Technical, Technological and Economic Aspects of Thin-Seams Coal Mining
International Mining Forum 2007

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Preface

“Sustainable Development”, defined for the first time in 1987 in “Our Common Future”, a report compiled by the UN Environment and Development Committee, is a term which has recently made a remarkable career in scientific circles – and indeed, among the broad public as well.

Sustainable development was defined in the report as a process, aimed at meeting the development needs of the present generation – in such a way as to make it possible for future generations to meet theirs. At the same time, due to the multiplicity of factors, which may influence the environment, three main areas on which to focus when designing an effective sustainable development strategy were defined.

These are:

– protection of the environment and rational management of natural resources;
– economic growth and fair distribution of resultant profits; and
– social development.

Considering the above-mentioned areas from the mining industry's point of view, we can confidently define sustainable development as “managing mineral resources using methods that result in mining which is economical, environment-friendly and socially acceptable”.

Phrased in this way, the definition provokes several basic questions:

– does current mineral resource management in Poland – which as a matter of course, vitally influences the future of the entire Polish mining industry – comply with principles of sustainable development?
– is the common Polish belief of the long-term sufficiency of domestic mineral resources well-grounded, and does it justify abstinence from mining thin deposits?
– is the mining of thin deposits at all economically viable, in the current realities of the Polish economy?
– is it proper to bequeath future generations with nothing else but thin, inferior deposits?

Stated in this way, the seemingly simple questions become difficult to answer explicitly. Everything depends on the perspective from which one looks at the thin seam-mining phenomenon. Is one merely focused on an analysis of the technical and technological solutions involved in the mining process, does one consider its economics, or does one look at the problem in its entirety, keeping in mind efficient utilization of the natural resources and the energetic safety of the country, as the prime objective?

Not concluding at this stage from which perspective the problem of thin seam mining should be looked at, the need to objectively assess the place and role of this category of mineral resources in the total national resource/reserve base, is undoubted.

The International Mining Forum 2007 is predominantly focused on technical and economic aspects of mining deposits belonging to this category. A particularly large part of the book was dedicated to describing the huge experience in this regard, of the Ukrainian mining industry, whose existence depends mostly on thin seams. Some issues from the Canadian and Chinese mining Industries were also presented.
The International Mining Forum was held thanks to the support of the Chair of Underground Mining, the Faculty of Mining and Geoengineering of the University of Science and Technology (AGH), the Mineral and Energy Economy Research Institute of the Polish Academy of Science in Krakow, KGHM Polska Miedz S.A., LW Bogdanka S.A., Jastrzebska Coal Company, Katowice Coal Holding, MIDO Ltd, MMDE ZOK Ltd, EŁGOR+HANSEN S.A.

The organizers would also like to express their gratitude to all other persons, companies and institutions, who helped bring the Forum into being. We hope that the Forum will contribute to the exchange of interesting experiences and, as has become tradition, the establishing of new friendships.

Jerzy Kicki
Chairman of the Organizing Committee 2007
Organization

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Technical, Technological and Economic Aspects of Thin-Seams Coal Mining
Advanced Experience and Direction of Mining of Thin Coal Seams in Ukraine

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ABSTRACT: The authors described the technology and experience of mining thin and very thin coal seams in Ukraine. Geological conditions of Western Donbass mines allow mining coal together with roof rocks. Such technological changes were approved for “Geroiv Kosmosu” mine PC “Pavlogradvugillia”.

KEYWORDS: Thin and very thin coal seams, auger coal mining, underground gasification, mechanized mining sets

1. INTRODUCTION

The change of world fuel balance causes that in the nearest future coal, along with nuclear energy, will be the priority raw material in energy production. Unfortunately, the foremost coal mining countries met the problem of coal exploration in difficult geological conditions, increase of mining depth and exploration of thin seams. It results in worsening of personnel work safety, increased temperature and stress of ambient rocks, dynamic and geodynamic rockmass behaviour.

In Ukraine, about 95% of coal is mined from seams of thickness less than 1.5 m. That’s why this experience can be useful for other coal mining countries, which explored thin and very thing seams.

In our country there are some classifications of coal seams developed by the underground method according to their thickness. Most accepted is the following division of seams on thickness: < 0.7 m – very thin, 0.7–1.2 m – thin, 1.21–3.5 m – average, and > 3.5 m – thick coal seams.

Principles of application of mining technique and comfort of operation in working space of longwall faces are fixed on the basis of this classification.

The primary concern of the mining industry is the increase of daily output from a productive face working thin and very thin seams to 1500–6000 tones. It will allow decreasing the number of operating faces and using a more simple and economical one- and two-level methods of mine fields’ development. Such approach is instrumental in decreasing the length of supported workings and reduction of mining capital costs. This allows multiplying the return on capital investments and decreasing the work and timing to prepare new mining blocks. Researching rational technological schemes providing for considerable increase of productive faces output and improvement of coal quality is the important task, which is necessary to be solved in the Ukrainian coal industry.
2. ANALYSIS OF TRADITIONAL METHODS OF MINING

There are three main mining methods of coal extraction in Ukraine. They are unique by technique usage in technological process [3].

2.1. Mechanized mining sets with cutting loaders in longwall faces

This technology of mining is most common in Ukraine. In most technological systems cyclic organization of work is used in coal mining. It is characterized by: constancy of working space, saturation by mining mechanized equipment, continuous ventilation, the observance of safety standards on the content of harmful gases and dust particles in the mine atmosphere.

This mining technology is well described in specialized and technical literature. Therefore we will not depict the technological circuit of the mining processes at a longwall face. In thin and very thin coal seams the technological processes are carried out with permanent and partial presence of people in the working space of the face.

In accordance with the requirements of the Ukrainian regulations, the largest permissible thickness of coal seam suitable for mechanized mining with permanent presence of people at the face is 0.9 m. Mining of thinner seams means extracting roof or footwall rock.

For quality mining of coal, technologies of separate and selective coal and waste rock mining were developed. The technological solutions enable to separate waste rocks and coal at the face. Modern mechanized sets are utilized in this mining technique.

Negative features of the selective and separate mining of coal and rock are large power demand from coal and rock mining and transport. For these technologies it is possible to apply only narrow cutter loaders. All this results in production cost of coal rapidly rising. Also the questions of goaf backfill and rock storage on the surface are not solved.

2.2. Mining technologies of plowing, conveyor plowing and scraper plowing

The technological circuit of the plow mining method consists of a plow installation, scraper conveyor, jacks and mechanized or individual support. Such mining of coal is applied in coal seams characterized by relatively strong roofs allowing to be exposed over spans of 1.1–1.3 m for the period of duration of the extraction process.

At the beginning of the cycle the plow is situated in a niche and hydraulic jacks press the conveyor to the face. The conveyor pans are used as an elastic beam and help the plow to constantly stay on the coal seam. Conveyor drive head is usually ahead of the line of the face by 0.2–0.5 m. It is necessary in order to maintain the best contact of the plow with the longwall face. Each hydraulic jack is installed between sections of the mechanized support and the frame of the conveyor. The plow moves between the longwall face and the conveyor, the extracted coal is loaded on the conveyor. Mining of coal is conducted in cuts of 150–200 mm, in both directions. Conveyor drive heads move after each pass of the plow. Niches 5–6 m in length and up to 3 m deep are arranged for their accommodation. The niches are prepared with the help of drilling and blasting or by jackhammers. In favourable geological conditions plow drive heads are installed in the preparatory workings. Duration of mining is determined by the coal's strength properties and the plow capacity, and also the step of mechanized support movement.

Scraper plowing is simpler in technical and technological performance and is used in shortwall faces. Scraper plows are attached to cables and enable not only to extract but also to transport coal. Scraper plows and plows are intended to work only at constant face widths. In order to prevent face closure it is, as a rule, necessary to apply backfilling of the goaf. Scraper plowing is characterized by low cost of mining equipment. It is used with individual face supports. If scraper plowing installation is lost, it is necessary to prepare a new column.
In Ukraine, technologically advanced plows are industrially manufactured: KMC98M (plow mechanized set); UST4 and UST2M; and scraper plows: US2, US2M, US3 and other. Type of extracting tools on the unit is chosen according to the geological condition and strength of coal. Installations of tear and ram actions are most widely applied.

In conditions of inclined coal layers an effective way of mining is application of conveyor plowing. They are constructed in the form of a panelboard. Conveyor plowing is used in steeply inclined coal seams frontally to seam dip. The length of production face is 40–60 m.

Mining begins from a niche or a ledge and is conducted up towards the ventilation workings. Mining is done by working units equipped with picks, which move on a directing beam. The technological installation consist of a conveyor plow, a panelboard of mechanized support, hydraulic jacks, pump station and other devices.

Coal is transported along the face by scrapers fixed on a round-link calibrated chain moving on the footwall of the seam. To the haulage way the mined coal is transported by gravitation. It is necessary to always leave some coal above the unloading chute to minimize the impact on the chute.

2.3. Auger coal mining

This mining technology utilizes special augering installations installed in preparatory workings. They allow mining coal from pillars, geologically disturbed areas, zones of high mining stress and other otherwise uneconomic coal reserves. The last modification of the augering method can be applied in gas-bearing seams (up to 20 m³) and in conditions of below average strength of the surrounding rocks. Ventilation of the mining site is conducted in a regular manner. Direction of movement of drill-rod along the seam is carried out with the use of special sensors, which automatically correct the coal mining.

Drilling of mining panels is done from preparatory workings with cross-sections of no less than 11.2 m², developed with footwall ripped for not less than 0.6 m. The limits of coal seam dip angle are as follows: up – max. 25°; down – max. 10°. The slope of the preparatory workings must be less than 3°.

The setup consists of an augering machine, auger drill, and system of ventilation. Auger drill of the augering machine is equipped with three boring bits. Rotation of the auger drill is carried out by two separate hydraulically operated drives on the frame. Special skids are used to move the equipment and place it in the working position. For the mechanization of docking and undocking of the auger drill the installation has a centring block, which fixes the drills in the direction of the panel. A monorail transport system is used to help with the assembly of the augering elements.

The ventilation of the working area is provided by ventilation pipes. Necessary quantity of air in the vent pipeline is controlled by a gas detection apparatus. The system of ventilation consists of a fan and a pipeline, which is extended with the progress of mining.

Application of augering is limited. Presence of stable rock conditions is the obligatory condition for normal work of augering. In weak rocks it is not possible to retain the auger drill within the limits of the coal seam and the sensors controlling the position of the augering machine.

3. UNCONVENTIONAL METHODS OF MINING OF THIN AND VERY THIN COAL SEAMS

These technologies foresee transformation of coal to gaseous or liquid state, or changing of its morphological properties under the action of external energy fields. Presently, technologies, which use thermal sources for such coal transformation hadn’t found wide application.

3.1. Technologies of coking and semicoking of coals

This technology means the change of morphological properties of coal by usage of high temperatures without air access. Difference between process of coking and semicoking is in the usage of
different temperatures for coal transformation. It is considered that at action of temperature 450–
700°C, coal is transformed to semicoke; at rather high temperatures (800–1100°C) the primary
product is coke. Such technologies are difficult to conduct in situ. Accordingly these technologies do
not solve the problem of extracting of thin and very thin coal seams.

3.2. Technologies of underground gasification and incineration of coal

One of the ways of maintenance of fuel balance of the country is a qualitative change of mineral
extraction technologies. These technologies differ by principles of producing gaseous fuel from coal.
Underground incineration of coal means that the main produced energy sources are the products of
coal burning.

Application of underground gasification for extraction of coal at different depths is one of the
ways to solve this problem. Transformation of solid fuel into gaseous directly in its location is one
of the perspective directions, especially by exploration of thin and very thin layers. It is rather pro-
blematic to extract these reserves with a sufficient level of economic efficiency by application of
traditional mechanized mining technology. Underground gasification of coal is connected to a num-
ber of negative after-effects such as deformation and devastation of agricultural lands and emission
of harmful gases to the atmosphere.

In the process of gasification of a coal layer voids are formed and their borders are subject to
complex pressure. Under the action of pressure caving and displacement of roof rocks occurs, that
in its turn brings to danger of pollution of geo-environment, excessive inflow of water to the gasifi-
cation channel, increased losses of coal and UCG (underground coal gasification) products and sub-
sidence of the surface. To better the understanding of the mechanism of rockmass behaviour during
underground gasification, a number of site measurements, bench and analytical researches [1] have
been conducted.

Introduction of such technologies has certain psychological rejection. They conduce the change
of all mine infrastructure and considerable reduction in the number of employees. Ecological safety
is also important, as harmful gases get to the surface through cracks and pores in the rock.

So the most actual task, which requires an urgent solution is the technical and technological
change in mechanized productive faces which mine thin and very thin coal seams.

The technology of longwall coal mining is a flexible structure. The number of elements compo-
sing the structure can change depending on geological conditions and the accepted elements of
mining mechanization. At any case, such technology consists of: extracting coal, extracting waste
rock (simultaneously with coal to another conveyor flight or after coal extraction), loading of coal
and rock, haulage of coal and rock, support of the working space, movement of scraper conveyor,
processes at the ends of the longwall face, management of the mining stress.

Implementation of the mining is carried out in connection with auxiliary operations, organization
of work, providing face ventilation and absolute observance of safety rules.

4. PROPOSED TECHNOLOGICAL CHANGES IN MINING
OF THIN AND VERY THIN COAL SEAMS

Increasing the efficiency of mine operations demands a systematic and economically proved com-
plex change of technologies of coal mining according to opportunities of mechanized equipment
sets. The important direction of increase in economic parameters is research of internal reserves on
which quantity and quality of extracted coal depends. Extracting large coal volumes is a priority task
of the coal industry of Ukraine. Increasing production capacity of mines is possible in two ways:
extensive and intensive [2].

The extensive way of development means that the increase of coal production is based on the
increase in the number of production faces. Such way demands an essential capital investment. So,
extent of mining enterprise operational expenses for coal production is increased. Such development is economically not favourable, if there is only numerical increase of production faces without qualitative change of engineering and technologies of coal extraction.

The intensive way of development provides introduction of technologically advanced mechanized systems and modification of mining technologies. The most essential technological parameters, which influence coal production, are: face advance, coal seam thickness, and length of the longwall and face mining limit. Changes of these parameters have influences on the mine’s technical situation. Therefore, the decisions should be based on an analysis of actual mine geological conditions. Taking into account complex structure of mining deposits, limitations of mining width, it is necessary to approach the variable production parameters on their own merit. Such approach guarantees adequate technological change of coal extraction being adopted for specific geological situation. As a result, the intensive way of development will decrease coal cost price and time of return on the expenditure on equipment, and increase profitability of the coal mining enterprises. Its introduction is impossible without attracting new scientific development, new mining engineering and updating some technological parts of the mine.

The main deterrent is the increase in quantity of methane gas in the face area and necessity to solve the ventilation problem.

Solution to this problem is carried out by normative implementation of degassing holes in technological circuit. The distance between holes is 20–40 m depending on mining geological conditions. Such practice is used at the Ukrainian mines. Unfortunately, in most cases the received gas is released into the atmosphere and is actually not used.

The direct-flow ventilation is frequently provided for the ventilation improvement in mechanized faces. This technological circuit means change in the preparation of mine fields. It is conducted with enough complicated maintenance, when the workings are supported in a goaf.

Technological schemes are developed in which the production face is divided into one, two, three or four parts [4]. The corresponding number of additional ventilation workings is necessary to provide the effective ventilation in the separated parts. Besides, the gas emission in each of these parts will be different.

The authors develop theoretical aspects of an opportunity to increase cross-sizes of production faces and remove the restricting gas factor for the conditions of the Western Donbass mines. The geologic structure of this region is specific: coal seams are stronger than the adjacent rocks. That is why mining of the surrounding rocks is not a power-consuming process. Mining of adjacent rocks is a necessary factor for intensification of mining.

In our opinion, in this case, it is expedient to make use of selective mining of roof rocks and coal. It will provide preliminary methane drainage from the seam and abatement of methane emissions from broken coal, and increase output by 2–3 times. Also, its allows to reduce ash content of the extracted coal, to use the mined rock as backfill material for the protection of workings, and also to leave rock in the goaf. The result will be cut down expenses for transportation and recycling of waste, the ecological situation in coal-mining regions will improve due to the reduction of harmful gas outbursts from waste heaps and other.

A calculation of daily output at variable mine technical and technological conditions of extraction was carried out at “Gerojiv Kosmosu” mine, PC “Pavlogradvugillia”: mechanized equipment set – KD-99, cutting loader – KA-80.

Design length of the production face – 250 m. Such calculations are conducted for all new production faces in mines of PC “Pavlogradvugillia”.

Coal-mining with roof rock cutting of: 15 (current situation at the mine), 30, 40 and 50 cm.

**Speed of the cutting loader**

- Mined roof rock thickness: 15 cm – \( v_{n15} = 6,7 \text{ m/min} \) (current situation);
- Mined roof rock thickness: 30 cm – \( v_{n30} = 6,9 \text{ m/min} \);
− Mined roof rock thickness: 40 cm – \( V_n^{40} = 7,1 \, \text{m/min} \);
− Mined roof rock thickness: 50 cm – \( V_n^{50} = 7,4 \, \text{m/min} \).

*Speed of face supporting*

− Mined roof rock thickness: 15 cm – \( V_n^{15} = 2,8 \, \text{m/min} \);
− Mined roof rock thickness: 30 cm – \( V_n^{30} = 3,3 \, \text{m/min} \);
− Mined roof rock thickness: 40 cm – \( V_n^{40} = 4,4 \, \text{m/min} \);
− Mined roof rock thickness: 50 cm – \( V_n^{50} = 4,7 \, \text{m/min} \).

*Daily output of rock mass*

− Mined roof rock thickness: 15 cm – \( Q_{\text{max}}^{15} = 2477 \, \text{t/day} \);
− Mined roof rock thickness: 30 cm – \( Q_{\text{max}}^{30} = 3168/4226 \, \text{t/day} \);
− Mined roof rock thickness: 40 cm – \( Q_{\text{max}}^{40} = 3406/4774 \, \text{t/day} \);
− Mined roof rock thickness: 50 cm – \( Q_{\text{max}}^{50} = 3640/5096 \, \text{t/day} \).

Extraction volumes (coal and rock) is shown in Table 1.

<table>
<thead>
<tr>
<th>Parameters</th>
<th>( Q_{\text{max}} ) [t/day]</th>
<th>( Q_{\text{max}} ) [t/day]</th>
<th>( Q_{\text{max}} ) [%]</th>
<th>( Q_{\text{max}} ) [%]</th>
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<tbody>
<tr>
<td></td>
<td>(coal)</td>
<td>(rock)</td>
<td>(coal)</td>
<td>(rock)</td>
</tr>
<tr>
<td>15 mm (current situation)</td>
<td>2477</td>
<td>1983</td>
<td>80</td>
<td>20</td>
</tr>
<tr>
<td>30 cm</td>
<td>3168/4226</td>
<td>2430/3240</td>
<td>738/986</td>
<td>76/24</td>
</tr>
<tr>
<td>40 cm</td>
<td>3406/4774</td>
<td>2430/3240</td>
<td>976/1534</td>
<td>71/29</td>
</tr>
<tr>
<td>50 cm</td>
<td>3640/5096</td>
<td>2430/3240</td>
<td>1210/1854</td>
<td>66/34</td>
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Transporting the rock into the goaf will improve roof condition in the longwall, reducing convergence, and surface subsidence. It is actually for mines of the Western Donbass, because the mining is conducted under the Samara river floodplain, railway and automobile ways.

Calculations of maximum coal output from a production face [5], show that the change of the face cross-section from 2,1 to 3,0 m², can provide the maximal daily coal extraction increase in 2,5 times and more.

The received productivity of the face does not demand change of all technological links on mine. Extraction of coal at a level of 2500 t/day from one production face, and leaving waste rock underground, demands substituting only scraper conveyors in the longwall, the existing mine belt conveyors may still be used. The increase in the cross-section sizes of the production face not only solves questions of ventilation and removes the restrictions to maximal output due to the gas factor, but also improves the work conditions.

**CONCLUSION**

The choice of the mining system and technical providing of output processes must be based on comprehensive research of actual geological conditions of mines.

Directions of the mechanized mining have been oriented towards modern techniques with the change of extraction technology.

The successful work of 10 mines PC “Pavlogradvugilla” can prove the correctness of such approach to the change of technological processes. Restructuring of technical, technological and economic balance of PC, and also correct investment policy caused that more than 12,5 millions tones of coal were mined in 2005. That is above 17% of overall coal production in Ukraine in that year.
REFERENCES


A Concept of Shearer Designed for Coal Mine’s Low Longwall Conditions

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ABSTRACT: An analysis of mining and geologic conditions prevailing in low longwall faces allowed specifying the technical requirements that a longwall shearer working in low faces had to meet. To satisfy both these and the assumed economically justified daily output, the structural, kinematic and power parameters of machines and equipment comprising a mechanised longwall system were established. As an outcome, a concept of a shearer suitable for low longwalls emerged and the extent of the necessary modifications to the powered support and the face conveyor was specified. Taking all the abovementioned factors into account, the most efficient in low longwall conditions version of the cutter loader was pinpointed.

KEYWORDS: Thin coal seam mining, low longwall faces, longwall shearers

1. INTRODUCTION

Coal deposits occur in the form of seams of various widths and dips. The seams may be geologically disturbed by discontinuities such as faults, washouts or waste interlayers, hindering the mining activity. The geologic conditions determine the choice of the mining technique and the technical parameters demanded from the longwall face machinery and equipment. This is why it is so important to exactly determine the width and the dip of the seam (the height and inclination of the face), a coal mining machine is to work in.

According to their width and inclination coal seams may be divided as follows:

- thin, widths up to 1.5 m;
- medium, widths between 1.5 and 3.0 m;
- thick, widths above 3.0 m;

and:

- flat, dipping at 0 to 12°;
- shallow dipping, inclined at 12 to 35°;
- significantly inclined, dipping at 35 to 55°;
- steep, inclination more than 55°.

Currently, the medium-width, shallow-dipping seams are the most extensively exploited group of coal deposits, as mining them is the easiest to mechanize, the most efficient and the cheapest. Thicker coal seams may be mined, albeit laboriously, at full width or divided into several cuts, the width of one slice approximately equal to that of a medium-width seam.

The most unfavourable conditions, as far as mining is concerned, are found in the case of thin seams of changing dips. The major factor responsible for the low efficiency of mining operations...
in such conditions is the face height, effectively hindering the introduction of efficient and reliable mechanization and achieving high daily output levels.

In Poland, the entire coal production comes from mechanized longwall faces utilizing cutter loaders as the coal mining tool. Their dominant position shearers owe the fact the entire mining is conducted in coal seams thicker than 1.5 m. Unfortunately, even at 1.5 m it is difficult to run a conventional longwall face and the efficiency, or daily production, is greatly limited.

Taking the above into account it would be prudent to divide the seams according to the methods employed to mine them. In this case, the faces up to 1 m high can be classified as mineable solely with the use of plows. Faces between 1 and 1.5 m high could be mined with the use of plows or shearers. Faces higher than 1.5 m should be mainly equipped with shearers (DBT currently offers plows suitable for faces up to 2 m high) [1], [3]. In each case the most important selection criterion is the ability to achieve the set daily production target, which in turn depends on the operating cost and the coal price. In the realities of the Polish coal mining industry the minimum daily production figure allowing obtaining a minimum satisfactory profit margin was established as approximately 3000 t/d.

It is currently difficult to meet this requirement in low longwall conditions because of the structural, kinematic and power parameters of face equipment, especially shearers, available on the market.

The shearers manufactured in Poland are suitable for faces higher than 1.5 m. This is mainly due to their dimensions but also due to the size of other face equipment (powered supports, face conveyors). Hence, to be able to effectively mine thin seams (1.0 to 1.5 m thick), a new type of shearer, designed specifically for long wall conditions, is required. Modifications to the powered supports and the face conveyor will also be necessary to allow their effective work with the new type of shearer. It also seems advisable to look into introducing a suitable remote control system for the longwall equipment system to eliminate or at least limit the number of miners employed at the face.

2. ASSUMPTIONS REGARDING EQUIPMENT SYSTEMS SUITABLE FOR LOW LONGWALLS

Longwall mechanized systems comprise the following equipment and machines:

- mechanized self-propelled roof supports, whose main task is to ensure stability of the excavation at the face;
- an armoured face conveyor to remove the broken coal from the face and discharge it onto the entry haulage system;
- a longwall shearer, a complex machine for cutting and loading of coal onto the face conveyor in a single operation.

The powered shield supports are self-advancing and their other function is to flit the face conveyor and push against the face during their forward move.

Additionally to performing its main function as a broken coal transport medium, the face conveyor serves the shearer for traction and support.

All the component elements of a longwall system were purposely described in so much detail to stress the importance of selecting them appropriately, i.e. so as be able to achieve the planned daily production target [2]. This is why it is necessary to establish the most appropriate for the particular production rate and mining and geologic conditions structural, kinematic and power parameters of the shearer, face conveyor and the powered support units.

Since, as stated above, the equipment is tailor-made for particular conditions, let us first assume the technical parameters of the face where a mechanized longwall system is to be installed to be as follows:

- face height range – 1 to 1.6 m;
- face length – up to 200 m;
– web – up to 1 m;
– longitudinal inclination – up to 20°;
– transverse inclination – up to ±5°;
– mining direction – both ways;
– daily production – 4000 Mg and more.

In addition to the above parameters, the shearer was assumed to travel on or beside the face conveyor and the whole system to be controlled remotely from an entry gate.

In order to achieve the set daily output $V_d$ it is necessary to determine the speeds of the shearer and the conveyor and the time of the roof support forward move cycle [2].

Assuming the face length $L = 200$ m, bi-directional mining, effective face working time of 18 hours, web $z = 0.8$ m, $t_{ps} = 30$ min, the minimum required shearer speed $v_p$ necessary to reach the daily production figure $V_d = 4000$ Mg/d is calculated for the following two face heights as:

- $H = 1.0$ m, $v_p \geq 7$ m/min;
- $H = 1.6$ m, $v_p \geq 3$ m/min.

The coal stream produced by the shearer has to be handled by the face conveyor. To meet the capacity requirement, the technical parameters of an armoured face conveyor suitable for a longwall face high between 1 and 1.6 m have to be as follows:

- capacity – 1200 Mg/h;
- chain speed – 1.3 m/s;
- pan width – 850 mm;
- pan height – 200 mm;

implying the following maximum allowed shearer speeds, depending on the relative shearer-conveyor travel direction:

- $H = 1$ m, $v_{ps} \leq 11.0$ m/min (with), $v_{pp} \leq 15.0$ m/min (against);
- $H = 1.6$ m, $v_{ps} \leq 7.0$ m/min (with), $v_{pp} \leq 9.0$ m/min (against).

The coal stream produced by the shearer has to be handled by the face conveyor. To meet the capacity requirement, the technical parameters of an armoured face conveyor suitable for a longwall face high between 1 and 1.6 m have to be as follows:

- speed – 0÷12 m/min;
- power – ≥200 kW;
- web – up to 1.0 m;
- traction type – chainless or haulage chain;
- travel – on or alongside the face conveyor;
- control remote;
- cutter drums diameter – 1000÷1600 mm;
- cutting speed up to 3.0 m/s.

In the case where the shearer runs on the face conveyor, its total height, including the underbody clearance of 200 mm, must not exceed 850 mm. The height of a shearer travelling beside the face conveyor should not exceed 700 mm.