The Social Sciences 11 (16): 4035-4039, 2016
ISSN: 1818-5800
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Restructuring Results of Donbass Coal Mining Enterprises

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Abstract: The information on the status of coal mining in Russia is provided. The information about Russian Donbass past and present is provided. The restructuring of regional coal mining enterprises are classified with the loss of valuable resources. It was shown that the closure of mines without taking into account the consequences for economy related sectors is a major mistake with the ecological, economic and social consequences. It was proved that the development of extracted coal processing technologies can be effective even with sub-standard stocks.

Key words: Coal, extraction, processing, restructuring, mine, economy, utilization

INTRODUCTION

The raw material base of the coal industry in Russia is represented by Kuznetsk Basin, the Eastern Donbass, Pechora basin, Kansk-Achinsk, South Yakutia basin and other coal deposits. The explored brown coal reserves put to balance make more than 100 billion tons, the corresponding reserves of black coal make up to 100 billion tons, including more than 40 billion tons of coking ones (Russian, 2013).

Donets Coal Basin produced its first coal in 1723 and since 1945 it began to produce more coal than any other coal basin of the USSR. Since 70th, the coal industry of the Eastern Donbass has the tendency of production increase at the reduction of coal quality. The advisory group of the USSR Academy of Sciences justified the economic feasibility of production reduction on Donbas and the compensation of Kuzbass rich deposits at their expense (Gatinsky and Vishnevskaya, 2003; Shafranik *et al*., 2004; Krasnyansky, 2010).

The increase selling prices for materials and energy, the development of deep horizons and areas in difficult mining and geological conditions led to higher costs. The coal losses reached 24% at the underground method of development.

By the beginning of 1995, the company "RosUgol" possessed 230 mines and 65 quarries. 417 mln. tons was extracted in Russia in 1988. After the restructuring the production fell to 225 million tons in 1998. The construction of new, the reconstruction and modernization of existing mines was stopped by the cessation of state funding. They started to import coking coal.

The restructuring of coal mining, carried out from the selective use point of view concerning the richest reserves and inflicting an irreparable damage to mineral resources, demands some cognition for possible corrections (Golik *et al*., 2015).

MATERIALS AND METHODS

Main part: In Russian Donbas with the area of 12,000 km^2 the coal reserves exceed 1.6 billion tons, of which more than 1.3 billion tons are suitable for an effective development. The development system by long columns on the strike with the mining of columns by backflow and the control of the roof and collapse. Most mines develop only one layer.

Even in 1995, the Eastern Donbass united 60 mines. The number of coal industry workers was about 150 thousand people among the 1.2 million of population. For the majority of these areas settlements the coal industry was the city-forming one. Mines provided the needs of Russia high-calorie raw materials and supplied coal abroad. The age of most Eastern Donbass mines makes 30 years (Razorenov *et al*., 2013).

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More than 80% of the prospective mines were left without funds for reconstruction and re-equipment. The accounts payable among the joint stock companies of the Eastern Donbass increased nearly five times. The debts of fine payment to the budget and extra-budgetary funds increased by nearly 300% in 1997. Among the fired people from operating mines 3508 are employed, 7527 people are transferred to the employment centers, and 2,300 men remained unemployed. The number of active mines decreased threefold, the coal production decreased by almost 2.5 times, the efficiency of the remaining mine operation did not increase and productivity declined.

The expenses for the liquidation of mines were much more than the costs for their profitability provision. For example, in order to eliminate "Tatsinskaya" mine with the sufficient reserves for 100 years, 192 million rubles were provided, while only 32 mln. rub. were required to make it profitable.

The objective assessment of abandoned coal reserves may be performed taking into account their quality and their stage of development. The specific expenses for reserves exploration, for the construction of a mine, the mining and the processing of coal, rub./t. were calculated as follows:

$$S = C_{гр} + C_{с} + C_{д} + C_{о} + C_{э}$$

where c_3 the unit cost of exploration, mine construction, coal mining and processing of coal, rub./t.

Construction costs, rub./t:

$$C_{с} = C_{В} + C_{д} + C_{Н}$$

Where:

$C_В$ = The cost of construction, rub./t

$C_П$ = The cost of tunneling for preparation mining, rub./t

$C_Н$ = The cost of board gate tunneling, rub./t.

Extracted coal value, rub./t:

$$П_{Дп} = \sum_{i=1}^{n} \gamma_i П_i$$

Where:

n = Is the number of coal distribution areas

γ_i = The share of coal, used according to i-th direction, shares of unit

$П_I$ = Selling price of commodity coal or its product, rub./t.

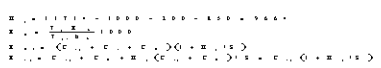
If coal is sold without enrichment, then m $П_i = П_у$, Where: $П_у$= is its price, rub./t. If coal is sold abroad after processing, then $П_i = \gamma_0 П_{сКВ}$, where $K_Ц$ commodity coal output after processing, shares of unit; - commodity coal price in FCC/t; $K_Ц$ - FCC - rubles conversion factor.

If coal is used for domestic electricity generation, then $П_i = \gamma_э П_э$, where $\gamma_э$ the output of electricity from the combustion of 1 ton of coal, kWt-h/t; $П_э$ - The selling price of electricity in the country, rub./ kWt-h.

If coal is used for electricity production with its sale within FCC, then $П_i = \gamma_э П_{сКВэ}.K_Т$, where $П_{сКВэ}$ the selling price of electricity sold abroad, FCC/kWt-h. The specific profit amount, rub./t:

$$П_р = П_{Дп} - С_{Дп}$$

Coal price at the stages of exploration, extraction and processing: The a of explored coal (rub./t)



The б of discovered reserves (rub./t)

$$П_{Ву} = C_{гр} + C_{В} + П_р\left(C_{гр} + C_{В}\right) / S = C_{гр}\left(1 + П_р / S\right)$$

The В of discovered and prepared reserves (rub./t)

$$П_{пу} = \left(C_{гр} + C_{В} + C_{П}\right)\left(1 + П_р / S\right)$$

The г of reserves ready for mining (rub./t)

$$П_{гу} = \left(C_{гр} + C_{с}\right)\left(1 + П_р / S\right)$$

The Дof mined coal (rub./t)

$$П_{Ду} = \left(C_{гр} + C_{с} + C_{Д}\right)\left(1 + П_р / S\right)$$

The $П_0$of clean coal (rub./t)

$$П_{0у} = \left(C_{гр} + C_{с} + C_{Д}\right)\left(1 + П_р / S\right)$$

For example, if they extract anthracite at the cost of 1000 rub./t and sell it at the price of 1200 rub./t, a mine makes the profit of 200 rub./t. But if coal is cleaned and sold at the price of 3300 rub./t, at the cost of cleaning 200 rub./t the extracted value will be the following one:

$$П_{Д0} = \gamma_о . П_Д$$

where $\gamma_о$ salable coal output after cleaning; Specific profit from sale:

$$П_р = П_{Д0} - С_Д - С_0 = 0,8.33 - 1000 - 200 = 1440 \text{ rub./t.}$$

If we consider the extraction of coal with the operation of a power plant at the costs of cleaned coal burning 850 rubles/t, its extracted value at combustion heat of 8,000 kcal^{-kg} is the following one:

$$П_Д = \frac{T_у . П_э}{T_{уг} . б_э} . 1000$$

Where and - the calorific value of estimated coal and 1 t of equivalent fuel, kcal^{-kg}; - The price of electricity sales, rub./ kWt-h; - The consumption of equivalent fuel for the production of 1 kWt-h of electricity (0.32 kg^{-kw}t-h):

$$\frac{8000.328.1000}{7000.032} = 11714 \text{ rub./t.}$$

Profit margin:

$$П_р = 11714 - 1000 - 200 - 850 = 9664 \text{ rub./t}$$

The lost reserves of coal are much more valuable than it was defined by the restructuring program. For example, the calorific value of anthracites makes 8,000-8,200 kcal^{-kg} according to their ash content, so during the burning of these coals a HS gets not 3125 kWt-h as from 1 ton of equivalent fuel, but 3600-3800 kWt-h.

If the production cost is twice as high as the selling price of coal, the mine operation from the perspective of mine-HS interests is efficient, and from the standpoint the complex mine-HS-electricity network it is highly effective.

The extractable value of coal is several times more than its selling price. Therefore, the increase of coal utilization efficiency is achieved by the aggregation of mines and coal processing enterprises up to the final product sale (Riazi Rajender Gupta, 2016; Rolf Dieter Stoll *et al*., 2009).

The mineral resources of Russia are characterized by the depletion of the rich and large deposits of many minerals with the prospect of smaller deposit development according to reserves and the content of deposit useful components. Therefore, mining and processing technologies that provide a more complete and integrated use of subsoil acquire their relevance (Pfütze Martin, 2012).

The efficiency of coal production may be enhanced by optimizing the parameters of a field development (Fig. 1). The complex use of coal and other mineral resources of the region is provided by the development of main trends: the production of electrode products and its derivatives from thermal anthracite and thermal mass, the production of electric energy, the production of filter materials, the production of briquetted coal (Fig. 2).

The substantiation of effective technological schemes should take into account the impact of mined coal quality on the economic results of the complex for the extraction, the processing and the realization of coal (Fig. 3) (Harris and Roach, 2013; Capilla and Delgado, 2015).

The processes of resource saving, including the complexity and the disposability are of global significance in terms of population growth and the need to involve a growing number of mineral raw materials in the field of life support (Wang, 2009; Freeman, 2014; Dubiński, 2013).

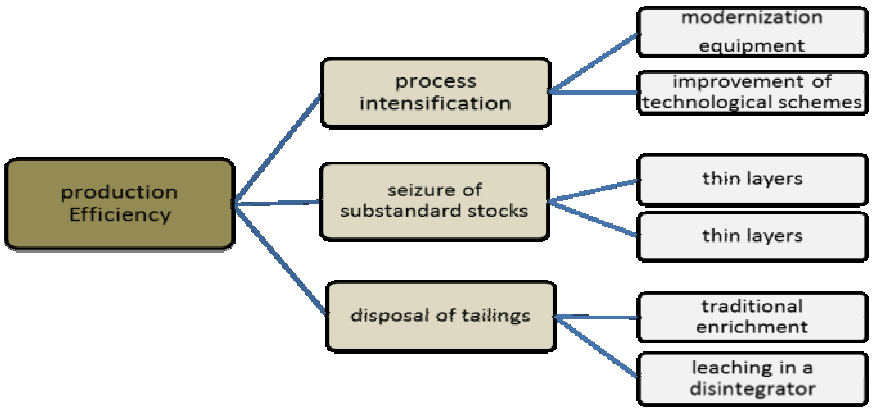


Fig.1: Deposit development parameter optimization

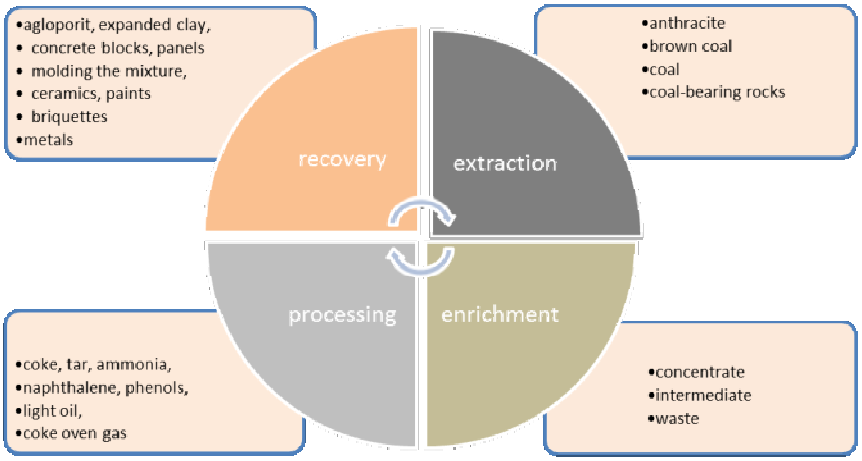


Fig.2. Products of coal extraction and processing

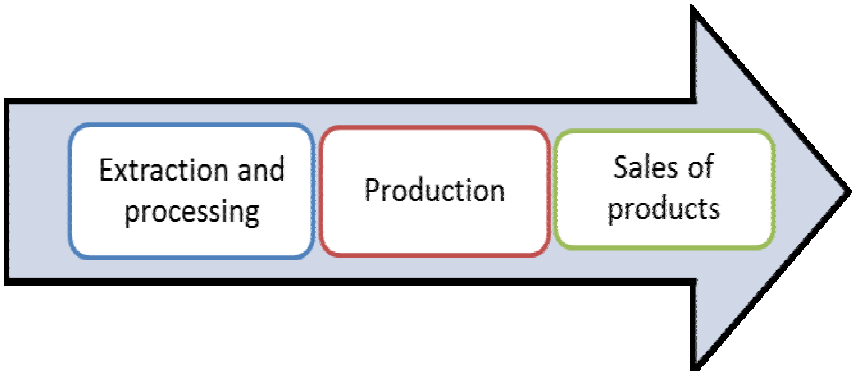


Fig.3. The integration of coal product production steps

CONCLUSION

The elimination of unprofitable enterprises with the transfer of reserves to the category of inactive ones complicates the problems of mineral provision for future generations.

The economic well-being at the operation of reserves unprofitable for traditional technology may be provided by the creation of coal processing facilities with the production of new marketable products.

Coal production restructuring generates unsolvable economic, environmental and social problems.

SUMMARY

The restructuring of coal industry created a major problem. An unauthorized use of abandoned anthropogenic deposits pollutes the region with chemically dangerous products. Instead of profit provision due to the introduction of new technologies the deposit writing off took place with half spent stocks, which could become a mineral - raw material base for new technologies, such as metal leaching from the cleaned coal tailings in a disintegrator, the co-product of which is scarce nonferrous, noble and rare earth metals.

Taking the decisions concerning the fate of coal deposits on the basis of a short-term profit makes it impossible to increase the recoverable coal value through processing. At that components are lost, comparable to the cost of coal. The restructuring of coal industry on the basis of a sectoral approach without taking into account the efficiency of their processing is a big mistake with the economic, environmental and social consequences which were not estimated thoroughly.

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