Program Committee International scientific and practical conference “Ensuring sustainable development in the context of agriculture, green energy, ecology and earth science” (ESDCA 2021)

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Potential for pipeline transportation of Kuzbass coal

Potential for pipeline transportation of Kuzbass coal

V I Murko, O P Chernikova, A B Yuriev and E N Temlyantseva

Siberian state industrial University, 42, Kirov Str., Novokuznetsk, 654007, Russia

E-mail: chernikovaop@yandex.ru

Abstract. The transition of the world energy sector to a new technological paradigm, combining the growth of energy efficiency of production with the simultaneous search for alternative fuel resources to ensure an improvement in the quality of life of the population and the environmental situation of the host regions, imposes special obligations on the management of coal and energy companies and government bodies associated with the development of resource efficient and energy saving organizational -technical solutions. To solve these problems, not only energy-generating enterprises that are fuel consumers should be transformed, but also their suppliers - mines and open-pit mines, adapting the quality characteristics and sales channels of coal products to the requirements of the time. Within the framework of the research carried out by the team of authors: an analysis of the world practice of using pipeline coal transport was carried out; a proposal was formulated for organizing the transportation of Kuzbass coal in the form of coal-water fuel through pipelines to energy enterprises in Western Siberia and the Eastern Urals, a factor analysis of its implementation was carried out: the advantages of hydro transportation of coal in comparison with its supply by rail were identified, possible risks and disadvantages were assessed.

1. Introduction

Russia is one of the world powers mining and exporting coal, in which, as of 01.01.2020, there were 187 operating coal mining enterprises (57 mines and 130 open-pit mines) and 64 processing plants. The scale of coal processing is growing every year: the total volume of coal preparation in 2019 amounted to 207.6 million tons (1.9% more than in 2018), at factories - 205.9 million tons (2.8% more than in 2018).

The Kuznetsk Basin produces 57% of the total volume of Russian coal and 75% of coking coal. The main problem of the marketing policy of coal mining companies is the geographic location of the Kemerovo Region, which is due to the significant distance from seaports (the average distance to which is 5075 km) and from border crossings (the average distance to which is 4093 km). Almost 100% of products from the region are exported by rail.

In connection with the high turnover of coal products, the issue of the throughput of railways, which is far from always sufficient to ensure rhythmic supplies, becomes relevant. At present, the traffic density of the Trans-Siberian Railway has increased, and therefore "traffic jams" are a frequent occurrence at the exits from the Kemerovo Region.

In addition, the experience of the last thirty years testifies to a significant excess of the growth rate of railway tariffs over the growth rate of prices for transported coal products: over the 19 years to 2009, wholesale coal prices increased 34 thousand times, transportation tariffs - 53 thousand times [1]. After 2009, the trend continues. Today, transport costs account for up to 60% of the price of Kuznetsk coal, which, when delivered to ports, more than doubles the cost. The growth of railway tariffs negates

the competitive advantages of the Kuznetsk Basin (quality characteristics of products, volumes of mineral reserves in the bowels of the earth, demand from consumers).

In modern conditions, the sales component of the cost of products (depending on the size of transportation tariffs), the presence of bottlenecks in the transport infrastructure of the carrier, the complexity of coordinating production and transport processes determine the main risks for the development of the coal business in Kuzbass and the industry as a whole.

This logistic problem can be solved in two ways: first, the carrier is revising freight rates and investing in measures to increase the capacity of railways; the second - coal mining enterprises and authorities are implementing projects for alternative methods of coal transportation, one of which is the transportation of Kuzbass coal in the form of coal-water fuel through pipelines.

2. Materials and methods

The empirical basis of the study was the analysis of Russian and international experience in using an alternative energy source - coal-water fuel. A comprehensive study of this issue was carried out on the basis of a systematic approach. The methodological basis of the study was the scientific and educational literature given in the list of sources.

When setting the goal and defining the main tasks at the initial stage, the team of authors used an abstract-logical research method to study the possibilities and directions of transporting Russian coal through pipelines.

Methods of comparative analysis, synthesis, modeling of production processes of the fuel and energy system made it possible to identify, generalize and systematize the advantages of coal-pipeline transport in comparison with railway.

3. Results and discussion

The high competitiveness of Kuznetsk coals on a global scale is due to both qualitative characteristics (high heat capacity, low ash content of products, low content of moisture, sulfur and other impurities), and economic (low price due to optimal costs for mining).

Kuzbass coking coals and coke, due to the location of consumers, are in demand in the western direction from the region. All metallurgical plants in the country are in demand for the products of the region, while consumers of the Eastern Urals consider our producers as the only suppliers of coal. For example, OJSC Altai-koks, which sells coke products to the Novolipetsk Metallurgical Plant and sends them for export, is a significant buyer of the basin's coking coal.

Coal of energy grades is primarily in demand in the western direction from the region. The main consumer organizations in the western regions include Novosibirsk thermal power plants 2-5, Tomsk state regional power plant, Barnaul thermal power plants 2 and 3, Biysk thermal power plant, as well as local boiler houses. In addition, Kuznetsk coal is used for energy purposes in the Urals, the Volga region, Central Russia, and the Center of the Black Earth Region.

Eastern Siberia is self-sufficient in the energy aspect, since there are large hydroelectric power plants on its territory, as well as Kansk-Achinsk and other coal basins. In the Far Eastern economic region, thermal coal is in demand by boiler houses, power plants and thermal power plants of the Khabarovsk, Kamchatka, Primorsky Territories and the Magadan Region.

On the world stage, there are more than 50 countries - importers of Kuznetsk coal and coke. The export volumes of coal-fired energy exceed those of the export of coking coal. Regarding the location of Kuzbass, ¾ sales volumes are carried out westward to Europe, the Caribbean, the Middle East, South Asia and Kazakhstan. Products are sent through the seaports of Murmansk, Tuapse, Ust-Luga, the Baltic States and Ukraine, and are also exported through Kazakhstan, Ukraine, Belarus, Finland. Kuzbass coal and energy products are imported by the fuel and energy complexes of Great Britain, Finland, Romania, Poland, and coking - by production companies from Germany, Spain, Belgium, Slovakia, Hungary, Kazakhstan, Turkey, India, the United Arab Emirates, Japan, Korea, China and Taiwan.

Long-term scientific research of scientists and practitioners in Russia and abroad has confirmed the technical capabilities and economic feasibility of transporting coal in the form of coal-water fuel through pipelines [2-10]. In the context of an increasing rate of changes in the energy sector, an economic analysis that allows identifying the position of a coal-mining region in the industry segment, adjusting the production and marketing strategy, and thereby increasing the economic efficiency of its activities, is in great demand [11].

In addition, there are practical examples in the world of implementing projects for the hydro transportation of coal in the USA, Canada, France, Italy, the People's Republic of China, and India. The pipelines have different transportation distances, pipe diameters, throughput [12].

In Russia, there is also an example of the practical functioning of the long-distance delivery of coal through pipes: in 1989, a coal pipeline was built, connecting the Kemerovo and Novosibirsk regions, "Belovo - Novosibirsk" [13]. The implementation of this project in Soviet times and its almost five-year operation have proved the potential of pipeline delivery of coal-water fuel over long distances, its suitability for combustion in power boilers of combined heat and power plants and economic efficiency. The disadvantage of this project was its dependence on the only fuel consumer (Novosibirsk CHPP-5), which in 1993, in the context of the transition to a market economy, decided to replace the fuel resource with gas. In the absence of funding for activities in an unstable political situation in the country, the operation of the coal pipeline in 1993 was terminated.

For the first time in many years, in 2019, the volume of coal production in Kuzbass decreased compared to 2018 (from 255 million tons to 251 million tons). In the winter of 2020, Poland, the largest consumer of the EU countries, stopped importing Russian coal. Coal mining enterprises of Kuzbass and the regional authorities defended the priority of the region in transporting coal along the BAM and Transsib in the eastern direction. At the same time, the throughput capacity of railways in the eastern direction does not meet the needs of the real sector of the economy, and work to increase it is delayed or not carried out at all.

Against the background of intensified shipment of products to the east by enterprises of the Far Eastern region, Kuzbass coal producers need a radical solution to the issue of reducing logistics costs by optimizing railway tariffs. At the same time, Russian Railways will, from October 2020, cancel the 12.8% discount set in March 2020 for the delivery of energy-grade coal over a distance of over 3,000 kilometers, which should have been valid until the end of the year, justifying its decision by the depreciation of the ruble, the rise in quotations in the ports of the North-West by 20% and the failure of coal companies to fulfill their obligations in terms of the volume of transported products.

Due to the need to increase the competitiveness of Kuzbass coal products, expand sales markets against the background of unresolved infrastructure problems on the railways and the high cost of transportation, as well as the existing successful practical application of coal pipelines in the world economy, the team of authors considers it appropriate to consider a project for the construction of a coal pipeline from the Kemerovo region to the Urals for the supply of coal-water fuel to the energy sector of Western Siberia and the Eastern Urals and conducting a factor analysis of its implementation.

It makes sense to build a long-distance pipeline only in the direction west of Kuzbass, since the Irkutsk Region and Krasnoyarsk Territory are rich in their own coal reserves and large hydroelectric power plants operate on their territories. Such a coal pipeline can be laid through Novosibirsk, Omsk, Tyumen, Yekaterinburg, and further to the western border of Russia to ensure the transport of "liquid coal" to Europe.

In addition, one of the main strategic directions for the development of world energy provides for a significant reduction in the technogenic load on the environment with its preservation in a state favorable for human life, through the introduction of "green" energy practices. Construction and the further need to ensure constant transportation of coal-water fuel through the pipeline would help to solve environmental problems in Kuzbass. One of the problems of coal generation is the formation of processing waste.

In the regions of coal mining of Russia on the territories of mines, open-pit mines, and processing plants, large volumes of coal sludge accumulate, polluting either free landscapes, ravines, or reservoirs

and worked-out workings of mining enterprises. These are highly toxic products containing flocculants and coagulants used in processing plants, which should not be released into the environment [14]. The total volume of coal sludge produced by the Kuzbass enrichment plants is more than 10,500 thousand tons per year.

At the same time, the development strategy of Kuzbass until 2035 takes a trend towards the concentration of industrial production with strict observance of environmental requirements by enterprises of all industries and spheres of activity.

Every resident of Kuzbass has the right to a comfortable life in ecologically clean conditions. In this regard, the President of the Russian Federation ordered the government of the Kemerovo region to ensure the environmental safety of the region. In the requirements for Kuzbass, environmental problems of Novokuznetsk are separately highlighted, therefore, from 2019, the city provides for the implementation of measures aimed at reducing environmental pollution by industrial enterprises, heat power engineering, transport, as well as strengthening state control and supervision of the environmental situation. The volume of investments for their implementation is 17 billion rubles. By 2021, in Novokuznetsk, the planned reduction in harmful emissions is 7%, and by 2024 - 20%.

Therefore, the ways of using coal in the energy sector should be modern, corresponding to the “chosen course”. New technologies are needed to use the advantages of this fuel resource, minimize the negative consequences of its use, and protect the health of the Kuzbass population. One of the solutions to the above problems is the active use of coal-water fuel (a dispersed system consisting of coal, water and a plasticizer reagent).

Competitive advantages of coal pipeline transportation in comparison with rail transportation are formed by: high throughput of the pipeline system; averaging the quality characteristics of the fuel resource and their independence from weather conditions; uniformity and continuity of the flow of movement of products; no loss of minerals during transportation; reducing the negative impact on the environment of the regions of the holding; the need to use a small number of workers to service; high automation capabilities for loading and unloading and transport operations.

In addition, the pipes used for transportation are laid in the ground and do not require replacement for a long time, so the earth's surface above them can be used in the production and economic activities of enterprises and organizations. Coal transport is one of the most reliable. The reliability indicators of its operation are higher than those of other types of transport (for example, the reliability of the Black Mesa coal pipeline during the year is 99%).

The main disadvantage of using coal pipelines is the high capital costs of construction, but if we compare these investments with investments in the construction of the railway, they are clearly less. For example, the construction of the Black Mess pipeline required 4 times less funds than would have been the capital cost of building a railway of similar length. In addition, the payback of coal pipeline projects is guaranteed by lower operating costs.

4. Conclusion

Based on the above:

- The analysis of the sales component of the activities of the mining companies of Kuzbass made it possible to identify shortcomings - a low potential for expanding the throughput of railways, a high level of freight tariffs and actualized the task of finding alternative solutions that would allow the fuel and energy complex of Russia to provide the necessary volumes of product supplies to consumers at an optimal cost level.
- Analysis of the world practice of using pipeline coal transport, as well as similar Russian experience, allowed the team of authors to formulate a proposal for the construction of a pipeline for the supply of coal-water fuel to energy enterprises in Western Siberia and the Eastern Urals.
- As part of the study, the competitive advantages of hydro transportation of coal products in comparison with railway delivery were identified and systematized: high throughput of the

pipeline system; averaging the quality characteristics of the fuel resource and their independence from weather conditions; uniformity and continuity of the flow of movement of products; no loss of minerals during transportation; reducing the negative impact on the environment of the regions of the holding; the need to use a small number of workers to service; high possibilities of automation of loading and unloading and transport operations; the possibility of using the earth's surface, under which the pipeline is laid; high indicators of operational reliability.

- The main disadvantage of using coal pipelines is determined by the high capital costs of construction, but they are paid off by the lower cost of transportation.

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