) were once purchased overseas, however, according to contemporary estimates, the efficiency of these lines now does not look impressive. Over the last 20 years, the unit powers of the technological plants producing gas and petrochemical products increased on average two times. Some products (e.g., terephthalic acid) became large-scale; their unit production capacity were, at best several tens of thousand tons per year (now it is hundreds of thousands) in the 1980's until the early 1990's.

Russia also does not have presently any serious practical feasibility of producing modern chemical and petrochemical equipment. One may speculate on the ability of domestic mechanical engineering enterprises to produce the required equipment, however, there are too

many obstacles in practice, starting, for example, with certification. The equipment should be certified by foreign licensors (holders of rights on chemical technologies) as suitable for the use in the respective technological processes.

From the above, the conclusion follows that in the foreseeable future, the practical implementation of any large-scale gas chemical projects in Russia will involve not only foreign technologies, but also imported complete equipment.

As the practice shows, it is now much easier and cheaper to build a chemical plant in Saudi Arabia or China than in Russia (a fortiori in the oil and gas regions of Eastern Siberia, where the necessary infrastructure is almost absent). Moreover, our distances of 3–3.5 thousand kilometers to main consumers (in both Western and Eastern directions) add the transportation costs of 100–150 US dollars/t to the production cost, which does not make Russian chemical products more competitive in foreign markets. On the other hand, as for the domestic market, our distances and these transportation costs of 100–150 US dollars/t well protect domestic companies from foreign competitors.

As for the domestic market, the Russian market capacity of chemical products is so small that it is very difficult to compare the production and consumption indicators of the main types of chemical products in Russia and developed countries. So, for example, per capita production of five basic polymers in Russia is about 21 kg, which is almost 4 times lower than in West European countries (Table 1).

Table 1. Indicators of per capita chemical production in 2008, kg/person

	Russian	Western Europe
Polyethylene	9.9	29.0
Polypropylene	4.2	21.8
Polyvinylchloride	3.7	14.8
Polystyrene	1.8	5.8
Polyethylenetherephthalate	1.9	5.5
Ethyleneglycol	1.6	4.5

Chemical fibers and threads	1.1	10.3
Synthetic rubbers	6.7	5.0
Methanol	16.1	6.5

Source: Kim S. Per Capita Gap, The Chemical Journal, 2010, No. 3, pp. 46-49; Facts and Figures: The European Chemical Industry in Worldwide Perspective, CEFIC, 2009, 46 p.

At present, Russia outruns West European countries only in the production of synthetic rubbers, methanol, and mineral fertilizers that are the main item of Russian export of chemical products. However, even leading in their production, Russia is significantly behind developed foreign countries in their consumption. For example, the amount of mineral fertilizers used per unit of agricultural land in Russia is by an order of magnitude less than in West European countries with intensive agriculture, and 3-4 times less than in Canada. Correspondingly, yield of agricultural crops in Russia is about 3 times lower than in the Netherlands and Great Britain, and 1.5 times lower than in Canada [2].

The total domestic production capacity of some chemical products (e.g., polyethylene, polypropylene, ethyleneglycol) is now lower than the unit capacity of plants commissioned in the Middle East annually. Hence, all chemical enterprises of the Russian Federation are at present no more than local players.

Under these conditions, the evolutionary development of the chemical industry based on the existing capacities will not change the current situation. A qualitative leap is required in the development, which is possible only through the construction of large enterprises based on modern technologies aimed at the production of quality products meeting the demands of Russian and foreign markets. At the same time, however, it should be noted that under current Russian conditions the implementation of these projects is very difficult because of the absence of own technologies, insufficient capacities of the domestic chemical engineering, specific infrastructural limitations, and state nonfeasance.

And yet under proper stimulation of domestic consumption, it is possible to expect considerable growth in demand for chemical products from the domestic engineering, agriculture, transport, and other industries. At the same time, the estimations of the internal

demand prospects for chemical products cannot be simply algorithmically related to economic growth rates (GDP growth), population size and incomes. Along with economic growth rates, there is also the concept of the quality of economic growth. In the last 5–7 pre-crisis years, Russia outpaced almost all large countries, except China and India, in economic growth rates. However, these so high growth rates were mainly determined by the dynamics of the development of the mineral raw material sector of economy (first and foremost, oil and gas), which was in turn boosted by an exclusively favorable situation in the world market of raw materials. And there was no sign of any jump in the development of the processing sector, in particular, in the oil-refining and petrochemical industries. Neither the example of Middle East oil producing countries, which have developed own highly competitive petrochemical industry on the top of the oil boom with export orientation, nor the example of China, where the annual growth rates of the petrochemical industry, mainly aimed at the domestic market, have recently reached 15–20%, became contagious for Russia.

We speak about a catastrophic gap between Russia and “old” and “new” industrial countries not only in the development of the chemical (including petrochemical) industry *per se*, but also in the consumption of chemical products, in the level of chemicalization of the sectors of national economy. This in turn is an evidence of an extremely low quality of economic growth, of the absence of essential fundamental prerequisites for increasing the economic and energy efficiency of the national economy. Fairly speaking, it is vital for Russia to make a leap in the development of chemistry and petrochemistry in order not to fall behind the other industrial countries forever – it is evident that our country simply does not have an alternative. If we want to have automotive, aircraft, furniture, textile, and other industries, the military-industrial complex, and the developing space sector, we have to meet the demands of these industries with Russian chemical materials.

The development of gas resources in the east of our country provides very promising prerequisites for such a “chemical leap”.

First, the development of the gas industry in the Eastern Siberia (unlike the Western Siberia or the Ural-Volga region) is only being

started, which gives some time allowance for the preparation and implementation of large-scale gas (oil) chemical projects. The increasing rather than decreasing volumes of gas production will underlie these projects.

Second, in the development of gas (oil) chemistry in the Eastern Siberia, the total energy potential of the territory can be effectively used. Losing to the central and border regions of the country because of transport costs, the Eastern Siberia has, for example, obvious advantages in hydropower supply, and here, unlike the other regions, it is not required to burn gas to generate electricity for chemical plants.

Third, the Eastern Siberia possesses significant potential for increasing own consumption of chemical products due to the development of the wood processing industry, mechanical, industrial, and civil engineering, and agriculture.

Fourth, in a number of polymer products the Eastern Siberia is in a good competitive position to export to APR countries.

At the same time, it is evident that the above favorable prerequisites cannot be implemented of their own accord. It is impossible to start the process of the intensive development of gas (oil) chemistry to the benefit of the national economy without the active and direct participation of the state. Not also effective measures of the state stimulation of process industries themselves (by tax reliefs, transport and electric rate limitations, etc.) are required, but also a whole complex of measures aimed at the stimulation of the domestic demand for chemical products.

An increase in the degree of use of modern high technology construction materials is the most important element of the economic and industrial policy. The program should

- first, be based on that the current state of the chemical industry along with the volumes and character of chemical product consumption in Russia, a colossal gap between Russia and other industrially developed countries in this aspect are incompatible with the plans for the transition of the national economy as a whole to innovative development;
- second, rest upon long-term strategic principles rather than be limited only to anticrisis measures that are necessary to support

chemical producers under today's conditions, but fail to radically solve the set of problems accumulated over the last 20 years.

Chemicalization refers to almost all types of economic activity, all economic and social industries. Within the actions relating to each particular industry and type of activity, the consumption features (volumes, growth dynamics, product structure, price preferences, effects on economic indicators) should be taken into account; the stimulation measures for demand and the orientation of the effect on particular chemical products should be selected (Table 2).

Table 2. Elements of the state policy on the development of the domestic demand for chemical products

Oil and gas chemical production	Main petrochemical consuming industries	State measures to support demand
Polyethylene, PVC, thermoplastic elastomers	<i>Construction engineering:</i> pipes, construction elements, motorways	Programs for the extension and stimulation of the construction engineering complex. Introduction of norms and rules for the use of modern materials and their products
Polyethylene, polypropylene, polycarbonates, polyolefines Rubbers	<i>Automotive industry:</i> autocomponents, tires	Stimulation of the demand for cars produced in Russia Development of clear requirements for localizing the production of autocomponents for foreign companies that have assembly facilities in Russia
Polyethylene, polypropylene, PET, PVC, polystyrene	<i>Consumer goods:</i> packaging units, plastic products	Import substitution Support for plastic processing enterprises
Carbamide, niter	<i>Agriculture:</i> fertilizers	Investment and financial support for agricultural producers Stimulation of long-term investments in cultivated land

The status of stimulating measures covering every sphere of consumption should be directly related to the potential scale of application of chemical products and the social economic effect that can be obtained.

The stimulation of the development of gas and oil chemistry through the development of the domestic demand implies

- the preparation and implementation of programs for the expansion and stimulation of the construction sector;
- the development and introduction of norms and rules (within the legislation on technical regulation) for the use of modern materials and their products;
- the elaboration and implementation of measures to stimulate the demand for cars produced in Russia;
- the implementation of measures for import substitution (first of all, polyolefins and rubbers);
- investment and financial support for agricultural producers.

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This collection of articles contains the main points of research of young scientists in such areas as municipal and regional development, management of industries, corporate finance, economic sociology. This book will be of great value to a wide range of scholars, practitioners, and interested observers of the Russian economy.

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