COMPARATIVE ANALYSIS OF THE RAW MATERIALS BASE OF COAL INDUSTRY IN THE WORLD AND C.I.S. COUNTRIES

Bukayeva, Aliya D. (aliya_asper@rambler.ru)

ABSTRACT

The share of coal in mining energy resources and supply-demand balance of the world had formed over 70% at the beginning of the XX century. The coal serves the dominant source of the electric power reception on the world. The coal resources have explored in 75 countries on the world. The largest coal deposits are concentrated in the USA (445 billion tons), China (272 billion tons), Russia (200 billion tons), the SAR (130 billion tons), Germany (100 billion tons), Australia (90 billion tons), Great Britain (50 billion tons), Canada (50 billion tons), India (29 billion tons), and Poland (25 billion tons). Industrial, research and social-economic progress is normally connected with growing of the consumption of mineral resources, particularly coal that reveals itself on example of developed countries, even that of them, which is not enough provided their own resources. The most probable trends of development of the world coal industry could be the improvement of the mining and consumption of coal infrastructure, the increasing of safety level of coal mining and efficiency of its transportation.

Keywords: coal industry, fuel-energy complex, world, Commonwealth Independent States (C.I.S.)

RESUMO

A quota do carvão no conjunto dos recursos energéticos de origem mineral, bem como na balança mundial de oferta e procura, ultrapassou os 70% no início do século XX. O carvão tornou-se a fonte dominante na produção de energia elétrica à escala do planeta. Os recursos disponíveis deste mineral são explorados em 75 países. As reservas mais abundantes estão concentradas nos EUA (445 mil milhões de toneladas), China (272 mil milhões de toneladas), Rússia (200 mil milhões de toneladas), República da África do Sul (130 mil milhões de toneladas), Alemanha (100 mil milhões de
toneladas), Austrália (90 mil milhões de toneladas), Grã-Bretanha (50 mil milhões de toneladas), Canadá (50 mil milhões de toneladas), Índia (29 mil milhões de toneladas) e Polónia (25 mil milhões de toneladas). Pesquisa industrial e progresso socioeconômico estão normalmente ligados ao crescimento do consumo de recursos minerais, em particular o carvão, que revela por si só o índice de desenvolvimento dos países, incluindo aqueles que não estão suficientemente providos nesse campo. As tendências mais prováveis da evolução da indústria mundial do carvão passam pelo aumento da extração e do consumo e pela melhoria dos níveis de segurança da indústria mineira e da eficiência dos seus meios e processos de transporte.

Palavras-chave: indústria de carvão, complexo de combustível de energia, mundo, CIS.

RESUMEN

La proporción de carbón en la minería y en los recursos energéticos de la oferta y demanda equilibrio del mundo representan más de 70% a principios del siglo XX. El carbón sirve como la fuente dominante de la recepción de energía eléctrica en el mundo. Los recursos de carbón se encuentran en 75 países en el mundo. Los mayores depósitos de carbón se concentran en los EE.UU. (445 millones de toneladas), China (272 millones de toneladas), Rusia (200 millones de toneladas), el SAR (130 millones de toneladas), Alemania (100 millones de toneladas), Australia (90 millones de toneladas), Gran Bretaña (50 millones de toneladas), Canadá (50 millones de toneladas), Índia (29 millones de toneladas) y Polonia (25 millones de toneladas). El progreso industrial, la investigación social y económica se conecta normalmente con el crecimiento del consumo de los recursos minerales, especialmente el carbón que se revela en el ejemplo de los países desarrollados, incluso la de ellos, que no siempre es suficiente con sus propios recursos. La tendencia más probable de desarrollo de la industria mundial del carbón podría ser la mejora de la minería y de la infraestructura en consumo en carbón, el aumento del nivel de seguridad de la minería del carbón y la eficiencia de su transporte.

Palabras clave: la industria del carbón, el combustible de energía complejo, mundial, CEI.

* Bukayeva Aliya, (aliya_asper@rambler.ru), PhD, Director, “Semey-my home” NGO, Semey City, Kazakhstan, E-mail: asper1975@mail.ru.

Submission: 7th February 2011
Acceptation: 20th July 2011
1. INTRODUCTION

For the world economy the coal is the most scale energy resource. On reserves of coal its repeatedly exceeds all other energy resources. According to the data of the World Coal Institute on share of coal falls approximately 90% of energy potential of all suitable for development of the organic origin mineral products. The coal is broadly wide-spread in terrestrial cortex: it is known more than 3,6 thou. pools and coal fields, which in the aggregate are occupying 15% of the earth’s crust. In general, in the world on share of coal falls 70-75% of all fuel resources (in standard coal).

2. CONDITION OF THE RAW MATERIALS BASE OF COAL INDUSTRY IN THE WORLD IN COMPARISON WITH CIS COUNTRIES

The coal serves the dominant source of the electric power reception on the world. At the expense of coal it is provided 40-42% of the electric power production in the world (in the USA - 57-60%; in India and China - 70%; in Australia - 76%, but in Russia - only 26%). At the main coal mining countries the coal mining is systematically growing, but in China and the USA it has already exceeded 1 billion tons per annum. Today in world energy occur serious changes, and demand on coal grows quicker than on the other energy resources. For example, the world demand of coal for the last three years grown up on 25%, in gas - on 92%, in oil - on 6%. Each country in one’s own way solves their energy problems. It depends on that than it disposes. The world explored reserves of coal have exceeded 1730 billion tons. On the world as well as on economic groups of countries from the beginning of 1990s the explored reserves practically did not change. The developed countries have disposed approximately 930 billion tons reserves (54% from worldwide reserves, including the USA - 445 billion tons, 26% from worldwide reserves), the developing countries have more than 160 billion tons (9,2%), the countries with planned and transition economies have 640 billion tons (36, 9%). [5].

In general, the world coal resources are more significant, and supply by them is more than by the other types of fuel. In the last several years in the world grows an importance of coal as the source to energy and it is expected that in prospect such trend will be retained. In 2004
at the expense of coal was provided no less than 26% of the world demand in primary energy. In accordance with projection of “Energy Information Administration” ("EIA"), to 2030 the share of coal in the world consumption of energy resources will form about 28%, but in production of the electric power - approximately 45% (in 2004 - 43%). At present time the coal has a price advantages over oil and natural gas. The transport network and logistics connected with coal branch have actively developed, there is growing the world commerce of coal. In spite of increasing costs of transportation, some analysts have named the coal as “competitive energy resource of the future”. [12].

In 2006 the extracted resources of coal in the world had been valued in approximately 909 billion tons; more than 66% of them had been concentrated in four countries: the USA - 27%, Russia - 17%, China - 12, 6%, and India - 10%.

TABLE 1- Explored coal resources on the world in 2006

<table>
<thead>
<tr>
<th></th>
<th>Total, billion tons</th>
<th>Bituminous coal and anthracite, billion tons</th>
<th>Sub bituminous and brown coal, billion tons</th>
<th>Share of world reserves, %</th>
</tr>
</thead>
<tbody>
<tr>
<td>USA</td>
<td>246,64</td>
<td>111,33</td>
<td>135,3</td>
<td>27,1</td>
</tr>
<tr>
<td>Russia</td>
<td>157,01</td>
<td>49,09</td>
<td>107,92</td>
<td>17,3</td>
</tr>
<tr>
<td>China</td>
<td>114,5</td>
<td>62,2</td>
<td>52,3</td>
<td>12,6</td>
</tr>
<tr>
<td>India</td>
<td>92,45</td>
<td>90,09</td>
<td>2,36</td>
<td>10,2</td>
</tr>
<tr>
<td>Australia</td>
<td>78,5</td>
<td>38,6</td>
<td>39,9</td>
<td>8,6</td>
</tr>
<tr>
<td>African countries</td>
<td>50,34</td>
<td>50,16</td>
<td>0,17</td>
<td>5,6</td>
</tr>
<tr>
<td>Ukraine</td>
<td>34,15</td>
<td>16,27</td>
<td>17,88</td>
<td>3,8</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>31,28</td>
<td>28,15</td>
<td>3,13</td>
<td>3,4</td>
</tr>
<tr>
<td>Brazil</td>
<td>10,11</td>
<td></td>
<td>10,11</td>
<td>1,1</td>
</tr>
<tr>
<td>Columbia</td>
<td>6,61</td>
<td>6,23</td>
<td>0,38</td>
<td>0,7</td>
</tr>
<tr>
<td>Canada</td>
<td>6,58</td>
<td>3,47</td>
<td>3,11</td>
<td>0,7</td>
</tr>
<tr>
<td>Total</td>
<td>909,06</td>
<td>478,77</td>
<td>430,29</td>
<td>100</td>
</tr>
</tbody>
</table>


Either as in past centuries, the coal continues to play the most important role for development of the world civilization in general, including for the metallurgical and industrial production and ensuring of the population by heat and electric energy. The coal forms the main part of prognosis organic fuel-energy resources of the Earth (87, 5%), which had formed on estimation of 1970s 12,8 trln. tons of conditional fuel, or 15,86 trln. t in recalculation on total tonnage of black coal, brown coal and lignite. Taken into account the world coal resources had formed nearly 14,0 trln. tons, moreover the volume of brown coal and lignite reserves reaches 42%. [6].
On condition on the beginning of XXI century the defined world explored reserves of black coal and brown coal are formed over 5 trln. t, but reliable reserves are about 1,8 trln. t. [20].

On different regions of the world the taken into account world reserves of coal allocated extremely unevenly, that have an impact on volumes of coal mining in corresponding countries. [11, 19].

Taken into account the world coal reserves are 14,0 tril. t. The main share is concentrated in Asia (58,4%), the North America (29,9%), and Europe (8,0%), the remained 3,7% is on account for Africa, the South America and Australia. [6].

The coal resources had been explored in 75 countries of the world. The largest coal deposits are concentrated in the USA (445 mldr. t), China (272 mldr. t), Russia (200 mldr. t), the SAR (130 mldr. t), Germany (100 mldr. t), Australia (90 mldr. t), Great Britain (50 mldr. t), Canada (50 mldr. t), India (29 mldr. t), and Poland (25 mldr. t). [20].

The share of coal in mining energy resources and supply-demand balance of the world had formed over 70% at the beginning of the XX century. [3].

With increase of the volume of the oil and gas mining, share of coal in produced and consumed power resources in the world gradually decreased up to the end of XX century. So, in general volume of power resources the share of coal varied in 1970-1975 years from 35 % till 30%, in 1985 the share of coal formed 25,9%, in 1990 - 25,16%, in 1995 - 24,35%, in 2000 - reached the minimum number - 22,3%. [8]

However, at the first years of the XX century already the contribution of coal in volume of mined power resources in the world became newly to increase exceeding 25% in 2005-2006. [19].

In spite of decline of the relative share of coal in volume of mined power resources in the world in past century, the annual coal mining constantly increased in general. [11].

So, at the period from 1950 till 1974 the total coal mining in the world had increased in 1,7 times, exceeding the number 3,0 mldr. t. [6].

At the following years the coal mining in the world increased as far back as 2 times, having reached in 2006 the numbers about 6,0 mldr. t. [8].

To account of the growth of volume of coal production the contribution of coal to mined power resources in the world in 2007 has exceeded already the respective level of 1985 forming more than 25%. [19].

In 2006 the main producers of coal were China, where coal mining has formed 1212, 3 mln. t o.e. (in tons of the oil equivalent), or
more than 2.5 mln.d.t. of coal in absolute value; the USA (595.1 mln. t.
o.e.); India (209.7 mln. t o.e.); Australia (203.1 mln. t o.e.); the South-
African Republic (144.8 mln. t o.e.); Russia (144.5 mln. t o.e.); Indonesia
(119.9 mln. t o.e.); Poland (67.8 mln. t o.e.); Germany (50.3 mln. t
o.e.); Kazakhstan (49.2 mln. t o.e.); Columbia (42.7 mln. t o.e.); the
Ukraine (41.8 mln. t o.e.). [7, 8, 11, 14].

It is presents the interest of the quantitative analysis of growing
coal mining in the world and number of the countries being its leading
producer, during last 20-25 years period, which can serve the reference
mark for undertaking the coal mining prognostic estimation. The
temporary changes on years are presented on diagram 2 the value of
coal mining (N(t)) in the world, in the number of countries (China, the
USA, being its main producers for period 1981-2006), and other
countries. [4, 8, 11, 14, 16.]

There is seen that amounts of coal mining in the world and in
China have changed synchronously, and on these curves possible
clearly to select 3 different temporary phases (periods) of the increase of
coal mining, characterized by different steepness of the growth (1st
phase accounts for 1985-1990, 2nd phase with greater steepness of
the growing - on 1994-1997 and 3rd period of the most growing,
apparently, not yet completed because of observed trend of the
significant growing of coal mining, - for a period of 2001-2006), as well
as 2 short-term phases of the decline of the volume of coal mining (1st

The data of dependence get through 2 local maximum in 1990,
with volume of coal mining 2215.41 mln. t. o.e., and in 1997 - with level
of the mining 2332.44 mln. t o.e., as well as through 2 local minimum of
coal mining, falls on 1991 with volume of the mining 2167.94 mln. t o.e.
and on 2000 with level of the mining 2250.24 mln. t o.e. Beginning from
2001 and up to 2007 exists firmly growing of coal mining in the world in
general, in China, and summary in rest of the coal mining countries. The
contribution of China in worldwide coal mining becomes at the last years
not only maximal, but also all is more significant. So, the volume of coal
mining in China increased from 309.9 mln. t. o.e. (or 16.7% of world
production), reached in 1981 the value 1212.3 mln. t. o.e. (39.37% of
world production) in 2006 under explored for industrial mastering of
resources more than 270.0 mln. t. [4].

During the period 1981-2006 China has provided more than
73.5% of the world increase of the coal mining that forms 902.4 mln. t
o.e. The contribution of other countries - producers of coal in increase
of mining of coal in the world, in contrast with China, is comparatively small (26,5%), with the exclusion of Australia, where coal mining during 25 years increased in 3,1 times, India - an increase of the mining in 3,3 times, the South African Republic (the growing of the volume of coal mining nearly in 2 times). The most impressive growing of the coal mining volume for the last 25 years has occurred in Indonesia (the growing in 600 times) and Columbia (the growing in 21, 5 times). [8, 19].

In ditto time, in number of the European countries, traditionally mining coal, had observed the significant decline of coal mining. So, in France during the period 1981-2006 the volume of coal mining decreased in 63 times, in Great Britain - in 6,7 times; in Germany - in 2,9 times; in Czechia - in 1,8 times. For more short period from 1988 till 2006 has occurred also essential reduction of coal mining in Poland in 1,8 times and on Ukraine - in nearly 2,5 times. In Russia during the period 1992-2000 the reduction of the coal mining volume in contrast with 1990 has formed more than 40%. In Japan its own coal mining also decreased during the period 1981-2006 nearly in 16 times, and at present time the coal mining practically cancelled. [8].

There are visible two opposite trends. On the one hand, this is the growing of the coal mining volumes in countries of the Asiatic-Pacific continent (China, India, Indonesia, Australia), as well as in the South African Republic and in Columbia. On the other hand, there is the decline of the coal mining volumes in countries of Europe (Great Britain, France, Germany, Russia, Poland, Ukraine, and Czechia) and Japan. [3, 8].

These two trends of the growing and decline of the coal mining volumes observed in different countries, provide in total to presence of the typical particularities on curve of coal mining for period 1981-2006. In recent years the annual export of coal forms 370-390 mln. t o.e. The main countries-exporters of coal are Australia (in 2006 export has formed 75% of mined coal or 152,0 mln. t o.e., i.e. more than 40% of the worldwide export volume); Indonesia (the export more than 75% of mined coal, or about 90,0 mln. t o.e., that forms about 25% of the worldwide export); the South African Republic (the export of coal annually about 50,0 mln. t o.e.); Columbia (from 25,0 till 40,0 mln. t o.e. annually); Russia (from 25 till 30 mln. t o.e. annually); China (from 20,0 till 30,0 mln. t.o.e. annually at the period of 2000-2006); the USA (from 15 till 25,0 mln. t o.e. annually); Poland (from 10,0 till 12,0 mln. t o.e. annually for the last 30 years). [4, 14, 16, 19].
The note should be taken that such industrial developed countries as Japan, Germany, Great Britain, France, Italy, Brazil, the South Korea and Taiwan in 1981-2006 transformed in the main importers of coal that possible to see from table 2, formed by the author on the base of analytical data. [8].

**TABLE 2-Main coal importers**

<table>
<thead>
<tr>
<th>Countries</th>
<th>Coal mining, mln.t.</th>
<th>Consumption of coal, mln.t.</th>
<th>Import of coal, mln.t.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Brazil</td>
<td>2,6</td>
<td>2,4</td>
<td>5,7</td>
</tr>
<tr>
<td>Germany</td>
<td>146,3</td>
<td>50,3</td>
<td>141,3</td>
</tr>
<tr>
<td>Great Britain</td>
<td>75,7</td>
<td>11,3</td>
<td>70,7</td>
</tr>
<tr>
<td>France</td>
<td>12,6</td>
<td>0,2</td>
<td>25,1</td>
</tr>
<tr>
<td>Italy</td>
<td>-</td>
<td>-</td>
<td>12,9</td>
</tr>
<tr>
<td>India</td>
<td>64,2</td>
<td>209,7</td>
<td>62,9</td>
</tr>
<tr>
<td>South Korea</td>
<td>9,1</td>
<td>1,3</td>
<td>15,2</td>
</tr>
<tr>
<td>Taiwan</td>
<td>-</td>
<td>-</td>
<td>3,5</td>
</tr>
<tr>
<td>Japan</td>
<td>11,1</td>
<td>0,7</td>
<td>63,6</td>
</tr>
</tbody>
</table>


So, the economy of Japan had required in 2004-2006 the import of coal in amount of 120 mln. t o.e. annually, moreover for 25 years in the country has occurred more than double increase of the volume of the import of coal. For this period the import of coal greatly increased in Great Britain, Germany, Italy, but particularly in Taiwan (the growing of the import of coal more then in 11,5 times), the South Korea (the growing of the import of coal nearly in 9 times), and Brazil (the growing of the import of coal in 3,5 times). In India, in spite of significant growing of own coal mining, there is realized its import in volume till 12% from the average annual value of coal consumption. [19, 20].

The last decennial events of XX century is possible to characterize by origin the row of total trends in development of coal industry in the world, including the increasing of the share of coal in volume of the mined primary power resources and the expansion of coal production market. [1].

As to the first from noted most general trends, that it is not only remained, but also became more brightly expressed at the first years of the XXI century. [19, 20].

The analysis of sources data on coal mining and its contribution in the produced world power resources, allows selecting the most important trends, shown in change of these factors for the period of 1981-2006, and on their base to do the following findings. [8, 14].
The main volume of coal mining for the last 25-30 years was redistributed in geographical aspect from countries of the North America (the USA) and Europe (Germany, Great Britain, Poland, Czechia, Russia, the Ukraine) in favour of countries of the Asiatic-Pacific continent (China, Australia, India, Indonesia), as well as the South Africa. [19, 20, 21].

According to the forecast of “EIA”, in 2030 in contrast with 2004 the world consumption of coal will be increased on 74% approximately. In 2004-2015 the annual increase of the coal consumption will be form at the average 2.6%, at period from 2015 till 2030 - 1.8%, that will be caused by expected deceleration of the rate of economical development of the Asiatic-Pacific region (ATR) states and developing countries after 2015. In 2030 in contrast with 2005 the international coal trade will be increased on 44%. The condition of the raw materials basis of coal industry of the C.I.S. countries is more favorable. In subsurface areas of these countries have concentrated 270 mlrd.t. of all coal types resources (22% of the world stocks), including the brown coal. The main countries on its resources amongst C.I.S. are Russia (198 mlrd.t or 73% of total reserves of the C.I.S. countries), the Ukraine (34,4 mlrd.t-13%) and Kazakhstan (90 mlrd.t-30%). [15].

The reduction of the unit weight of coal in production of the energy had begun in 1950-1960. Because of displacing the coal by oil, gas, as well as development of the atomic energy has lead to the reduction of its share in the world energy balance from more than 60% till 28% in 1990s. However, from medium of 1990s, the demand for coal became to increase, and in many country was marked the trend to increasing of its mining and use in production of the electric power. In the world the share of coal in this production has reached approximately 45%, including in the USA -60%, China and India - till 70%, Australia - till 75%, Poland - over 80%. The world mining and consumption of coal by the end of 1990s has exceeded 4750 mlrd.t. The main producers are 8 countries mining more than 80% of coal in the world: China (1350 mln. t; 28.3% from worldwide mining), the USA (1050 mln. t, 22%), India (6.5%), Australia (6.2%), Germany (5%), Russia (4.8%), the South African Republic (4.3%), and Poland (4.2%). On all the rest countries became 18% of the world coal mining. [15].

The dominating part of coal is used by countries of the coal producers. However, in the coal industry of the C.I.S. countries continues to remain extremely low. On coal mining the level of use of the production powers does not exceed in the main coal mining countries - Kazakhstan, Russia and the Ukraine - 60-75%, in Kyrgyzstan - 30%, in Georgia- practically minimized. [15].
3. CONCLUSIONS

The enormous coal resources in the world, the possibility of use of coal without soiling environment allow to consider that coal remained in the list of the most reliable power energy resources. The industrial, research and socio-economic progress is normally connected with growing of the mineral resources consumption, particularly coal, that reveals itself on example of the developed countries, even that of them, which is not enough had been provided by their own resources. These and the other forecasts under their different variances and unconditional probability, however, objectively reflect the natural directivity on increase of the resources consumptions scale. The most probable trends of development of the world coal industry could be the improvement of the mining and consumption of coal infrastructure, the increasing of safety level of coal mining and efficiency of its transportation.

Acknowledgements

I would like to express many thanks to my parents and relatives. Special thanks to Prof. Doutor Fernando Augusto de Sá Neves dos Santos, Director of EGITANEIA SCIENCIA Scientific Review.

BIBLIOGRAPHY

11. Hudyakov N., When one department disturbs other, World power engineering.-M., #8 (44); 2007.