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NEW TRENDS IN MECHANIZATION AND AUTOMATIZATION IN THE OKD (Ostrava - Karviná Mines company)

Summary. This paper describes an actual of a mechanization and automation of the Czech mining. The mining complex uses in 6m. coal-bed. which is exploited at once. is described like an example in this paper (including acquisition experiences). There are noticed far ther mining complexes which will be used in Czech republik in this paper.

NOWE KIERUNKI MECHANIZACJI I AUTOMATYZACJI KOPALŃ OKD (Ostrawsko-Karwińskich Kopalniach)

Streszczenie. W artykule przedstawiono aktualny stan mechanizacji i automatyzacji kopalń w Zagłębiu Węglowym OKD w Republice Czeskiej. Jako przykład przedstawiono system mechanizacji kompleksowej przeznaczony dla pokładów węgla o grubości do 6 m. W kompleksie tym wszystkie jego składowe elementy wykorzystywane są jednocześnie z uwzględnieniem dotychczasowych doświadczeń.

Introduction

At present, hard coal in the amount of approx. 11 million t/year is mined underground in the Czech Republic. During the past years, the production of hard coal reached about 24 million t. However, in the last seven years all mines in the Ostrava part of the district have been closed, and in the remaining mines, the exploitation has been concentrated in high-capacity faces.

The following four mining plants were formed by the reorganization of OKD:
Československá armáda Mine
Darkov Mine
Lazy Mine
Paskov Mine.
To them, so-called branch plants were affiliated

In all the mines of the Czech Republic, the mining technology "longwalling" is in use. According to the thickness, the seam is mined in one bench or in more benches. A daily

production moved from 350 t/day to 1500 t/day in one face. The length of the face ranged from 100 to 150 m. The thickness of mined seams was 0.5 to 5 m. The above presented outputs from the face may be considered very low, but with regard to the mine-geological conditions they were sufficiently high.

Since 1989, attention has begun to be paid to economy in exploitation in the coal industry: the number of faces being substantially reduced. The drop in the number of faces, however, brought a substantial extension of the length of faces, namely up to 250 m. Because in the framework of damping in the mining industry the exploitation was wholly stopped in mines with seams of the small thickness, the average thickness of mined seams was increased as well, and the maximum mined thickness in one bench grew to the 6 m boundary.

These changes resulted in a rise of the daily production from one face at 2500 t/day, and then at 7000 t/day as a maximum. To make it possible to reach these productions, new mining complexes had to be introduced to the face that were able, on the basis of good organization and management , to achieve these outputs.

In my contribution, I would like to familiarize you with the mining technique that participated most in the substantial increase in the outputs of particular faces, and to indicate the next trends suitable for mining in the OKD.

As far as the exploitation by using shearer complexes is concerned, a mining complex supplied by the French firm CdF representing the MFI, Gerlach, Sagen and SAIT firms was introduced to the Lazy Mine, branch plant of OKD, joint-stock company, in 1993. This mining complex was intended for the mined thickness of even 6 m, the length of the face was 230 m and the maximum production was determined at 5300 t/day. It was introduced to the face 138704.

Description of the machinery:

Powered support	MFI WS 1.7
Height range	min. 2800 mm, max. 6000 mm
Support resistance	max. 1052 kN/m^2
Step	850 mm
Weight	26 t

The support is of the 2 leg type with a two-telescopic extension equipped with anti-burst valves. The roof can be ensured with extensible bars. For ensuring the pillar against sliding, an abutment with a telescopic extension is intended. A so-called multifunctional (20 functions) control device is used.

Shearer Sagem Panda:

Mining range	min. 2800 mm, max. 5600 mm
Cut	800 mm
Output	2 x 450 kW
Rate of advance	10.5 m/min
Tractive force	800 kN
Voltage	1000 V
Weight	72 t

The shearer is characterized by a low height of construction and extremely long arms (2.9 m). Cutting elements of a 2.5 m diameter from the firm Krummenauer are equipped with nozzles placed after knives and exhausting ejectors. To improve loading, hydraulically rotating loading shields can be used. The travel of the shearer is ensured by the hydraulic winch and the travel system Dynatrac.

Face conveyor Gerlach HB 280-1000:

Length	230 m
Width	1000 mm
Haulage	1500t/h
EM input	2x300 kW
Chain	1x ø 42 mm

The route of the conveyor consists of compact members of the route with a closed lower branch and renewable inserts of the upper half of the section. Each trough has an inspectional function as well. The strength of connecting elements of the route members is 3000 kN. In the route, the integrated travel gear Dynatrac with a 38/48 mm chain moves.

Gathering conveyors Gerlach 4 E74 VS:

Length	45/55 mm
Width	832 mm
Haulage	min. 1500 t/h
Chain	2x ø 30 mm
EM input	1x160 kW

Two gathering conveyors are placed in such a way that the first one runs on the second at shifting, which enables a 20 m advance of the face. The second conveyor is transferred simultaneously with shortening the belt conveyor, with whose reversible unit it is firmly connected.

Working in the face 138704

The launching of the face was connected with problems following from the mode of preparatory works. A snicket gate was driven under the roof, and therefore the face had to be driven underhand and then it was possible to begin a full-seam extraction. At launching, roof failures occurred and the roof fell upon the shearer and conveyor. Large blocks of stone were lifted laboriously to the dividing gate and liquidated there. In addition, a passage through the assembly chamber caused certain complications. All problems were managed successfully within the first two months at output parameters getting better and better.

Achieved results in the face in November 1993 - April 1994

face length	226.4 m
pure thickness	502 cm
mined thickness	509 cm

month	11/93	12/93	1/94	2/94	3/94	4/94
daily production (t)	3086	5366	3958	4826	5502	6356
daily advance (m)	2.09	3.17	2.27	2.88	3.35	3.88
face output (t/shift)	30.7	63.7	47.4	56.0	63.6	75.6

Since the beginning of operation, belt conveyors form a limiting factor. For this reason, they move in service within the limits of their capabilities and under very unfavourable conditions due to great quantities of water from the shearer spraying.

It is large blocks of stone falling from the pillar before the shearer that remain to be the greatest problem. Those blocks cross the advance of the shearer before the entry to the shearer tunnel. Therefore, it is necessary to keep in returning the shearer and in crushing the blocks by the arm. The support of the long arm did not make it possible to solve satisfactorily the installation of the crusher on the shearer. In case of the reverse cutting run of the shearer, the same problems could occur at the bottom dead centre of the face.

Working in the face No.139702

The exploitation of the face No.138704 having been completed, the whole equipment was transferred to the face No.139702.

In this face belonging to the Saddle Seams of the Karviná Formation, whose seam thickness varies from 3.6 to 6.3 m and the average thickness is 5.02 m, this complex went into operation in August 1995.

The course of exploitation can be divided into the following 3 stages depending upon the face length:

Stage I: - face length 155 m
- section number 101 pieces
- face life in terms of distance 220 m
- total mined amount 258 757 t
- average daily production 5 390 t

Stage II: - face length 202 m
- section number 138 pieces
- face life in terms of distance 360 m
- total mined amount 502 465 t
- average daily production 4 085 t

Stage III:- face length 108 m
- section number 76 pieces
- expected face life in terms of distance 97 m
- total amount mined by Jan.20, 1997 59 989 t
- average daily production in this period 3 000 t

In the course of mining, several situations emerged resulting in rather long interruptions in exploitation. The most serious of them were as follows:

- heating in the seam:

On December 5, 1995 the situation worsened sharply during the shift III - in the samples of mine air were found 77 ppm of CO, acetylene and higher hydrocarbons; the mined block had to be closed.

The first opening was carried out on the basis of results of analyses made with taken samples of mine air on April 8, 1996, and on April 12, 1996 the face was put into operation. The operation lasted merely by the shift II on April 20, 1996, when the situation again worsened - in the samples of mine air, 170 ppm of CO and acetylene were determined. Thus the face was closed repeatedly on April 22, 1996.

The second opening was made after exhausting only in the shift I on June 15, 1996 and already in the shift III, extraction was launched.

- worsened mine-geological conditions:

1) From September 4 to October 1, 1996 the roof broke, owing to tectonic development, within the interval of support sections Nos. 65-118, into the height of more than 2m. In this period, the removal of oversized rock blocks, secondary blasting, gradual supporting of the roof and pillar sticking were done. From October 2, 1996 conditions were created suitable for the travel of the shearer along the whole face. The gradual supporting of the roof, inserting of the artificial roof, drilling to the roof from the gate No.39 701-1 by means of the steel-plane support and ZD 80 rails, pillar sticking and floor rock blasting were performed. All these operations were executed before shortening the face, i.e. November 1, 1996.

2) From December 16, 1996 to Januar 9, 1997 the sliding of the pillar and falling of the roof occurred in the interval of support sections Nos.33-65. In virtue of this state the bolting of the pillar with sticked bolts as well as the inserting of the artificial roof was introduced step by step into the whole face. After extracting 14 cuts with the artificial roof, the situation was stabilized, and therefore these measures were abandoned and mining without any measures was possible.

As can be seen from facts noted above, conditions for mining were not at all simple, but in spite of these problems, the following results (see the table below) were successfully achieved in the duration of operation of the mining complex:

PERIOD	Production (t)	Working days	Average production (t)	Maximum production (t)	Minimum production (t)
August 95	37 811	10	3 781	3 850	2 150
September 95	121 795	21	5 800	6 000	3 200
October 95	113 901	19	5 995	6 400	3 600

November 95	134 908	24	5 621	7 000
4 300				
December 95	26 849	3	8 950	-
-				
April 96	35 580	6	5 930	-
-				
June 96	56 093	10		5 609
-	-			
July 96	99 835	25	3 993	6
300	1 600			
August 96	94 898	25	3 796	5 500
1 250				
September 96	18 706	10	1 870	4 300
100				
October 96	20 846	18	1 158	1 400
400				
December 96	18 100	17	1 064	3 000
300				
January 97	41 889	13	3 222	3 800
750				
(to Jan.20, 1997)				
Altogether	821 211	201	4 086	

Acquired experience

From the hitherto operation of the CdF complex in the Lazy Mine, the following experience have been gained:

- complexes must be introduced to appropriate conditions, for which they have been designed,
- all machines and equipment of complexes must have harmonized major output parameters and lives,
- the capacity face must be linked with haulage with a corresponding output reserve, for hourly production more than 1500 t, conveyors must be designed having the width of 1200 mm, as a minimum, and the velocity of 3 m/s,
- introduction of effective mining complexes is conditioned by the preparation of workings in corresponding profiles,
- modern machines require strict going by instructions concerning operation and maintenance, including keeping the quality of materials used, e.g. water, lubrications, cutting knives, etc.,
- a shortage in assembly time and transport is possible only when using efficient mechanization.

The hitherto operation of the face has unambiguously proved a justification of input parameters:

- it is possible to mine seams of a thickness of up to 6m in one bench,
- - it is possible to mine seams of considerably variable thicknesses in the range of 3.5-6 m using the only technology,
- a rapid advance of the face and the total exhaustion of coal matter of thick seams decrease a risk of self-ignition,
- modern technology brings a substantial increase in safety and a decrease in laboriousness.
- introduction of technology of really good guality ensures a substantial increase in efficiency parameters of the face and parameters of the whole mini.

Another mining complex introduced to the Czeskoslovenská armáda Mine, branch plant, - Jindrich plant, was a complex consisted of the following:

Shearer EDV 300 LH with the Eicotrack travel gear
Scraper chain conveyor DH 830
Powered supports FAZOS 25/53 Poz
Overall mined thickness was 4.9 m

Dip in the direction of advance	10 degrees as a maximum
Face length	150 m
Parameters of the shearer:	
Range of mined thickness	4890 mm
Number of cutting drums	2 pieces
Diameter of cutting drums	2200 mm
Type of travel gear	Eicotrack
Tractive force max	556 kN
Nominal power output of electromotors	300 kW
Parameters of the scraper conveyor:	
Haulage	1000 t/h
Transport length	155 m
Travel speed	0.32 ms-1
Operation speed	0.96 ms-1
Transport chain	PARSONS XTRA
Input of discharge drive unit	1x85/250 kW
Input of reversible drive unit	1x85/250 kW
Parameters of the support:	
Number of sections	96
Kind	fence, standing
Mined thickness	4.9 m
Number of props in section	4
Maximum support resistance	1640 kNm^{-2}
Weight	29 t

Average output was 3173 t/day.

In the Czeskoslovenská armáda Mine, branch plant, Doubrava plant, the mining complex was introduced in 1996, namely:

Shearer KSW 500/2A2V/2BPH/4.6

Face conveyor Rybnik 255/842/--/WB

Powered supports MEOS 22/46 and MEOS 22/46

What was a novelty was a gathering conveyor with the PZF-04 plant situated under the face. In the complex, the crusher DU1-P4 was placed too.

Main parameters of the plant:

Shearer:	
Type	KSV 500/2A2V/2BPH/4.6
Maximum mined thickness	4.6 m
Diameter of cutting organs	2200 mm
Width of drive unit	750 mm
Travel system	Eicotrack
Tractive force	500 kN
Installed capacity	2x200+ 100 kW
Remote control	Radian 1302
Face conveyor:	
Type	Rybnik 255/842/--/WB
Haulage	1000 t/h
Transport speed	0.37/1.12 ms^{-1}
Input	2x200 kW
Powered support:	
Type:	MEOS 22/46 MEOS 22/46 with extensions
Range of thickness	2.2-4.6 m 2.7-5.1 m
Support resistance	582-800 kNm^{-2}

At present, the following mining complex is being put into trial operation at the Lazy Mine, branch plant.

Shearer	KGE 800
Scraper conveyor	PF 4-932
Powered support	MEOS 17/37/0.5-442

It is a case of the complex for the thickness less than 4.9 m. The electric winch of the shearer is a speciality here. This mining complex has the daily output of about 3000 t/day.

With the previous mining complex, I have mentioned the plant PZF 04 situated under the face. These days, the firm FITE, joint-stock company, has already produced another type of this plant, namely PZF 05.

This is a set of accessories of the gathering scraper conveyor TH 700 and the belt conveyor of the width of 1000 mm. The set of accessories is intended for solving the shift of the gathering scraper conveyor simultaneously with the face advance with a possibility of mechanical connection of the gathering scraper conveyor and the drive of the face conveyor. In virtue of experience in these plants, it can be stated that this plant substantially decreases

the quantity of work invested in the area of the lower transfer point and thus increases the effectivity of mining.

As for the next trend in the development of mechanization, the daily output seems to be increased on the basis of introduction of mining complexes that will have a longer life.

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Omówienie

W artykule przedstawiono akutalny stan mechanizacji i automatyzacji kopalń w Zagłębiu Węglowym OKD w Republice Czeskiej. Jako przykład przedstawiono system mechanizacji kompleksowej przeznaczony dla pokładów węgla o grubości do 6 m. W kompleksie tym wszystkie jego składowe elementy wykorzystywane są jednocześnie z uwzględnieniem dotychczasowych doświadczeń. W artykule podano także informacje o innych kompleksach ścianowych górniczych, które będą również wykorzystywane w czeskim górnictwie węglowym. Na podstawie dotychczasowych doświadczeń w kopalniach, w których stosowano przedstawione kompleksy ścianowe, można wnioskować, że w zakładach tych znacznie obniżyły się koszty związane z transportem oraz wzrosła ogólnie efektywność eksploatacji. Rozwój techniki urabiania w OKD idzie w kierunku stosowania kompleksów ścianowych o dużej trwałości ich elementów.