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The new approach to creating progressive and low-waste mining technology for thin coal seams

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Abstract. The problem of mining low-thickness coal seams in the Western Donbas is described in the article. Technological, economic and environmental reasons reducing the effectiveness of traditional technologies for their development are analyzed in detail and the new progressive approach is proposed to solve it. Attention is paid to the importance of hard coal for Ukraine energy independence and thin coal seams, which is the lowest indicator among coal deposits exploited in the developed countries worldwide. The key role of the Western Donbas mines in the Ukraine coal mining industry development is shown, where coal seams with a geological thickness in a range of 0.55 – 0.80 m take more than 50% of coal reserves. It leads to coal clogging and rising of the further enrichment costs. The interrelation of mining, geological seam thickness, and wall rock undercut is established, as well as decade-long tendency out of seam size increase is evaluated. It appropriately correlates with the general tendency of a geological thickness decrease and it leads to an increase of total ash content. The sources are defined and the volumes of waste rock run from coal mine to the surface are quantified, where 80 – 90% are underground mine working development and wall rock undercut while longwall mining operations. The negative influence of the applied mining technologies for low-thickness seams is shown. Whereby existing waste rock dumps are additionally replenished annually by 3.0 – 3.5 million of large-sized coal enrichment wastes and transported back onto waste rock dumps for very high expenses. It is determined that three waste dumps are located near urban settlements, which increases the environmental fee for their placement in three times. The new approach for selective mining of low-thickness seams with rock undercut placement in the gob area is proposed and it is characterized by the addition to the mechanized support of horizontally-closed scraper backfilling conveyor with a tamping device for rock compaction, which reduces the mine rock output by 25 – 30%. The preliminary calculations of parameters and prospective economic efficiency of the proposed mining technology for low-thickness coal seams are carried out in case of one typical longwall face taking into account the mined rock transportation cost to coal-preparation plant and its enrichment, reducing the cost of mine working supports. Its technology is by 17% more cost effective, than traditional mining technology while rough coal ash content does not exceed 21%.

Key words: longwall operations, mining and geological thickness, wall rock undercut, coal ash, selective mining, waste rock placement, waste rock flow

Новий підхід до створення прогресивної та маловідходної технології відпрацювання малопотужних вугільних пластів

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Анотація. У даній статті детально поставлена проблема розробки малопотужних вугільних пластів Західного Донбасу, аналізуються технологічні, економічні та екологічні причини, що знижують ефективність традиційних технологій з повним обваленням порід покрівлі у виробленому просторі їх розробки, і пропонується новий прогресивний підхід її рішення. Акцентовано увагу на важливості кам'яного вугілля для енергонезалежності України та малої потужності вугільних пластів, який є найменшим показником серед вугільних родовищ, що експлуатуються в розвинених країнах світу. Показана ключова роль шахт Західного Донбасу в розвитку вугледобувної галузі України, де більше 50% припадає на пласти з геологічною потужністю від 0.55 – 0.80 м, що призводить до засмічення вугілля і подальших витрат на збагачення. Встановлено взаємозв'язок геологічної потужності пластів, що виймаються, і присічки бічних порід, а також виявлена десятирічна тенденція збільшення розмірів прісічок вміщуючих порід, що закономірно корелюється із загальною тенденцією зниження геологічної потужності пластів і призводить до збільшення середньої зольності видобутої гірничої маси. Виявлено джерела та визначено обсяги руху породних потоків з вугільної шахти до поверхні, 80 – 90% яких становить проведення підземних гірничих виробок і присічка вміщуючих порід при очисних роботах. Показано негативний вплив застосовуваних технологій відпрацювання тонких пластів, в результаті чого діючі породні відвали додатково поповнюються щороку на 3.0 – 3.5 млн т крупнокусковими вуглевідходами збагачення й високовитратно транспортуються назад на породні відвали. Визначено, що 3 породних відвала розміщені біля населених пунктів, що здорожує екологічну плату за їх розміщення в 3 рази. Запропоновано новий підхід селективного відпрацювання тонких пластів із залишенням порід присічки у виробленому просторі лав, який відрізняється доповненням до секції механізованого кріплення горизонтально-замкнутого скребкового закладного конвеєра з трамбуючим пристроєм для ущільнення порід, що скорочує загальношахтний вихід порід на 25 – 30%. Проведено попередні розрахунки параметрів та очікуваної економічної ефективності запропонованої технології відпрацювання тонких вугільних пластів для одного середньостатистичного очисного вибою з урахуванням витрат на транспортування гірничої маси на збагачувальну фабрику та її збагачення, зниження витрат на повторне використання виїмкових виробок, яка на 17% економічніше в порівнянні з традиційною технологією відпрацювання пластів з повним обваленням порід покрівлі у виробленому просторі, при цьому зольність видобутої гірничої маси не перевищить 21%.

Ключові слова: очисні роботи, геологічна потужність, присікання порід, зольність вугілля, роздільне виймання, залишення порід, породні потоки

Introduction. Coal is a strategic type of mineral for Ukraine, capable of providing a significant part of energy independence at the current level of its development since thermal power plants (TTP) produce 37% of all electricity (Amosha, 2013; Snihur, Malashkevych, & Vvedenska, 2016; Mykhailov & Hrinchenko, 2018). The particular value for the energy sector is G black coal (gas-coal) because most of the TTP's energy production boilers are equipped specifically for this type of coal. The issue of developing new sources of energy resources is open and relevant (Bondarenko, Ganushevych, Sai, & Tyshchenko, 2011; Butyrskyi et al., 2019). However, the transformation of Ukrainian energy sector, which would meet the modern trends of developed countries, is proceeding rather slowly due to the predominance of the agro-industrial model of the economy.

In all of the most important world coal deposits, there is a noticeable tendency of reduction the developed coal seam thickness and increasing in the intensification of mining operations in low-thickness seams that is also typically for Ukraine. Worldwide coal reserves account 861 billion tons whereof 194.5 billion tons or 22.6% are concentrated in coal seams with thickness less than 1.2 m. Ukrainian bowels concentrate 33.9 billion tons of coal (4% of world reserves) or 27.1 billion tons in seams with a thickness less than 1.0 m (Fig. 1). It is the lowest indicator among coal deposits exploited in developed countries (Ukraine coal, 2013; International Energy Agency, 2017). The presence of low-thickness coal seams in the composition of industrial reserves makes the further functioning of coal mines significant for the energy sector irrational due to the sharp increase in the mining process cost.

The problem of coal mining from low-thickness seams stay is particularly acute at the Western Donbas mines included into the part of the PJSC "DTEK Pavlohradvuhillia" which currently occupies a key role in the development of Ukrainian coal mining industry and state economy (Pavlenko, Salli, Bondarenko, Dychkovskiy, & Piwniak, 2007; Petlovanyi, Lozynskyi, Saik, & Sai, 2018). The geological data analysis shows that more than 50% of 775 million tons of industrial reserves are present in seams with the geological thickness of 0.55 – 0.80 m and only 3% or 23 million tons of coal is bedded in seams with a thickness of more than 1.0 m that significantly limits the operational life of many mines in the region.

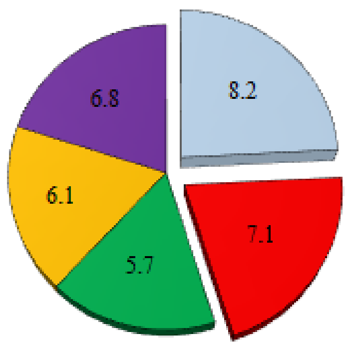

Fig. 1. Distribution of recoverable coal reserves by thickness (billion tons)

Thus, due to the mining completion of coal reserves in seams with a thickness of more than 0.80 m, it is planned to close 3 amongst 10 operating mines in this region during the following 2 – 3 years. Using the traditional technology of mechanized mining of low-thickness seams (bulk mining with full roof caving behind the longwall face), there is an increase in extracted coal ash content and the volume of waste rocks accumulation. Costs and loads on equipment in the integrated technological scheme of mining operations increase significantly: the load on underground and surface transport, mine hoisting, rough coal processing with a return of large-sized rock fragmentations to waste dumps.

Recently, the relevance of developing technologies allowing to create highly efficient, low-waste and environmentally friendly production while mining of mineral deposits has been growing in the world (Lozynskyi et al., 2018; Zhang & Xu, 2018). For the coal mining industry, the development of such technologies is one of the most important, as its production activities adversely affect the natural environment. One of the most important reasons for its deterioration is the accumulation of rock dumps in the mining allotment of coal mines, which occupy valuable land areas (Gorova, Pavlychenko, Kulyna, & Shkremetko, 2012; Petlovanyi et al., 2019; Pactwa, Woźniak, & Dudek, 2020). In foreign developed countries, which have thick and extra-thick coal seams bedding in their bowels, mining operations are carried out with gob backfilling. Accumulated waste rock from dumps is used as filling material to prevent dangerous deformations of the Earth's surface (Jiang, Cao, Huang, Fang, & Li, 2015; Wang & Tu, 2015; Zhang et al., 2019). The application of mining technologies with backfilling is also widespread during the development of ore deposits (Emad, Vennes, Mitri, & Kelly, 2014; Kuzmenko & Petlovanyi, 2015).

The technological and environmental difficulties of low-thickness seams treatment raise an urgent issue of a radical revision of traditional technologies and existing approaches to the extraction of coal from thin coal seams and the creation of new ones with a higher level of economic and environmental efficiency.

This article analyzes in detail the reasons that reduce the efficiency of mining low-thickness coal seams in the Western Donbas that lead to the additional waste formation on the surface. The technological features and advantages of the new approach to coal mining in difficult geological conditions are considered, which significantly reduces the level of waste rock formation by accumulating them in the mined out underground space.

Features of mining low-thickness seams in the Western Donbas. The Western Donbas occupies a special place in the energy supply of the Ukrainian industry. The territory has 7.2 billion tons of coal or 21.3% of the country's total reserves. Annually mines produce 60% of Ukrainian coal (Barabash & Cherednichenko, 2015). More than 80% of coal reserves are concentrated in seams with a thickness of less than 1.0 m, while more productive reserves with relatively favorable conditions have already been worked out or practically depleted in the minefields of coal mines.

Currently, mechanized complexes of the following types KD-80, KD-90, KD-99, DM with shearers KA-90, KA-200, UKD 200-500 are equipped in longwall stoppings. Equipment is designed to operate in the range of mining thickness of 1.05 – 1.25 m (Hrinov & Khorolskyi, 2018; Petlovanyi, Lozynskyi, Saik, & Sai, 2018). Therefore, with an average geological thickness of 0.82 m, the size of wall rock undercut (the difference between the mining and geological thickness) is 0.23 m. It leads to an increase in the mined coal ash content and the formation of additional waste volumes after processing. Clogging of mined minerals with waste rocks negatively affects the technical and economic indicators of mines (Khoyutanov & Gavrilov, 2018; Petlovanyi, Lozynskyi, Zubko, Saik, & Sai, 2019; Petlovanyi & Ruskykh, 2019).

The aforementioned longwall mining equipment, in the conditions of Western Donbas, is not able to mine coal seams with thickness less than 1.05 m without wall rock undercut. It is due to the dimensioning specifications of mechanized complexes and the necessary height of free passage along the longwall face for maintenance personnel. Therefore, the wall rock undercut in longwall faces is a necessary measure during mining very thin coal seams. The generally accepted minimal mining thickness of coal seams is 1.05 m. However, in many cases mining thickness is increased up to 1.1 – 1.15 m for the safe operation of the mechanized complex in difficult conditions with high rock pressure and preventing the support sections from sinking on a "rigid" base. The relationship between the mining, geological thickness und sizes of wall rock undercut is illustrated on the Fig. 2, where technological schemes of coal mining at "Zakhidno-Donbaska" and "Heroiv Kosmosu" mines are presented.

Analysis of the Fig. 2 shows that with equal general accepted mining thickness of coal seams 1.05 m, the size of wall rock undercut of coal seam C_{10}^{t} is 0.06 m, and C_{11} is 0.20 m. This aspect contributes to a mixing of loosened coal with the rock, the deterioration of its quality characteristics and the emergence of additional costs for transport and enrichment. Thus, the average rough coal ash content among the

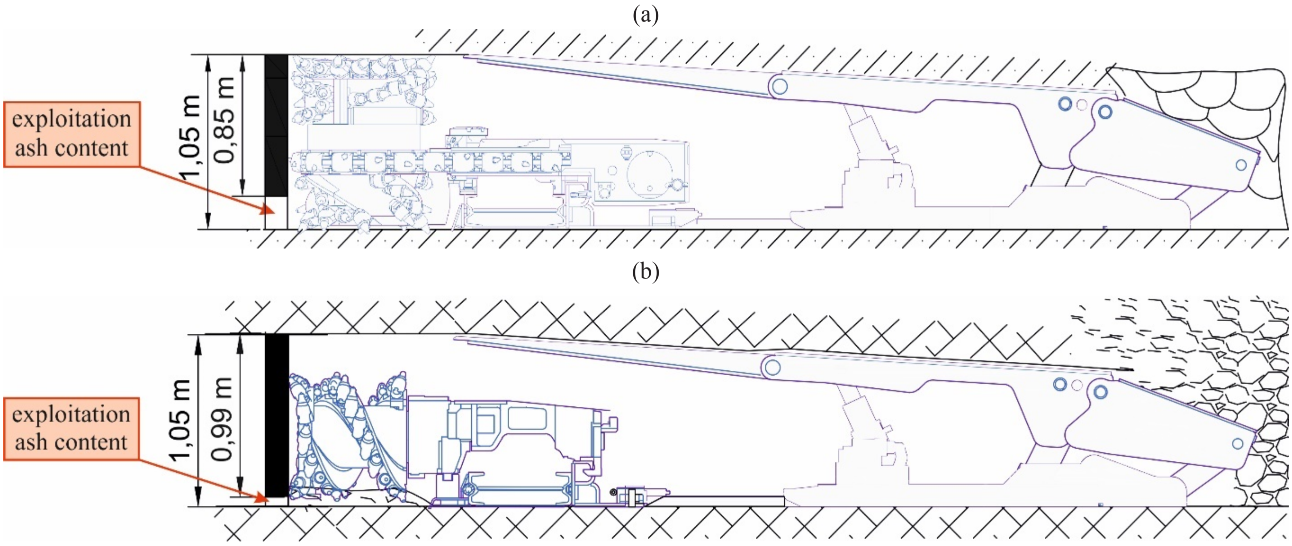

Fig. 2. Typical sections of longwall face with wall rock undercut: during C_{10}^{t} coal seam mining at "Zakhidno-Donbaska" mine (a) and C_{11} coal seam mining at "Heroiv Kosmosu" mine (b)

Western Donbas mines was 43.5% in 2018 (+ 6.7% compared to 2008). The most clogging of mined coal was observed at mines: "Heroiv Kosmosu" – 50.0%, "Samarska" – 47.0%, "Blahodatna" – 45.1%, "Zakhidno-Donbaska" – 40.5%. At the same time, there is a tendency to increase the mined coal ash content and respectively processing waste formation on the surface.

Processing and systematization of statistical production data of mining and geological thickness, the amount of wall rock undercut and coal ash content of the Western Donbas mines over a period of 2007 – 2018 allowed to identify important trends in these indicators (Fig. 3).

The Fig. 3 shows the tendency of steadily increasing the size of wall rock undercut. Thus, the average sizes of the wall rock undercut increased from 0.17 to 0.24 m for the considered period. In the range of geological thickness of mined coal seams of the West Donbas, the sizes of wall rock undercut changed from 0.06 m on the coal seams of more than 1.0 m to 0.44 m less than 0.70 m. At the same time, the mining thickness fits with the geological one only in 12% of longwall faces.

Studies of mining and geological statistics in the longwall faces of the PJSC "DTEK Pavlohradvuhillia" show that the average annual geological thickness of mining coal seams has decreased from 0.95 to 0.82 m (–0.13 m) over the past 10 years. It is accordingly entailed an increase in the produced coal ash content. The diagram pattern of produced coal ash content shows that rock hoisting has increased by 14% over

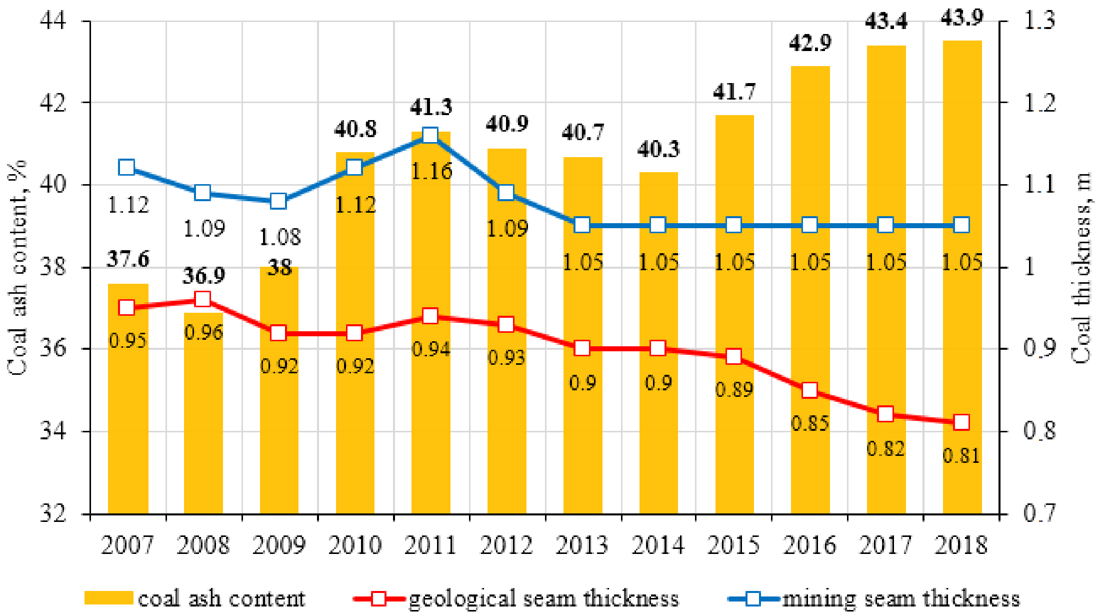

Fig. 3. Dynamic pattern of changing of geological thickness, sizes of wall rock undercut and produced coal ash content of the Western Donbas mines

the past 10 years. In 2018 mined coal ash content for some enterprises varied from 38.3 to 48.5% or 43.3% on average. At the same time, there is a tendency to increase the mined coal ash content and increase the coal waste accumulation on the surface.

Therefore, the issue of reducing the volume of hoisting rock from mines is particularly acute. The urgent need for its solution is dictated by both technical and economic requirements, and emerging environmental risks (Horban, Hornyk, & Kravchenko, 2019; Khorolskyi, Hrinov, Mamaikin, & Demchenko, 2019).

Analysis of the sources of formation and accumulation of coal waste during mining low-thickness seams in the Western Donbas. Waste rock is a reject of coal mining process stored in dumps usually near mines. Waste mine rocks belong to the IV waste hazard category and indicate their insignificant impact on the environment. The main environmental and economic aspects of the storage of rocks are the alienation of valuable land suitable for agricultural use, and the payment the fee by mining enterprises for the placement of 1 ton of waste, and when dumps are located near cities, the fee increases by 3 times.

A detailed analysis of coal mining technology shows that, depending on the processes of underground mining, a certain movement of the waste rock flow from the underground space to the surface is formed. The waste rocks of the Western Donbas mines are mainly contained siltstones – 50%, mudstones – 40% and sandstones – 10%.

In quantitative equivalents identified sources of mine rock input for the conditions of the Western Donbas mines based on the analysis of statistical information on the volumes of coal production, indicators of the total mine ash, analysis of the structure of the mining thickness (sizes of false roof and wall rock undercut), the volumes of mine workings and footwalling (Fig.4).

while longwall operations caused by the low geological thickness of coal seam (80 – 90% of total volumes of waste rock hoisting). It is practically impossible to prevent or reduce volumes of waste rock output from underground mine drivage under existing technological schemes. In the alternative, there is the experience of reducing volumes of wall rock undercut from longwall operations and gob backfilling (Koshka, Yavors'kyy, & Malashkevych, 2014). However, it did not find a wide application in the coal mining industry for a number of technological reasons.

Annually waste dumps of the coal mines in the Western Donbas are replenished by approximately equal volumes of rocks from mine working drivage (3.0 – 3.5 million tons). At the same time, there is the tendency of constantly increasing accumulation of waste rocks from wall undercut in longwall faces. Thus, mines produced a record amount of coal in the region – 20.0 million tons and wastes from coal processing plants – 4.6 million tons in 2018. At the same time, the volume of stockpiled rock in the waste dumps over the past 10 years has increased by 51% (Fig. 5), which naturally correlates with the general tendency of geological thickness decrease. These aspects show the current topicality of rock accumulation in underground spaces and creating new approaches for low-thickness coal seam mining.

Waste disposal sites (WDS) registry analysis of the Dnipropetrovsk region using the program Google Earth Pro 7.3.2 allowed to establish accumulation volumes, occupied areas and locations of coal wastes in Western Donbas (Fig. 6). In the Western Donbas there are 11 waste dumps formed during the period of industrial development of coal reserves. More than 100 million tons of waste rocks were accumulated with a total area of more than 200 ha. For example, in the territories of closed mine "Pershotravneva" and operating mines "M.I. Stashkova", "Dniprovska", "Samarska", "Ternivska", "Zakhidno-Donbaska" one waste dump

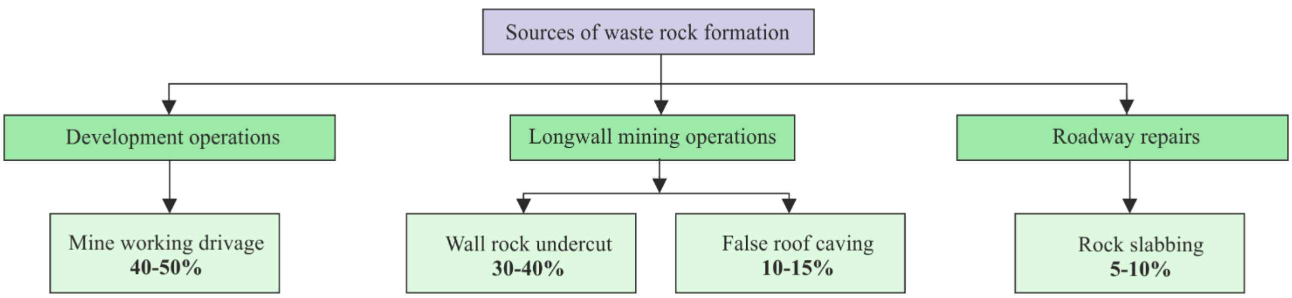

Fig. 4. The structure of waste rock flow while mining very thin coal seams in the Western Donbas

Analysis of the Fig. 4 shows that the largest volumes of movement waste rock flow are accounted for underground mine workings and wall rock undercut is located. The rest of Western Donbas mines have two exploited waste dumps in the limits of mine allotments. All dumps have a flat plan shape (Petlovanyi

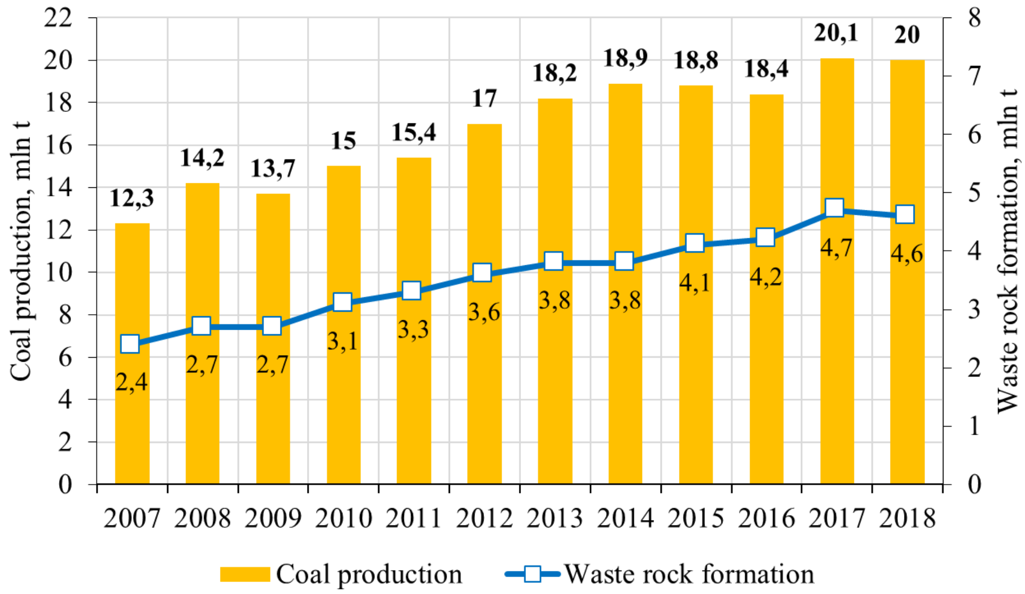

Fig. 5. Dynamics of coal production and additional formation of waste rocks in the Western Donbas conditions

& Medianyk, 2018). Moreover, there are three waste dumps located at a distance of less than three km from settlements. It is three times more expensive ecological payment for the placement of rocks.

It should be noted that 5 – 7 times larger area of lands suitable for agricultural use should be allocated for flat dumps compared to conical dumps. Therefore, from the environmental protection point of view, the waste rock accumulation requires reduction. The volumes of accumulated rock use are insignificant. It is mainly used for road constructions and tamponage of mine workings. It has been proven that waste dumps are sources of valuable mineral raw materials, and waste rocks are a significant resource for construction industry (Bini, Maleci, & Wahsha, 2017; Lèbre, Corder, & Golev, 2017).

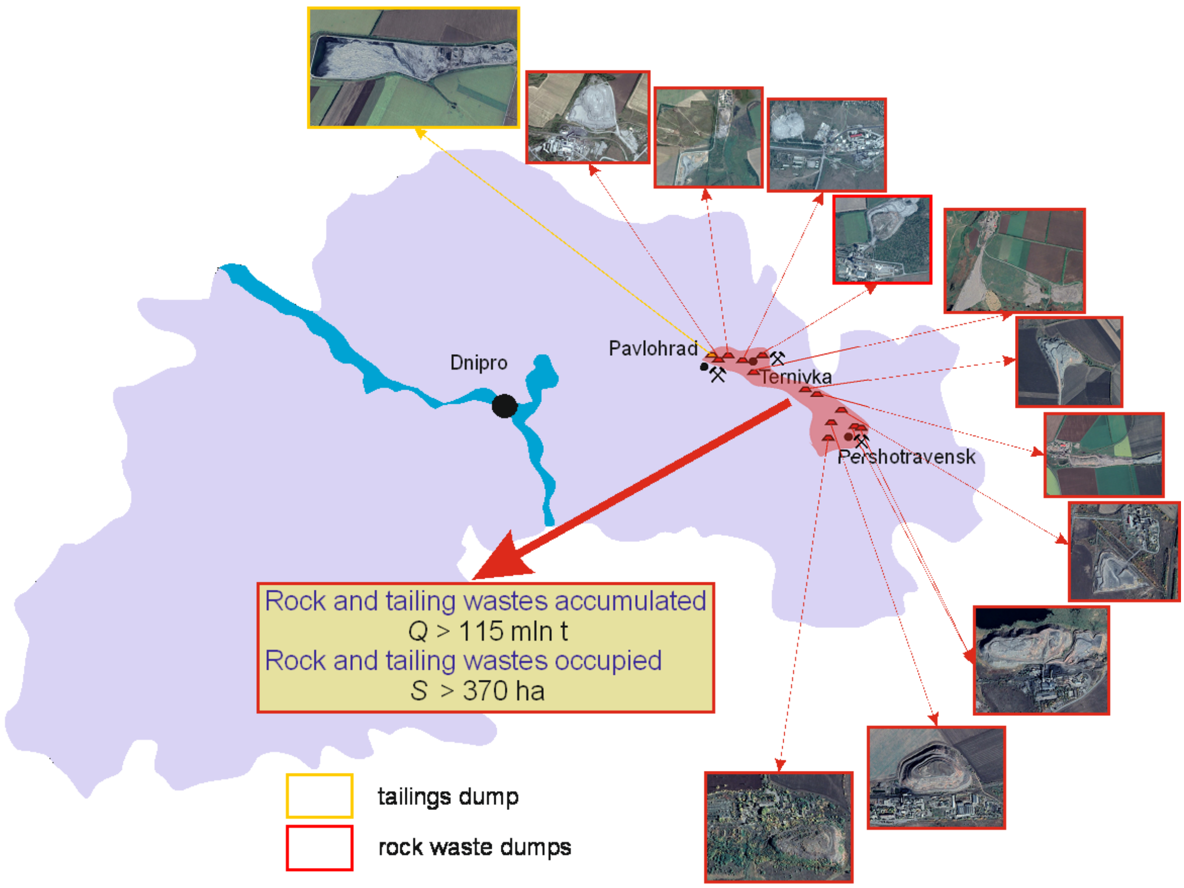

Fig. 6. Accumulation of mine waste dumps and their location in Western Donbas

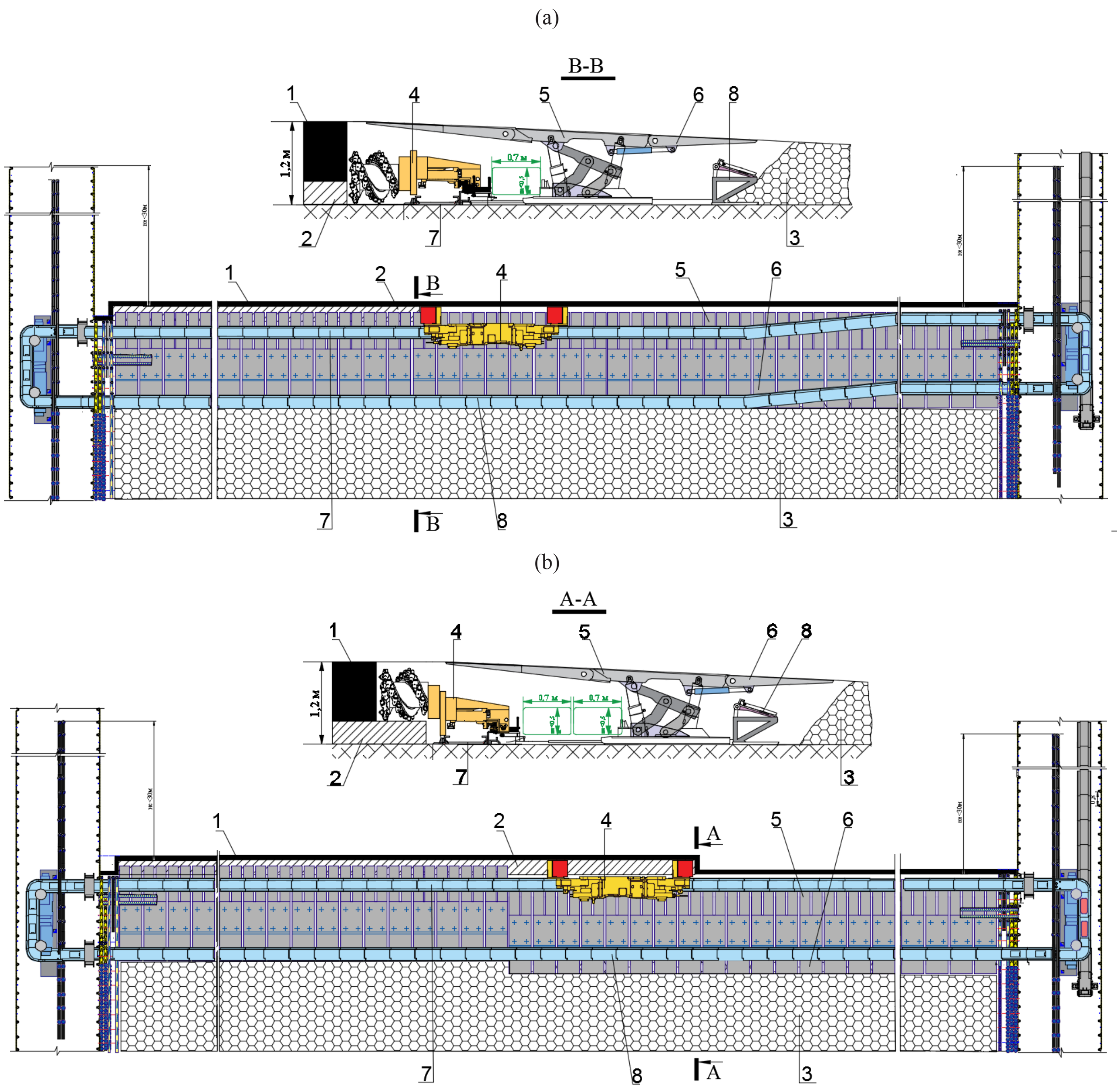

Fig. 7. The technological scheme of selective mining of very thin coal seam with rock placement: (a) coal extraction; (b) rock extraction and placement; 1 – coal seam; 2 – wall rock undercut; 6 – reverse cantilever of mechanized support, 7 and 8 – corresponding face and backfilling lines of horizontally-closed scraper conveyor

The central processing plant "Pavlohradska" operates in the region with an annual capacity of 6 million tons. The ash content of extracted coal reduced to the established quality standards of TTPs to the level of 23 – 24%. Wet fine coal wastes are stored in the tailings pond of 170 ha, and large-sized separated rock is returned to waste dumps nearby coal mines by heavy trucks. This fact testifies to the high costs of circulation of rock streams in the system "coal mine – processing plant".

Features of creating the technological scheme for selective mining of very thin coal seams. In the late 1990s, an attempt was made to create innovative technology for the selective mining of low-thickness coal seams with gob backfilling, but this technology did not receive further application (Byzylo, Koshka, Poymanov, & Malashkevych, 2015). The technology involved selective mining of coal seams with further mined out space backfill by pneumatic complex "Titan" located behind the longwall face in the mine drift. Brocken rock after shearer passing along the rock wall rock bench was transported to the backfilling pneumatic complex "Titan" where it was crushed and passed through the pipeline into the gob. The low productivity of longwall operations, the high dustiness along with the clogging of mine drift and the difficulty in performing tail operations were the main reasons for technology refusal.

Under current conditions and tendencies of coal mining industry development, the problem of low-thickness coal seam mining can be solved due to the introduction of selective mining of very thin coal seams and wall rock undercut with their subsequent placement in gob using new technological units in the mechanized complex that eliminate the disadvantages of the above technology (Bondarenko & Malashkevych, 2019). The technology involves coal seam mining with a thickness of 0.55 – 0.80 m, the subsequent extraction of wall rock undercut with a height of 0.40 – 0.65 m and placement it in the gob. Fig. 7 shows the technological scheme of selective mining of very thin coal seam with rock placement in the gob.

The mechanized complex includes the shearer MB-280E, the modernized mechanized support 1MKD-90 with an elongated face cantilever on 375 mm and the reverse shield with a length of 1500 mm. Transportation of coal and rock is carried out by the horizontally-closed scraper conveyor (Fig. 8).

The process of coal extraction is carried out in the following way. The support and the conveyor stand close to the face in the initial position. The section of the mechanized support is unfastened. The conveyor drive heads are shift. The shearer is cut into the coal seam at the ventilation drift. The forward drum is installed in the upper position and maintained by a seam roof, the back drum is maintained on the extraction of leaving rock bench. When the shearer moves from ventilation to conveyor drift the coal is removed without wall rock undercut. When the shearer moves in the opposite direction the section of the support is alternately moved, at the same time the face and backfilled conveyor lines are not moved.

The process of rock extraction and placement it in the worked-out space is performed as follows. After the extraction of coal and its transportation to the conveyor drift, the shearer is reversed. Further, the rock bench is extracted in the direction from conveyor to ventilation drift. The rock is transported from the face to the conveyor drift, and then it goes around the drift and, in the opposite direction, enters on the backfilling conveyor line of the horizontally closed scraper conveyor.

The backfilling line of the conveyor is installed at an angle to the seam floor plane. As the crushed rock moves along the inclined pans, it is self-unloading into the worked-out space with its subsequent packing by a tamping device. The laying of the backfilled massif is carried out continuously along the length of the worked-out space. The technology provides placing in mined-out space wall rock undercut and reducing waste hoisting by 25 – 30%.

Rock placement in mined-out space has a positive effect on the reduction of the stress state of coal-bearing massif as well as surrounding rock massif excavation mine workings allowing them to be reused (Kononenko, Petlovanyi, & Zubko, 2015; Malashkevych, Sotskov, Medyanyk, & Prykhodchenko, 2018).

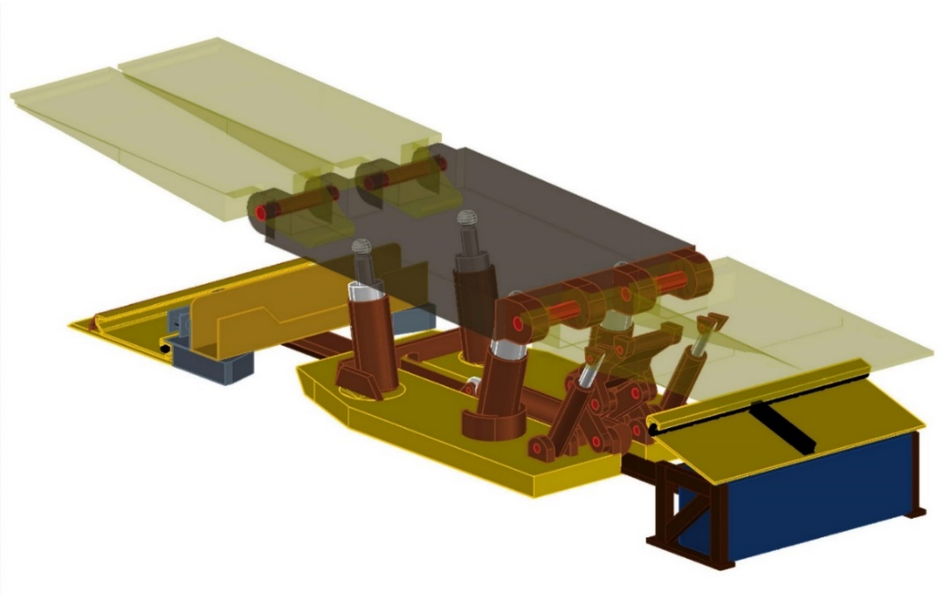

Fig. 8. Overall view of mechanized roof support and horizontally-closed scraper conveyor

The expected main technological parameters of the selective mining technology are pre-determined on the example of the mine “Ternivske” PJSC “DTEK Pavlohradvuhillia” conditions. Thus, the expected production output is 966 t/day at coal seam thickness of 0.55 m and 1314 t/day of clean coal at 0.80 m respectively. At the same time, the ash content of the produced coal in the range of the geological thickness of the seam 0.55 – 0.80 m varies insignificantly from 19.6% to 21.1% (with maternal A_d = 12.3%). The charts of the dependency graph per of the face output and the ash content of the extracted coal on the wall rock undercut values are shown in Fig. 9.

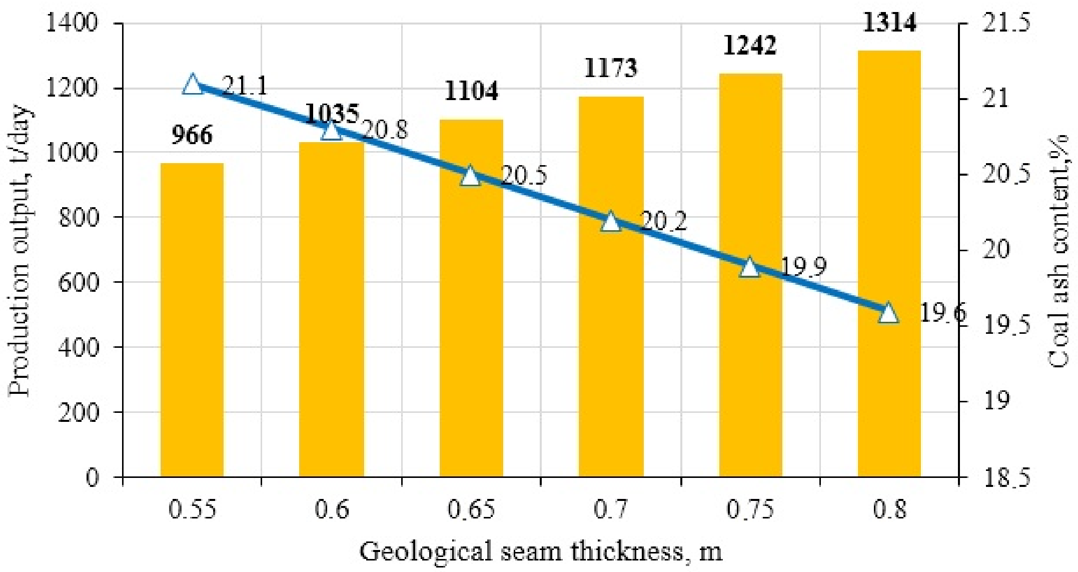

Fig. 9. The chart of the dependence of the face output and ash content of the extracted coal on the wall rock undercut values

To assess the economic efficiency of the application of selective coal mining technology, calculations were carried out with 2600 m longwall panel length and 250 m width, 1.05 m mining coal seam thickness and 0.70 m geological seam thickness. The end-use consumer is the TTP. The expected annual coal production will be 330 thousand tons; daily output will be 1120 tons; the amount of abandoned rocks in the mined-out space will be 310 thousand tons /year; ash content of mined coal will be 21%. The main economic indicators are presented in the Table 1.

Table 1. The main expected economic indicators of technology

Indicators	million **USD**	Indicators	million **USD**
Revenue	17.01	IC	71.5
OPEX	–5.27	NPV	58.6
EBITDA	11.73	PLC	10.0
Net profit	7.78	DPP	4.3
CAPEX with VAT	57.48	IRR	15.6
Working capital	6.18	ROI	15%

Based on the data achieved performance of the technology. The net profit from coal sale will be 7.78 million USD annually, which is 17% more than using the existing traditional technology, providing a gross excavation of coal with the cutting of surrounding rocks and the enrichment of contaminated rock mass on the surface. The obtained results are achieved due to almost two times reduction of the cost of transporting the rock mass to the processing plant and its enrichment, reducing the costs of re-using the excavation mine workings. Therefore, the preliminary economic calculations show that technology is progressive, as it provides growth in production indicators and improves the ecology of mining. The proposed technical solutions are at the pre-project stage of the development.

Conclusions. The progressive and low-waste technology of low-thickness coal seam mining is proposed in this article. The detailed study of current trends in the development of Ukraine coal mining industry, geological features of coal reserves occurrence, applied mining technologies is carried out. The relations of mining, geological thickness, and wall rock undercut height leading to the accumulation of large-scale waste of processing plants are identified.

In the course of the performed researches, several features and results were revealed:

– the Western Donbas mines play a key role in the development of Ukrainian coal mining industry (60%), where the PJSC “DTEK Pavlohradvuhillia” operates. Despite the achieved positive results, there is a problem of coal production from low-thickness coal reserves. More than 50% of 775 million tons of industrial reserves are coal seams with a thickness of 0.55 – 0.80 m. It is the main cause of coal clogging;

– the tendency of a steady increase in the sizes of surrounding rock undercut is determined. Wall rock undercut in the longwall faces of the Western Donbas mines has increased from 0.17 to 0.24 m for ten years. It has led to an increase in the average ash content of the extracted coal from 36.8 to 43.5%;

– the sources and volumes of waste rock are identified. The key places in waste rock formation are occupied by mine working drivage and undercuts while longwall operations caused by the low geological thickness. It makes up 80 – 90% of all rock flow from coal mines;

– during the development of coal reserves in the Western Donbas 11 waste dumps and 1 tailing were formed. Their volumes are more than 115 million tons located on 370 ha of valuable lands, whereof 3 waste dumps located at a distance of less than 3 km from settlements that in 3 times more expensive environmental fee for the placement of rocks;

– the technology of selective (separate) extraction of very thin coal seams and wall rock undercut with their subsequent placement in the mined-out space with the use of new technological units is presented. It is proposed to use horizontally-closed scraper backfilling conveyor with a tamping device as the part of the mechanized complex that leads to the reduction of waste rock hoisting by 25 – 30%;

– preliminary calculations of technological parameters and expected economic efficiency have shown that proposed technology is more cost effective than the existing traditional one by 17% due to almost 2 times reduction of the cost of transportation of the rock mass to the processing plant and its enrichment, as well as reducing costs re-use of excavation works.

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