
Dovzhuk I. V.

The article deals with the development of coal industry of the Donetsk basin and technical support of mineral fuel production in the mines of the region in the late XIX – early XX centuries. The last decade of the XIX century, characterized by the concentration of coal enterprises, which led to the widespread implementation of steam lifting, drainage and ventilation devices, the use of dynamite instead of gunpowder in the conduct of underground mining; construction of better equipped and capital super-mine technological complexes. It is noted that the coal mining enterprises of Donbass in 1914, although technically lagging behind the leading capitalist countries, were relatively modernized and showed positive tendencies to their further improvement. One of the major drawbacks of the beginning of the development of the Donbass coal industry was the lack of advanced machinery. Along with large capitalist enterprises that owned steam engines, mines with primitive equipment were ubiquitous. So, in the early 80's in Slavyanoserbsk county, 17 mines used steam engines, and the rest worked with horse-drawn turns. Even at large enterprises, foreign entrepreneurs continued to work with backward equipment, preferring cheap labor. At the mines of the South Russian Coal Society, two horse-drawn caravans operated alongside three steam lifting machines. Two equestrian wheels continued to operate at the mines of the French Society, along with the powerful steam engines of the new mine at the old Rutchenkovsky Mine. At three mines of the Novorossiysk Society acted hoist. Similarly, local entrepreneurs acted. Of the seven mines in the Makeevka mine in Ilovaisk, three were steam engines and four were horse-drawn wheels. Powerful drainage machines were used at the Petrovsky mine of Letunovsky, and on the other four they continued to work with horse-drawn rotors [3, p. 43-44, 50-54, 58; 9, p. 260-265; 10, p. 340].

However, due to the concentration of production, monopoly competition, significant expansion of the front of work and the deepening of mines in the coal industry of Donbass in the 1990s, some technical improvements were made.

Analysis of research and publications. The problem of development of the Donbass coal industry, in particular its technical support during the period under review, was covered in one way or another in the writings of V. Islavin, G. Bakulev, O. Terpigoriev and others.

The purpose of this exploration is to analyze a number of aspects of the development of the Donetsk Basin coal industry in the late 19th and early 20th centuries. To pay attention to the technical support of coal mining in the mines of the region.

Introduction. One of the major drawbacks of the beginning of the development of the Donbass coal industry was the lack of advanced machinery. Along with large capitalist enterprises that owned steam engines, mines with primitive equipment were ubiquitous. So, in the early 80's in Slavyanoserbsk county, 17 mines used steam engines, and the rest worked with horse-drawn turns. Even at large enterprises, foreign entrepreneurs continued to work with backward equipment, preferring cheap labor. At the mines of the South Russian Coal Society, two horse-drawn caravans operated alongside three steam lifting machines. Two equestrian wheels continued to operate at the mines of the French Society, along with the powerful steam engines of the new mine at the old Rutchenkovsky Mine. At three mines of the Novorossiysk Society acted horseback. Similarly, local entrepreneurs acted. Of the seven mines in the Makeevka mine in Ilovaisk, three were steam engines and four were horse-drawn wheels. Powerful drainage machines were used at the Petrovsky mine of Letunovsky, and on the other four they continued to work with horse-drawn rotors [3, p. 43-44, 50-54, 58; 9, p. 260-265; 10, p. 340].

However, due to the concentration of production, monopoly competition, significant expansion of the front of work and the deepening of mines in the coal industry of Donbass in the 1990s, some technical improvements were made.

Analysis of research and publications. The problem of development of the Donbass coal industry, in particular its technical support during the period under review, was covered in one way or another in the writings of V. Islavin, G. Bakulev, O. Terpigoriev and others.

The purpose of this exploration is to analyze a number of aspects of the development of the Donetsk Basin coal industry in the late 19th and early 20th centuries. To pay attention to the technical support of coal mining in the mines of the region.

Presenting main material. The last decade of the XIX century, characterized by the concentration of coal enterprises, - instead of "digging" was the construction...
of deeper mines, which led to the widespread embodiment of steam lifting, drainage and ventilation devices, the use of dynamite instead of gunpowder when conducting underground mining; construction of better equipped and capital superhigh technological complexes.

Thus, in 1895, there were 356 engines with a total capacity of 10,324 hp at 244 mines (consisting of 739 mines) located in the Donetsk basin. and 25459 (on underground) and 7064 (on surface) persons were employed in coal mining operations, the total production of which for the year amounted to 298.3 million pounds; in 1896, the surveyed 274 mines (or 821 mines) accounted for 406 engines (13312 hp) with a total of 33,212 workers, which allowed to produce 33.2 million pounds. coal. In 1897, the work of 256 mines (780 mines) was provided by 493 engines with a capacity of 23,136 hp. and 46174 miners with a total coal production of 46.2 million pounds. In 1898, there were already 610 engines with a capacity of 25181 hp in 760 mines (or 249 mines). and 49,827 miners with 461.9 million pounds mined. coal; In 1899, replies were sent to 276 coal mines (605 mines), which produced coal using a 621 27114 engine, employing 63833 miners producing 561.5 million pounds during the year. coal. By 1900, there were about 294 mines (880 mines) in the Donbass, which already had 973 engines with a capacity of 40858 hp. and 82420 people were employed, resulting in 67.1 million pounds. coal.

As you can see, the number of mechanical engines used in the coal industry of the Donetsk Basin during the six years increased every year and reached 1900 in 1900 in 973 with a total capacity of 40858 hp, against 356 engines with a total capacity of 10324 hp. in 1895, that is, the number of engines increased by almost three times during that period, and their power quadrupled. In this case, on average, one mine had to: in 1895 - 1.46 engine. capacity of 29 hp; 1896 - 1.48 engines. with a power of 32 hp; 1898 - 2.45. engines. capacity of 41 hp; 1899 - 2.25 engines. capacity of 43 hp; 1900 - 3.3 engines. with a power of 42 hp [4, p. 38, IX].

Over the next three years, technical shifts became even more noticeable. In 1903, the Donbass mines used technical equipment: 1265 steam boilers, 682 steam engines, 151 electric machines, 639 pumps, 64 locomotives, 2990 working horses, which averaged 9.66 steam boilers per company, 5, 2 steam engines, 1.15 electric machines, 4.88 pumps, 0.49 locomotives, 22 horses, etc. Also, during this period, a mixed rolling system, i.e., mechanical, manual and equestrian; although smaller businesses still had a manual rollback system. In this case, only mechanical rollback was applied to only 11 enterprises. Among the lighting systems on the surface, gas lighting was mostly used. There were 46 electric companies On the 27th we were safety lamps for work underground. Electric current was used mainly at large enterprises [5, p. VII-IX].

In order to reproduce a more or less objective picture of the technical condition of the coal industry immediately before the First World War, as well as to determine the dynamics in the technical arrangement of the coal-mining enterprises during the five to six years that preceded it, it is advisable to study the materials.

### Dynamics of quantitative and qualitative changes in technical support during 1909-1914. [6]

<table>
<thead>
<tr>
<th>Years</th>
<th>Total coal production at mines Donbass (millions of poods)</th>
<th>Steam Boilers</th>
<th>Steam Machines</th>
<th>Turbine, compressor, locomotives, etc.</th>
<th>Together with all the machines</th>
</tr>
</thead>
<tbody>
<tr>
<td>1914</td>
<td>1883,78</td>
<td>2778</td>
<td>684</td>
<td>2059</td>
<td>68,4</td>
</tr>
<tr>
<td>1909</td>
<td>1089,5</td>
<td>1796</td>
<td>618</td>
<td>1065</td>
<td>91,5</td>
</tr>
</tbody>
</table>

As we can see, the quantitative increase was quite noticeable, and this applied to all categories of mechanisms, while increasing their power (the exception was only steam engines, which was explained by the preference for more advanced engines).

The relative calculations also indicate a clear improvement in the level of technical support. Thus, during the period 1909-1914 the production of mineral fuel in the Donbass increased by 54.6%. The number of steam boilers increased by almost the same amount, namely by 54.7%; the average heating area of one boiler increased by 10.7%, making the total heating area of all steam increased by 71.5% over a five-year period. Consequently, the increase in the capacity of boilers at the Donetsk basin during 1909-1914 was ahead of the increase and production of coal. The number of steam engines (as well as other engines) in the preceding five years also increased significantly; in relation to coal production, this increase was 24.5% (for all machines - 28%), and in quantitative terms it doubled (from 1235 to 2486), and their total capacity doubled: 254221 hp. in 1914, 128114 hp. in 1909 [2, p. 76-84].

It is also worth pointing out that particularly significant improvements in technical improvement were made, first of all, by large enterprises that had more resources and opportunities to provide technical support for coal production. Yes, companies whose coal production exceeded 5 million poods. a year, owned and
the vast majority of technical means. Thus, during this period, a directly proportional dependence of technical support on the size of coal production in enterprises was observed, which was noted earlier, but to a lesser extent.

During this period, the costs of coal enterprises for the purchase of machinery and boilers increased faster than coal production, which is another significant indicator of this issue for the owners of these enterprises. Applied in this regard are indicators of relative increase over the specified period of coal production and costs for the acquisition of technical means [6, p. XIV-XVI]. So, if we take the production and costs in 1909 for 1.00, in the following years the following trend was observed:

<table>
<thead>
<tr>
<th>Years</th>
<th>Coal production growth</th>
<th>Cost increase for technical equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1909</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>1911</td>
<td>1.12</td>
<td>1.55</td>
</tr>
<tr>
<td>1913</td>
<td>1.42</td>
<td>2.24</td>
</tr>
<tr>
<td>1914</td>
<td>1.54</td>
<td>2.39</td>
</tr>
</tbody>
</table>

Thus, if production increased from 1 to 1.54, then the cost of maintenance - from 1 to 2.39, that is, entrepreneurs in the specified period more and more money was spent on the reconstruction and modernization of their enterprises. This tendency was marked by a certain constancy, from which it can be concluded that the innovations introduced were not aimed at obtaining fast profits, but on the overall improvement of the mining processes.

The above information is sufficiently informative for mine work in the region. In particular, there is a detailed analysis of the state of mechanization of practically all stages of mine work, namely the level of mechanization of the processes of lifting, drainage, ventilation, rollback, lighting, etc., and also find confirmation in other sources [8, p. 3-89].

In this regard, it should be noted that in 1914 the process of raising was mechanized at most coal enterprises. Thus, out of 133 companies that sent information, 112 used mechanical lifting means, 385 lifting machines were used to perform these works, which was 84.2%. Equestrian raising was used mainly in small mines with production up to 0.5 million pounds per year, such firms were 21, or 24.8%.

Another important step in the mine process was the drainage. However, no significant quantitative changes have taken place in this respect since 1909. Thus, in 1909, 136 companies operated 741 pumps, and in 1914, 133 firms - 752. However, their average profitability increased by 9%, but the average daily amount of pumped water was estimated at 1 million pounds.

Annual production in 1909 was 11343 buckets, and in 1914 - 14575 buckets, i.e., increased by 3232 buckets or 28.5% [6, p. XIV-XVI].

The given data, as well as other calculations of the State Bureau make it possible to summarize that during the period 1909-1914 the development of drainage at coal enterprises went mainly through the equipment of mines with more powerful pumps.

Ventilation systems also occupied a significant place in mine work, since not only the working conditions of miners depended on the well-being of their operation, but more importantly, the level of mine explosion. Therefore, this area of technical improvement was given particular attention. In the years 1909-1914, the ratio in the number of mines with natural and artificial ventilation changed quite markedly: in 1909 artificial ventilation was used in 43.3% of mines (at 123 firms - 121 fans), and in 1914 - already in 53% (there were 132 fans in 123 firms). It is worth paying attention to the increasing use of electric fan motors, along with steam engines. Thus, in 1909 49 steam and 37 electric motors were used, whereas in 1914 there were already 53 steam and 68 electric motors, that is, the relative share of electric motors in 1909 was 31.4%, and as early as 1914 - 56.2% of the total number of fan motors. This, in turn, significantly affected the average power of this category of engines, which in 1909 was 59.9 hp, and in 1914 - 92.9 hp.

The rollback systems used at the Donbass mines in 1914 were directly dependent on the size of the enterprise. Yes, of the 49 companies whose coal production was more than 5 million pounds, per year, mechanical rollback was applied at 37 enterprises (there were 196 engines and 2475 horses in use), however, here mechanical rollback was combined with other types (manual, equestrian), whereas only mechanical rollback was applied at one enterprise. In enterprises with a production of 1 to 5 million pounds mechanical recoil was used by 54.5% (which was provided with the use of 22 engines and 30 horses), and in firms with a production of up to 1 million recoil was mechanized only on seven of 45 or 15, 6% (four engines and 47 horses). In 26 enterprises only manual rollback was used in general [6, p. XX-XXII].

During the period under consideration, different lighting systems were used, which differed on the surface and underground. There were three types of surface illumination. Yes, electric was used at 48 enterprises out of 118 surveyed in 1914, out of this total only electric was used at 31 companies (26%) and mixed (electric and gas) - at 17 enterprises (14.5%). The other 70 companies (59.5%) used gas lighting. Significant changes have taken place in the distribution of the various underground lighting systems from 1909 to 1914. In particular, open lamps at this time were intensively supplanted by closed safety lamps.

Thus, in 1909 out of 134 companies that sent information, 71 (53%) used open lamps only, and in 1914 out of 119 surveyed companies only 24 (20%) [6, p. XXIII-XXX]. This trend, in addition to its technical significance, indicated that precautionary measures were taken to eliminate the factors of explosiveness and to prevent mine fires.

An important modernization measure aimed directly at the mechanization of the extraction process, and, consequently, the replacement of heavy manual mining work with mechanized work, was the introduction of cutting machines, as well as the expansion of drills and hammers.

It should be noted that the first cutting machines appeared in the Russian Empire quite early. For
example, in March 1875, the Mining Journal in the article "Cutting (cutting) machines and coal mines" points to two mines: the Russian Society and Nikitovsky, where there were already single cutting machines [1, p. 166]. During the same period, drilling machines were used in the Donbass, which acted, as indicated, with the help of compressors.

According to the Bureau of Statistics, by 1914, 127 reporting companies had only 40 (or 31.5%) used perforators and drill hammers (the vast majority of which had been used by powerful enterprises producing more than 5 million pounds - 714 out of 740 operating), and 26 firms, with only Group I, that is, with the production of more than 5 million poods., used machine tools, which numbered 56 [6, p. XXIV].

However, as it turned out, the data on the presence of cutting machines used in the Donets basin, sent to the Statbureau, were incomplete or inaccurate, since, according to the estimates of Prof. OM Terpigorieva, in 1914 120 units of different types of cutting machines were involved in the mines. These data are not in doubt because they have precise instructions on the place of use, as well as interesting calculations related to the use of these machines [7, p. 369-371]. Moreover, the "Description of the Donets Basin" prepared by him contains the analysis and generalizations made on the basis of the experience of using machines in Donbass. According to the data provided here, in 1914, 42 cutting and 78 impact cutting machines were used at the Donbass mines [11]. Their use, both in Soviet and modern historiography, is said to be largely experimental in nature, although it would be more correct to say that it was not widely used: at that time, the owners of coal enterprises were trying to find out the advantages of existing machines, especially as regards their productivity compared to manual labor. In addition, their effective implementation required significant changes in coal mining and lifting technology, which took some time. Nevertheless, the very preparation in 1915 of the aforementioned study indicated the significant efforts of the mining industry, according to the materials of which this description was created, to increase labor productivity due to the technical improvement and mechanization of the main types of mine work and the replacement of manual work by mechanical. However, the acquisition of such machines was not available to all mining firms because their cost was high.

By the middle of 1914, at the mines of the Donetsk Basin, at least 12 varieties of cutting machines had already been actively used, and the supply of disc and bar machines was carried out by English factories, chain - American, shock - English, American, as well as German. The cutting machines were of the heavy type and cost several times more expensive than the impact machines. The cutting machines were driven by pneumatic or electropneumatic engines. The main question regarding the economical and productive operation of these machines has not yet been fully understood due to the small number of machines at the mines, and the search for the most optimal type of them for use has continued. However, already at this time, their economic and technological feasibility in coal mining processes was obvious, which is why their quantitative growth during 1912-1914 was explained [11, vol. 2, p. 369-371].

Conclusions. Thus, the coal industry of the Donets basin at the turn of the XIX-XX centuries, acquired clear signs of the most developed within the Russian Empire, thanks to the concentration of significant capital here. Donbass coal-mining enterprises, in the run-up to the First World War, were technically technologically advanced, though lagging behind the leading capitalist countries, but were relatively modernized and showed positive trends for their further improvement.

Miners in search of maximum optimization and productivity of coal mining were increasingly concerned about the technical improvement of their enterprises, since the introduction of relevant innovations could significantly affect the economic feasibility and profitability of enterprises. This was also necessitated by the technological need in connection with the expansion of production and the constant shortage of labor.

Foreign owners and shareholders who tried to implement the advanced technologies of their countries played the last role in the introduction of innovations. In addition, technical improvements to the extraction processes have not only brought economic benefits to their owners, but have in some cases indirectly improved the working conditions and safety at the mining enterprises in the region.

References
4. Kamennougol'naja promyshlennost' Doneckogo bassejna v 1900 godu. – Har'kov, 1901. – 60 s.
Довжук І.В. Угольна промисловість Донбасу в конце XIX – на початку ХХ ст.

У статті розглянуто розвиток углівної промисловості Донецького басейну та технічне забезпечення видобутку мінерального палива на шахтах регіону в кінці XIX – на початку ХХ ст.

Останні десятиліття XIX ст. характеризується концентрацією углівних підприємств, що привело до широкого впровадження парових, дренажних і вентиляційних пристроїв, використання динаміту замість пороху при проведенні підземних видобувів; будівництво краще обладнаних та кінцевих сучасних технологічних комплексів. Зазначимо, що вуглеобробні підприємства Донбасу в 1914 році, хоча технічно відстали від проміжних капіталістичних країн, були вільно модернізовані та виходили з позитивних тенденцій до їх подальшого вдосконалення. Однак з головних недоліків початку розвитку углівної промисловості Донбасу була відсутність передового обладнання. До середини 1914 р. щонайменше дві тис. лісопідйомних машин вже активно використовувались на шахтах Донецького басейну, більше того, постачання дискових і стрижневих машин здійснювали британські фабрики, зайняли - американські, британські, англійські, та німецькі. Різкі верстати належали до важкого типу і компонували в кілька різних більш, ніж 1500. Різні машини приводились в рух гідромашинами або електропневматичними двигунами. Підкреслюється, що шахтарі в пошуках максимальної оптимізації та продуктивності витрачали всю більше спрямовані спеціально, виробничі відновлення шахтних і дільних пристроїв. Крім того, технічне вдосконалення гірничих процесів не тільки привнесло економічну корись для власників, але іноді опосередковано покращили умови праці та безпеку на гірничих об’єктах.

Ключові слова: угольна промисловість, Донбас, рудники, шахти, технічне забезпечення рудників.

Довжук І.В. Угольна промисловість Донбасу в конце XIX – на початку ХХ ст.

До статті вимагає технологічна необхідність у зв’язку з розвитком виробництва з постійною нестачею робочої сили. Важливу роль у впровадженні інновацій відігривали іноземні власники та акціонери, які намагалися впровадити передові технології своїх країн. Крім того, технічне вдосконалення гірничих процесів не тільки привнесло економічну корись для власників, але іноді опосередковано покращило умови праці та безпеку на гірничих об’єктах.

Ключові слова: угольна промисловість, Донбас, рудники, шахти, технічне забезпечення рудників.

Довжук Ігор Володимирович – доктор історичних наук, професор, професор кафедри документознавства Перевальського державного педагогічного університету імені Григорія Сковороди (м. Перевальськ). Email: lv.dovzhuk@ukr.net