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ANALYSIS OF THE STATE OF COALBED METHANE PRODUCTION IN KAZAKHSTAN

ҚАЗАҚСТАННЫҢ КӨМІР ҚАБАТТАРЫНЫҢ МЕТАН ӨНДІРУ ЖАҒДАЙЫН ТАЛДАУ

АНАЛИЗ СОСТОЯНИЯ ДОБЫЧИ МЕТАНА УГОЛЬНЫХ ПЛАСТОВ КАЗАХСТАНА

Abstract. *The experience of industrial methane extraction from coal seams in Kazakhstan is considered. A comparative analysis of the geological parameters of coal deposits in comparison with foreign ones has been carried out. The technology of intensive extraction of methane gas from coal seams and preparation for the integrated development of its resources in the Karaganda basin is substantiated. The implementation of proposals for possible associated methane production will have a social effect by providing the population with cheap fuel and reducing the environmental burden. The gas, metallurgical and chemical industries will be developed through the use of high-quality and cheap raw materials.*
Keywords: *methane, coal seams, mining prospects, degassing, industrial.*

Аңдатпа. *Қазақстанның көмір қабаттарының метанын өнеркәсіптік өндіру тәжірибесі қаралды. Шетелдік кен орындарымен салыстырғанда көмір кен орындарының геологиялық параметрлеріне салыстырмалы талдау жүргізілді. Көмір қабаттарынан метан газын қарқынды алу технологиясы және оның ресурстарын Қарағанды бассейнінде кешенді игеруге дайындау негізделген. Метанды жолай өндіру бойынша ұсыныстарды іске асыру халықты арзан отынмен қамтамасыз ету және экологиялық жүктемені азайту есебінен әлеуметтік әсер етеді. Газ, сондай-ақ металлургия және химия салалары сапалы және арзан шикізатты пайдалану есебінен дамиды.*
Түйін сөздер: *метан, көмір қабаттары, өндіріс перспективалары, газсыздандыру, өнеркәсіптік.*

Аннотация. *Рассмотрен опыт промышленной добычи метана угольных пластов Казахстана. Произведен сравнительный анализ геологических параметров угольных месторождений в сравнении с зарубежными. Обоснована технология интенсивного извлечения газа метана из угольных пластов и подготовка к комплексному освоению его ресурсов в Карагандинском бассейне. Реализация предложений по возможной попутной добыче метана будет иметь социальный эффект за счет обеспечения населения дешевым топливом, и снижения экологической нагрузки. Получат развитие газовая, а также металлургическая и химическая отрасли за счет использования качественного и дешевого сырья.*
Ключевые слова: *метан, угольные пласты, перспективы добычи, дегазация, промышленное.*

Introduction. Ensuring the safety of coal industry workers is an urgent problem today. The gas content of the layers increases with the depth of their occurrence and is a deterrent factor in mining operations. Sudden methane emissions can cause a large number of human casualties, financial losses and other consequences. In recent years alone, such accidents have claimed more than 140 human lives in the mines of the Karaganda coal basin.

However, by solving this important problem, it is possible to obtain associated gas. It is not easy to reduce the gas content index with existing degassing technologies. Formations have almost zero gas permeability and low gas output at the current depths of their development. That is why it is necessary to have an early impact on the coal bed in order to ensure the release of methane. This process will make it possible to obtain associated gas, which can be used for the needs of industry or the national economy. As a result, reducing the gas content of coal seams will reduce the risks of mining operations and improve occupational safety.

Investigating the issue of methane production, it can be concluded that the Karaganda coal basin is essentially a coal and gas field. Estimating methane reserves from various sources, it can be seen that they are comparable to natural gas reserves. From 1 to 4 trillion are concentrated in the Karaganda coal basin alone. m^3 of gas at a depth of up to 1800 m. At local enterprises, approximately 500 million m^3 of gas is extracted from the ground annually by means of degassing. At the same time, only 15% of this volume is used as fuel, the rest replenishes the emission indicators into the environment. Meanwhile, methane is 20-40 times more efficient than other gases. It destroys the ozone layer and absorbs infrared solar radiation. Comparing the anthropogenic increase in the concentration of greenhouse gases, it can be noted that the annual accumulation of methane in the atmosphere is 1-2%. This indicator exceeds the intensity of accumulation of other gases. However, methane is a good alternative energy source. It can also be considered as a component of the country's fuel and energy resource base. For example, for the chemical industry, methane of coal genesis will serve as a valuable raw material in the production of ammonia, methanol, acetylene, protein mass, etc.

Determining the source of methane release is a difficult scientific and technical task. According to modern concepts, a coal seam is a poorly permeable block–fractured medium under the influence of a huge number of different factors. At the same time, 80-90% of methane is in the coalbed in a sorbed state. This has a significant impact on the extraction process, compared to conventional gas extraction technologies.

Analyzing accidents at mines in the CIS countries over the past 5 years, it can be concluded that about 90% of emergencies at enterprises that suffered human casualties were sudden methane emissions. To reduce the risk of an explosion of a methane-air mixture during mining operations, the organization of methane extraction by wells from the surface will allow. This will make it possible to use gas for mine power plants, increase the profitability of coal mining and reduce the negative factors that affect the development of new horizons in underground coal mining. According to the analysis carried out, the resource potential of coal methane in Kazakhstan is estimated at 3000-4000 billion m^3, in general, in developed and developing countries - 93-285 trillion m^3.

Materials and methods of research. Kazakhstan is one of the twenty world leaders in terms of primary energy production and ranks 18th in the world. The raw material base of the coal industry, as well as the production potential of coal mining enterprises, make it possible to meet the solvent demand of coal consumers, both inside and outside the country (Figure 1) [1].

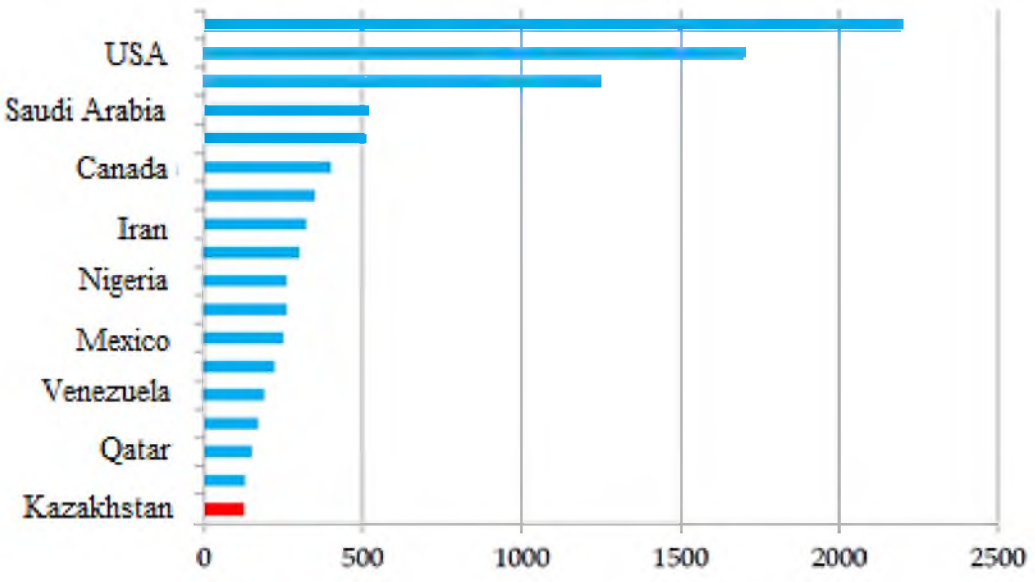

Figure 1. Production of primary energy resources by various countries of the world, million tons

Kazakhstan ranks eighth in the world in terms of proven coal reserves of all types and is one of the ten countries in which the largest coal deposits are located. Proven reserves are estimated at 34.2 billion tons. This is 4% of the global volume. Meanwhile, brown coal reserves account for 62%, and hard coal reserves for 38%. Our country is second in reserves only to the USA, Russia, China, Australia, India, Germany and Ukraine (Figure 2) [2].

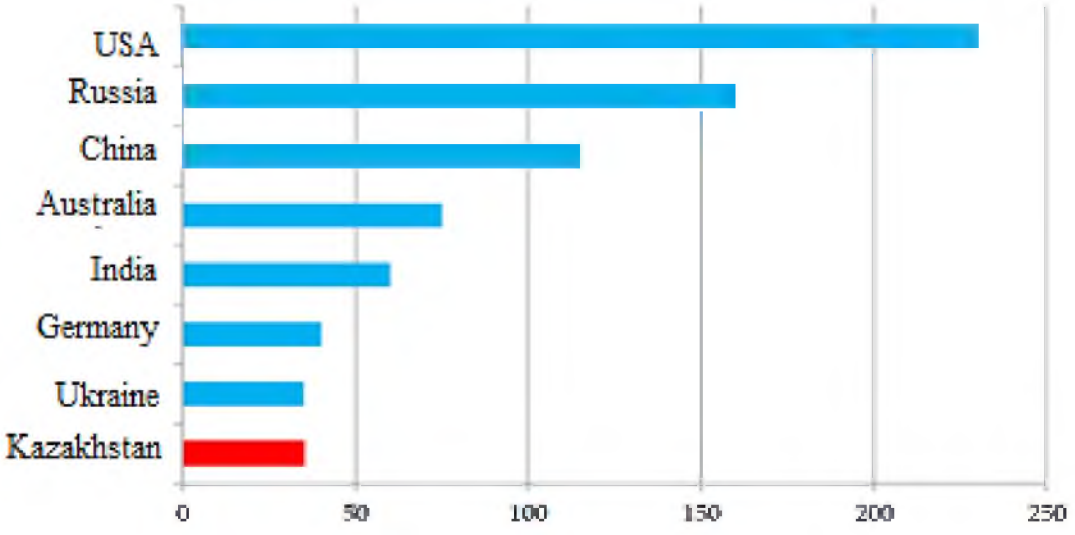

Figure 2. The volume of proven coal reserves in various countries of the world, million tons

The main share in the structure of Kazakhstan's recoverable natural energy resources is coal - 46%, uranium – 29%, and hydrocarbons account for up to 25% in total (Figure 1.3). Meanwhile, uranium accounts for the largest volume of exports - 255.8 million tons of ore or less than $2.5 billion. For oil - 79.2 million tons of oil, or $56.4 billion.

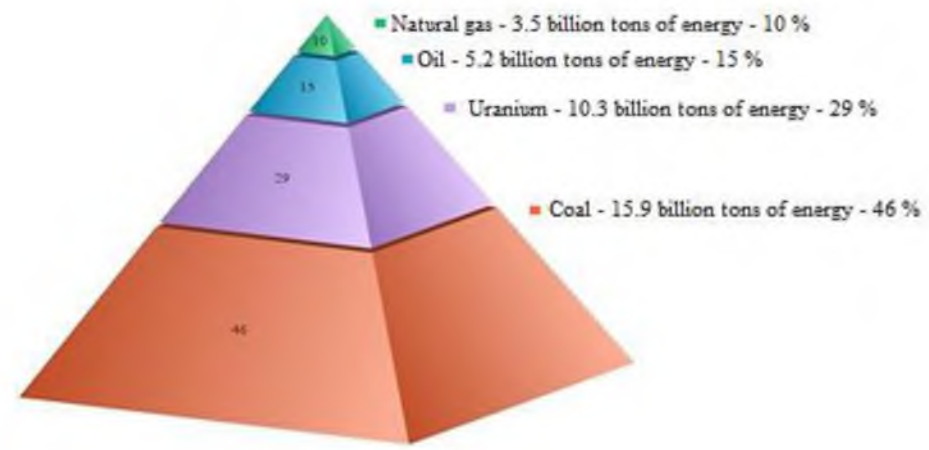

Figure 3. Proven reserves of fossil energy resources in Kazakhstan, million tons

The state balance sheet takes into account reserves for 49 fields. Most of them are concentrated in the Karaganda and Ekibastuz coal basins, as well as the Shubarkol deposit and in the Turgai coal basin in Northern Kazakhstan. All balance reserves of coking coal are located in the territory of the Karaganda region. The southern and western regions of the country have good industrial potential, but are experiencing an acute shortage of coal fuel (Figure 4) [3].

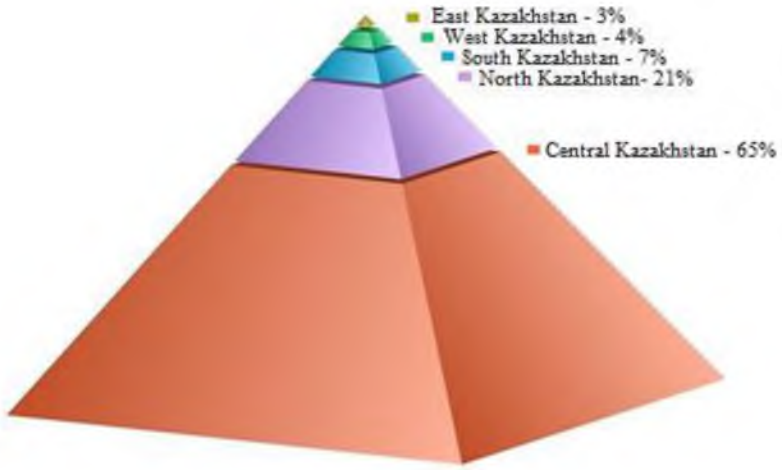

Figure 4. Placement of balance reserves of coal in the regions of Kazakhstan

In Kazakhstan, 130.4 million tons accounted for the total volume of coal production in 1991. This is 20.7% of the total production balance in the territory of the former USSR. The termination of state subsidies to the industry provoked a sharp decline in coal production in 1992-1996. The "freezing" of prices for coal products, a decrease in the level of solvent demand, the presence of an unprofitable mine fund and the slow adaptation of the industry to new economic conditions had an impact [4].

The complex of recreational activities was held in 1995-1998. At that time, all large coal mining enterprises of the Karaganda and Ekibastuz coal basins were privatized by foreign and domestic investors. This has reduced the level of social tension in the coal regions and ensured the continued functioning of the industry. Summary data on coal production in Kazakhstan from 1991 to 2018 is shown in Table 1.

Table 1. Summary data on coal production in Kazakhstan from 1991 to 2018

Years	Production, million tons	Coal delivered, million tons	
		to Kazakhstan	for export
1991	130.4	78.4	52
1992	126.5	92.8	33.7
1993	111.9	87.7	24.2
1994	104.6	81	23.6
1995	83.4	63.3	20.1
1996	76.8	55.7	21.1
1997	72.6	47.5	25.1
1998	69.8	46.1	23.7
1999	58.4	42.2	16.2
2000	74.9	49.7	25.2
2001	79.1	50.6	28.5
2002	73.7	51.1	22.6
2003	84.9	58	26.9
2004	86.8	62.5	24.3
2005	86.4	62.8	23.6
2006	96.3	68.5	27.8
2007	94.4	68.7	25.7
2008	104.9	72	32.9
2009	94.3	69.3	25
2010	105.3	No data available	No data available
2011	110.1	No data available	No data available
2012	114.3	88.9	31.3
2013	112.8	No data available	No data available
2014	107.6	No data available	No data available
2015	102.2	No data available	No data available
2016	98.5	71.8	26.2
2017	106.7	70	30
2018	113.7	No data available	No data available
Total	2 681.3	≈1 438.6	≈589.7

Since 2000, there has been a tendency for the coal industry to emerge from the crisis, restructuring took place and coal production began to increase and the economic potential of coal companies increased. This made it possible to preserve the main coal mining enterprises of the republic and ensure fuel production at the level of effective demand. Today, the coal industry in Kazakhstan provides: production of 74% of electricity; 100% utilization of coke production; fully meets the fuel needs of the municipal sector and the population. Meanwhile, the geography of Kazakh coal supplies has significantly expanded in recent years to the near and far abroad. The main importers of Kazakh coal are the power plants of the Urals and Western Siberia of the Russian Federation. According to the joint fuel and energy balance between Kazakhstan and Russia, by 2020, coal exports should be maintained in the amount of 20-22 million tons per year. In addition, Kazakh coal is supplied to Uzbekistan, Kyrgyzstan, Tajikistan, Ukraine, Bulgaria, Poland, Romania, Turkey, Finland and a number of other countries. A comparison of the volumes of coal production, export and domestic consumption in the Republic of Kazakhstan is shown in Figure 5 [6].

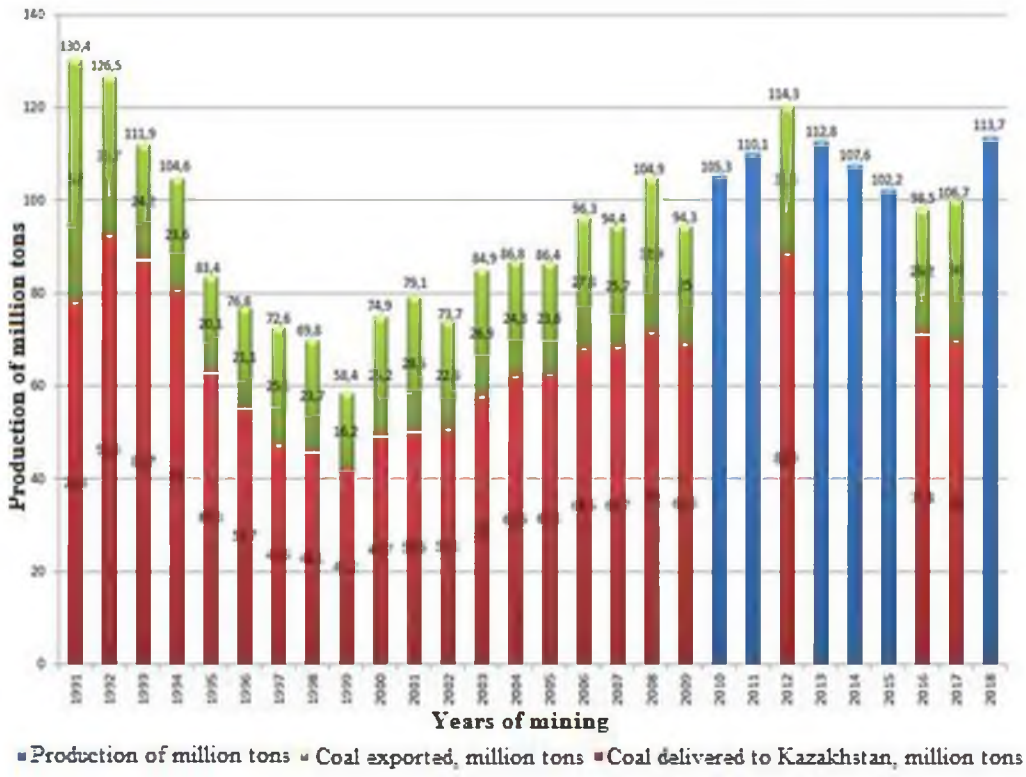

Figure 5. Volumes of coal production, export and domestic consumption in the Republic of Kazakhstan

In turn, the Ministry of Energy and Mineral Resources of Kazakhstan has developed a Concept for the development of the coal industry in Kazakhstan until 2020. It was approved by Government Resolution No. 644 of June 28, 2008. According to this document, an increase in coal production from 94.4 million tons operating in 2007 should occur by 2020 to 145.6 million tons. Annual statistics show that Kazakhstan is among the top ten world leaders in coal production. In 2015, this figure was 107.3 million tons. Coal accounts for about 2/3 of the country's primary energy consumption (Figure 6) [7,8].

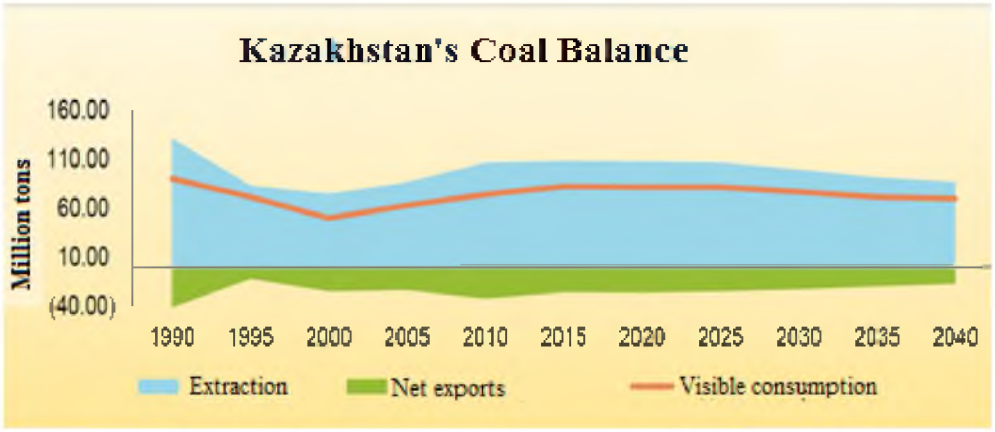

Figure 6. Coal balance of Kazakhstan, million tons

For a long time, methane contained in coal seams was considered as a harmful component that negatively affects the intensity of coal mining. Almost half of the costs of organizing coal mining were spent on creating safe working conditions. Meanwhile, the already familiar degassing of coal seams makes it possible to use methane as an associated mineral [9,10]. As a result, coal miners and power engineers looked at the huge reserves of black gold as storages of coal and hydrocarbon gas, where methane is the main one (Figure 7).

Figure 7. Map of the location of coal basins and deposits in Kazakhstan

Due to the degassing of coal seams in the Karaganda coal basin and methane exploration in accordance with the concluded subsurface use contracts, it will be possible to significantly increase the safety of work during subsequent coal mining, as well as improve the environmental situation by reducing methane emissions into the environment [11, 12].

Conclusions. The search for environmentally friendly energy carriers, improvement of the environmental situation in Kazakhstan, increase in energy security, the need to take measures to ensure the safety of coal mining formulate the tasks of searching, developing and applying modern and effective technologies for industrial extraction of coalbed methane. Active early degassing of mine fields will reduce the explosion hazard and risk of explosion of methane-air mixture in mines, which will lead to a decrease in mortality and injuries during underground work. [13].The use of methane from coal deposits will significantly improve the socio-economic situation in a number of regions of Kazakhstan. Methane extraction will radically improve the safety of mining operations and, in the future, increase the production of coking coal [14, 15]. The direct use of scientific developments of the Karaganda State Technical University and

foreign technologies makes it possible to create a basis for effective methane production and plan the possibility of further dissemination of this technology to other deposits and other regions of the country.

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