Current state and problems of integrated development of mineral resources base in Russia

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Abstract. The article deals with the issues of integrated development of subsoil resources taking into account the actual problems facing the Russian oil and gas complex. The key factors determining the need for integrated development of subsoil resources have been systematized and investigated. These factors are the change of the hydrocarbon resource base quality, the improvement of the depletion degree of basic (unique and major) oil fields, the increase in the number of small and smallest oil fields discovered and introduced into development, the increased capital intensity and the riskiness of geological exploration, and the territorial location of new subsoil use facilities.

1. Introduction

The oil and gas complex has a powerful influence on the Russian economy. Over the past twenty years, the oil and gas industry have been the guarantors of economic growth and contributed to the accumulation of state revenues [1, 2].

Long-term sustainable development of Russia's oil and gas complex is primarily related to the integrated development of mineral resources (IDMR). There are a number of important prerequisites that necessitate the transition to integrated development of subsoil resources including changing the quality of the hydrocarbon resource base, increasing the depletion degree of the base (unique and major) oil fields, increasing the number of small and smallest oil fields being discovered and introduced into development, the high capital intensity and riskiness of geological exploration, and the territorial location of new subsoil use facilities.

The transition to IDMR will allow to diversify the directions of economic growth and create new centers for the generation of value added (the cost created by processing industries), to reduce the dependence of the economy on the export of hydrocarbon raw materials.

2. Methods of research

As a methodological basis in the article, the system approach is implemented by way of a general scientific method of cognition, as well as applied methods of synthesis, classification, generalization and grouping, comparative and structural analysis. Based on the methods of system analysis, various aspects of the integrated development of mineral resources in Russia have been analyzed, and groups of factors that determine the complexity of development have been classified.

3. Results and discussion

3.1. Factors of integrated development of oil and gas industry in Russia

When formulating an effective policy for the integrated development of promising oil and gas areas, it is first of all necessary to take into account the strategic interests of the Russian Federation and the priority tasks of the social and economic development of these regions of the country. The need for integrated development of oil and gas reserves and resources is conditioned by the need to address the industry's priority tasks related to:

- changes in the quality of the hydrocarbon resource base;
- increasing the depletion degree of basic (unique and major) oil fields;
- an increase in the number of small and smallest oil fields discovered and put into development;
- high capital intensity and risky geological exploration;
- the territorial location of new subsoil use facilities, their distance from the traditional centers of production, processing and consumption.

The integrated development of oil and gas bearing areas should focus on the creation of new large centers, processing petroleum chemistry products. The core of integrated development is implementing a resource-innovative approach to the formation of the petroleum industry in Russia and resource-saving. *The resource-innovative approach* is understood as the restriction on the export of unprocessed raw materials as a complex mineral raw material and the creation in Russia of powerful centers to process the products of oil and gas chemistry, where high-tech products with high added value will be made. *The resource saving approach* means, firstly, minimizing the losses and waste of the raw materials complex due to the complex utilization of its products or conservation for future generations, if the production capacity exceeds the market needs, and secondly, the mandatory requirement of a qualified (giving the greatest value added) use of hydrocarbon raw materials.

3.2. Ensuring expanded reproduction of the mineral resource base

The reproduction of the oil and gas resource base ensures sustainable development and operation of the entire petroleum complex in Russia. The development of systems for the search, assessment and exploration of hydrocarbon reserves is one of the important elements of the complex technological re-equipment of the petroleum complex as a whole, its transfer to domestic equipment, technologies and software.

However, in recent years, the paradigm of reproduction of the resource base of oil and gas has changed. In mature oil and gas provinces, newly discovered fields and structures are represented by small and smallest objects in oil reserves, which in recent decades have been the main growth of reserves in Russia (table 1).

Table 1. Production and increment of oil reserves in Russia.

Indicator / Year	1991	1995	2000	2005	2010	2011	2012	2013	2014	2015	2016
Oil production, million tons	462	307	323	470	505	511	518	523	527	534	534
Increment in oil reserves, million tons	931	182	295	330	773	700	681	635	750	730	575
Multiplicity of oil reserves reproduction, units	2.0	0.6	0.9	0.7	1.5	1.4	1.3	1.2	1.4	1.4	1.1
"Eating" / expansion of oil reserves (increment minus production), million tons	469	-125	-28	-140	268	189	163	112	223	196	41

3.3. Ensuring the complex utilization of associated petroleum gas

The level of utilization of associated petroleum gas (APG) largely determines the degree of development efficiency of the entire oil and gas complex of the country. In this connection, the activities related to the extraction and use of APG in Russia are one of the topical and priority tasks for the sustainable development of Russia's oil and gas industry [3, 4].

The production of associated gas in Russia in 2015 amounted to 78.2 billion cubic meters, including 67.8 billion cubic meters (86.7%) extracted and used, and 10.4 billion cubic meters (13.3%) taken into account as gas burned in gas flares.

3.4. Need for processing of condensate gas

An important trend in the development of the Russian gas industry is the change in the structure of the raw materials base. The majority of hydrocarbon fields in East Siberia are of the oil-and-gas or gas-and-oil type, i.e. they contain oil, gas, condensate; and natural gas has a high content of homologues (methane, ethane, propane, butanes), as well as condensate and helium [5]. This is the so-called "fat gas", that requires the processing and separation of valuable components, which are raw materials for oil and gas manufactures (table 2).

Table 2. Comparative characteristics of natural (free) gas of East Siberia, the Republic of Sakha (Yakutia) and West Siberia.

Subject of the Russian Federation	Condensate content, g/m^3			Ethane content, g/m^3			Propane content, g/m^3			Content of butanes, g/m^3		
	weighted average	max	min	weighteda verage	max	min	weighted average	max	min	weighted average	max	min
Irkutsk region	132.9	200.0	11.0	70.0	161.9	60.6	32.2	76.3	19.9	21.3	51.1	14.0
Krasnoyarsk region	155.5	354.0	16.8	68.8	138.8	37.6	41.7	61.7	13.6	26.4	42.0	9.5
the Republic of Sakha (Yakutia)	39.4	139.0	1.5	60.2	108.8	25.0	27.9	63.2	3.4	13.9	23.7	3.0
East Siberia and the Republic of Sakha (Yakutia)	117.1	354.0	1.5	66.2	161.9	25.0	33.8	76.3	3.4	20.7	51.1	3.0

Therefore, when creating future oil and gas production centers in the east of the country, it is necessary to plan the establishment of facilities for processing and underground storage of hydrocarbons and associated components and synchronize the development programs for the oil and gas industries.

3.5. Providing separation and storage of associated components, for example helium

The main helium provinces of Russia are connected with the oil and gas basins of the East European and Siberian platforms. Helium is taken into account in dissolved gas at a content of not less than 0.035%, in free (including gas of gas caps) - not less than 0.05% [6].

The concentration of helium in the only developed Orenburg field in Russia is 0.053-0.055%. However, at the fields of East Siberia and the Republic of Sakha, which is the largest undeveloped helium province in the world, this indicator is significantly higher (on average 033-0.42%) and reaches 0.65% (table 3).

Table 3. Weighted average values of helium content in natural gas of East Siberia and the Republic of Sakha (Yakutia).

Subject of the Russian Federation	Structure of ABC1C2 reserves		Helium content,%	
	Helium-containing gas,%	Helium,%	max	min
Irkutsk region	47	34	0.32	0.04
Krasnoyarsk region	14	12	0.65	0.18

the Republic of Sakha (Yakutia)	39	54	0.65	0.04
East Siberia and the Republic of Sakha (Yakutia)	**100**	**100**	**0.65**	**0.04**

The start of large-scale natural gas production in the east of the country can make the regions of East Siberia the largest helium suppliers on the world market.

3.6. Ensuring the effective development of unique and major deposits

The strategy for the development of the Russian oil complex in the twentieth century was geared towards expanding the geography of the oil industry at the expense of new provinces on the continental part of Russia. At the same time, priority was given to the search and introduction into development of unique and major deposits. The expansion of oil production geography in Russia occurred from the western to the eastern and northern regions of Russia [7].

During the entire period of the petroleum industry development in Russia, 21 unique and 113major oil fields were discovered.

3.7. Ensuring the organizational and legislative environment for the development of small and smallest fields

Economic incentives for the development of oil and gas fields further strengthen the "biased" nature of the fields' choice. Naturally, giant and major fields are the first of the opened to be introduced in the development [8, 9]. At the same time, as the basins pass through the peak of their production, it is necessary to intensify the search and introduce small and smallest fields into development to maintain the oil production or to reduce its rate (table 4).

Table 4. Comparative characteristics of the resource base and the state of oil production in small and smallest fields in the Republics of Tatarstan and Bashkortostan by majors and independent companies.

Parameters	Tatarstan			Bashkortostan		
	majors	independ.	total	majors	independ.	total
Number of fields	89	89	178	160	1	161
Number of discovered fields, 1991-2013	46	38	84	35	1	36
Initial recoverable reserves, million tons	287.2	309.0	596.2	438.1	1.4	439.5
Cumulative production, million tons	88.0	80.2	168.2	267.5	0	267.5
Current production, 2013, million tons	3.5	5.3	8.8	5.8	0	5.8

4. Conclusions

Thus, the integrated development of subsoil is closely connected with the current problems of transformation of the oil and gas complex as a whole. At present, the issues of integrated development of subsoil resources are associated with the depletion of major fields and the increasing role of small and smallest fields and the need to change the institutional, legislative and organizational environment for subsoil use. Also, an important issue of ensuring the complexity of subsoil development is the qualified utilization of all associated components (APG, ethane, propane, butane, helium, condensate, etc.) [10, 11].

Ensuring the integrated nature of the subsoil resources development will allow us to diversify the economy, create new industrial centers, master remote areas and improve the socio-economic level of regional development.

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