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ПЕРСПЕКТИВЫ И ТЕХНОЛОГИЧЕСКИЕ ОСОБЕННОСТИ ДОБЫЧИ МЕТАНА УГОЛЬНЫХ ПЛАСТОВ

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В статье обосновываются перспективы использования нетрадиционных источников углеводородного газа в России на примере метана угольных пластов. Авторы статьи описывают технологические особенности добычи угольного газа. Представлено графическое изображение технического обустройства месторождения по добыче угольного газа и схема добычи метана с помощью гидроразрыва пласта.

Ключевые слова: Метан угольных пластов, нетрадиционные источники природного газа, гидроразрыв пласта, угольный газ, пропант, компрессор.

THE PROSPECTS AND TECHNOLOGICAL FEATURES OF COALBED METHANE PRODUCTION

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In the article the prospects of using unconventional sources of hydrocarbon gas in Russia on the example of coalbed methane are discussed. The authors of the article describe the technological features of coal gas production. A graphical representation of the technical arrangement of the coal gas field and a scheme of methane extraction using hydraulic fracturing are presented.

Keywords: Coalbed methane, unconventional sources of natural gas, hydraulic fracturing, coal gas, proppant, compressor.

Coal has been the main source of energy and heat since ancient times. It was used as a fuel in heating systems, ships and trains, in the chemical industry and metals production, etc. Coal was a single source of energy over time, but the development of the gas industry undermined its attitudes. High-energy and environment-friendly natural gas has determined the vector of development of the world fuel and energy complex. Currently, challenges of natural gas reservoir engineering are strategically important. The global consumption of natural gas is increasing every year, which leads to the depletion of gas-condensate fields. That is a reason for the exploration of new promising sources of hydrocarbons. One of them most potential methane of coal deposits.

Methane extraction at the early stages of coal deposits development will not only open new perspectives of expansion hydrocarbon gas resources and reduce the gas hazard of coal mining in future, but will also create new jobs at gas fields and gas processing plants.

Nowadays, scientists have already made an assessment of coalbed methane reserves, which are estimated to be about 30% of Russia's natural gas resources. Thus, coalbed methane has great prospects for development, production and processing [2]. The USA, Canada, Australia and some other countries have practical knowledge in the technical application of coal gas.

The development of unconventional hydrocarbons is becoming an important new area of global energy development. According to the data, published by the International Energy Agency, unconventional gas production in 2010 was estimated to be 485 billion m3 (15% of world production), and according to the forecast for 2035 will increase to 956 billion m3 (Table 1) [4].

Hopeful geological settings of gas-bearing coal basins in Russia are an objective prerequisite for the initiation of large-scale methane production as standalone products. It is important to note that the Kuznetsk coal basin, located in the south of Western Siberia, is one of the largest in the world and contains large reserves of gas [3].

Currently, there are three main ways to extract methane from coal seams:

- coal mine degasification, which reduces the volume of methane released into the mine workings. In this case, coal gas of varying concentrations is considered to be an associated mineral;
- methane extraction by drilling special wells from the surface using artificial methods of increasing gas permeability of coal seams. This direction is a promising method of obtaining gas with high (75-95 %) stable methane content for wide application in the national economy;
- methane extraction from abandoned mines.

Table 1 – The forecast of global unconventional gas production [4]

Countries	Unconventional gas production forecast, billoin m^3					Percentage in 2035, %
	2015	2020	2025	2030	2035	
North Amerika, including:	482,8	511,6	572,6	634,9	595,5	72,8
U.S.	418,4	441,6	485,8	520,1	561,2	56,7
Canada	64,4	57,2	81,2	103,6	117,6	12,3
Mexico	0,0	2,8	5,5	11,2	16,5	1,8
Central and South America, including:	0,0	0,0	0,0	14,0	33,5	3,5
Brazil	0,0	0,0	0,0	5,5	14,0	1,5
Middle East	0,0	0,0	0,0	0,0	2,8	0,3
Africa	0,0	0,0	0,0	0,0	2,8	0,3
Europe	0,0	0,0	11,2	19,5	30,8	3,2
Asia-Pacific region, including:	11,2	19,5	47,6	106,4	190,4	19,9
Australia, New Zealand	2,8	5,6	8,4	14	30,8	3,2
China	8,4	8,4	22,4	56,0	36,8	9,1

India	0,0	0,0	2,8	5,6	6,4	0,9
Russia	0,0	0,0	0,0	2,8	11,2	1,2
Total in the world	494,0	531,2	631,4	774,9	956,0	100,0

Technical features of coalbed methane extraction are related to processes of gas gathering and gas transport to the surface by compressors (Figure 1) [1].

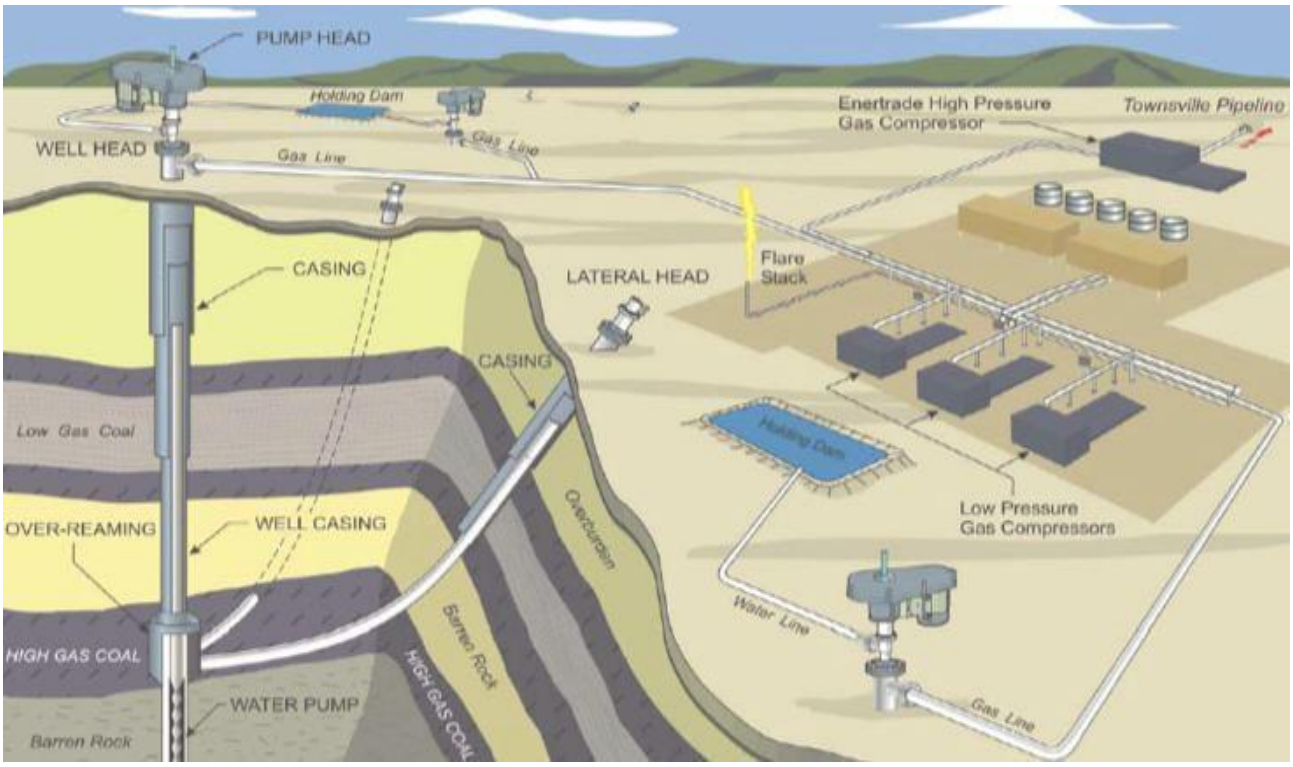

Figure 1 – Coalbed methane extraction

Source: Tagiev S.M. Coalbed methane production in the world and prospects of production in Kuzbass // Materials of XI International Research and Practice Conference. – Sheffield UK, 2015. V. 10. – pp. 77-80.

In such cases, vertical wells are drilled from the surface to reach the coal seams. The next step is a drilling of inclined-horizontal wells in the direction of the minefield extension. Such a method makes it possible to produce about 60% of coal gas, due to the low flow rate of the wells.

A variety of stimulation techniques, such as hydraulic fracturing, enable to increase the amount of produced gas (Figure 2).

Hydraulic fracturing is a special process of injecting liquid or gaseous fluid into the reservoir at a high pressure to cause breakdown of the formation.

Adding a special substance to the fracturing fluid is the next step of the hydrofracturing process. This is necessary in order to prevent the cavities from closing. Natural sands and artificial ceramic proppants are used as propping materials. At the same time, quartz sand is widespread as a proppant due to its availability and inexpensiveness [1].

Sand feed-through is essential both in newly created and existing cavities in the reservoir. After extraction, methane is purified from mechanical impurities (coal dust and sand), as well as water,

harmful gases, and others. The purified gas can then be transported by gas pipeline to a processing plant or to a small-scale natural gas liquefaction plant installed near the field. LNG production close to the production site will be able to provide industrial facilities with the fuel. Moreover, such LNG-fuel could be the basis of outlying regions gasification.

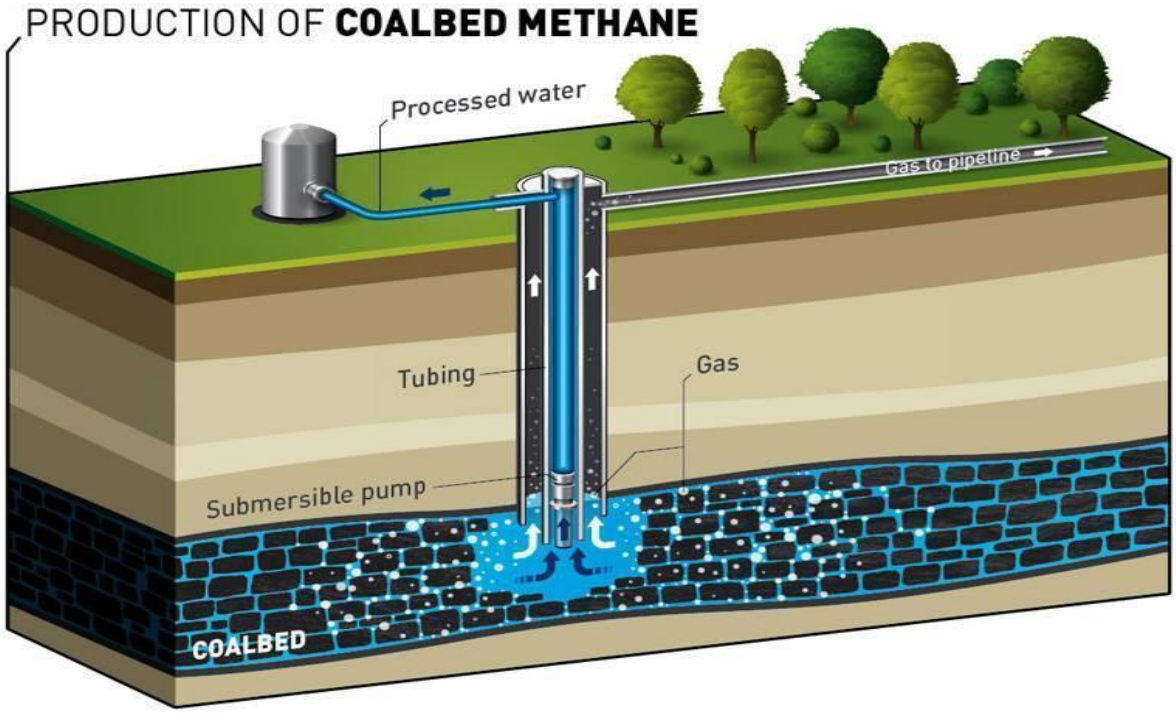

Figure 2 – Hydraulic fracturing for coal gas extraction
Source: Arkhipov, I.A. Analysis of technologies of methane extraction from coal reservoirs // GIAB. 2020. №6-1.

Consequently, it can be mentioned that coalbed methane production is a promising direction for Russia energy sector. Despite the associated problems, such as technological complexity, high price and environmental aspects, coalbed methane can act as a broadening hydrocarbon source for the chemical and gas processing industries, significantly reducing the load of conventional natural gas fields.

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