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EXTRACTION OF SEAM THICKNESS UP TO 6m IN THE CZECH REPUBLIC

DOBÝVÁNÍ VELMI MOCNÝCH SLOJÍ DO 6m V ČESKÉ REPUBLICCE

Abstract

Czech annual output of underground mined coal after significant reduction during the last ten years dropped to 13 million tons per year. By closing of non-effective mines has led to the concentration of faces in active mines. Width of faces increased up to 250 m, the thickness up to 6 m. The one slice extraction of such face thickness has introduced a problem of used mechanization and equipment.

Article describes application of one complex for the mentioned thickness on the mine Lazy, o.z. of OKD, a.s. (stock company), discusses problems arising during complex engagement, analyses working experiences and results from complex operating etc.

Abstrakt

Roční produkce černého uhlí v České republice po restrukturalizaci hlubinného hornictví klesla v současné době na přibližně 13 miliónů tun. Díky uzavírání neefektivních dolů došlo ke koncentraci porubů v aktivních dolech. Délka porubu se zvětšila z původních 120 m na současných přibližně 250 m s mocností sloje až 6 m. Stěnování velmi mocných slojí na jednu lávku však sebou nese určité problémy, které je nutno řešit.

Článek popisuje využití jednoho konkrétního komplexu pro dobývání velmi mocných slojí v plné mocnosti na řízený zával na dole Lazy v.o.j., OKD, a.s. Popisuje problémy, které bylo nutno řešit během jeho provozu, analyzuje zkušenosti s provozem komplexu a řešení dané problematiky.

Introduction

In the Czech Republic exists only one firm, which operates each of the underground mines – OKD, a.s. (part of syndicate Carbon Invest, a.s.). OKD, a.s. is the largest Czech mineral exploitation company. It is active in hard coal mining, coke production and other connected production activities in Ostrava and Karviná regions (region of Northern Moravia and Silesia – northeast of the Czech Republic). The company has a long history record because coal mining in Ostrava started more than 200 years ago. Presently, the OKD mineral exploitation company belongs to the strategically most important and to the largest Czech companies. Its annual production of about 13 tons of coal represents roughly 20% of the domestic primary energy sources. In 2002 OKD, a.s. employed on average 18 708 employees whose average wage amounted to CZK 20 672. This figure ranked the company as a leader not only amongst within firms at the northern Moravia region, but throughout the Czech Republic.

After firm's reorganization during 1990s it has four main parts, which operate individual underground mines. There are Mine ČSA, o.z.; Mine Darkov, o.z; Mine Lazy, o.z and Mine Paskov, o.z. Mine Lazy, which provided first shearer complex to seam thickness up to 6 m, is more productive mine from others, with average raw coal production up to 3 million per year from simultaneously operating of about 5 longwall faces.

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Technology and production development

At the present time, underground mined coal production in the Czech Republic, as mentioned, is average about 13 million tons per year (The Czech Republic has only underground mines to production of hard - black coal). Ten years ago the production was about 24 million tons per years. Declining in the Czech production is based on closing of several mines and thank to fact that production was concentrated mainly to high capacity faces. All mines use only longwall face technology with shearer or plough complexes according to face thickness and geological conditions.

During 1980s the average face production was from 350 to 1500 tons per day, average face width was 100 - 120 m, seam thickness 0,5 – 5 m. These parameters could be considered too low, but regarded to the geological conditions on several mines they were sufficiently high.

Sins 1989 (velvet revolution) real business was implemented also to the coal industry. During few years the mines had more money to purchase more useful complexes (mainly with shearer). Width of faces increase up to 250 m and extracted face thickness up to 6 m. Average daily production from one face raised to 2500 – 7000 tons per day.

Geological conditions

Mines of the Czech Republic have worse geological conditions from others underground mines around the world, which extract hard coal. Concrete in tracts of the mine Lazy, folded mountains are considerably dissected. Strata is folding to flat synclines and anticlines with inclination 6° - 10° . Failure of coal stratum is caused by few disruptions mainly with subsidence character. Thanks to the mentioned geological conditions, all mines use bring back (out-by) extraction methods. Firstly are made main and tail gates with cross entry. By means of it, they find out most of geological dislocations and could take decisions about extraction technology and whole extracting process of coal block.

Perspective carbonaceous bands (seams) in anticlinal folds are four: 37/559, 38/530, 39/512 and 40/504, where first no. is carbonaceous number from surface and second is overall number according to main seams numbering in the CR. Seams of alive carbon in working field are slightly folding to flat synclines and anticlines with general stretch from north-north-east to south-south-west and with lapse to north-north-east. Bedding is sub acinal and seam slope is up to 15° . This locating is dislocated by few fractures with subsidence character. Mentioned tectonics with sizes up to tens meters divide mining field to working blocks, which are further slightly dislocated by small tectonic disturbances.

Seam 37/559 at district of mine Lazy is full exhausted. Seam 38/530 was first time reached during 1970s. Its thickness is from 3,5 m to 6 m. Average seam placement is around 660 m from surface or around 380 m from sea level. Seam 39/512 is about 10 m to 29 m deeper then seam 38/530 and its thickness is from 2,5 m to 6,8 m and it is from 40 % exhausted. Between seams are siltite and sand rocks. Seam 40/504 with thickness from 4,5 m to 7 m is positioned around 820 m (up to 1000 m) from surface or around 540 m from sea level. Seam is from 35 % exhausted.

Diggability of saddle seam is from 150 kN.m^{-1} to 469 kN.kN.m^{-1} with average value 243 kN.m^{-1} . Resistance to pressure is in range from 14,6 MPa to 36,5 MPa with average value 29 MPa. Hard coal bulk density with 13 % of ash is $1,34 \text{ t.m}^{-3}$; with 26 % of ash is $1,45 \text{ t.m}^{-3}$ and with 39 % of ash is $1,58 \text{ t.m}^{-3}$

High production technology

Mine Lazy, as mine, which first time provides longwall face with shearer technology to seam thickness up to 6 m by one bed during 1990s, just now operates four seams with similar parameters. I would like to introduce you to the first one.

The complex was built-up by firm CdF (Charbonnages de France – Ingénierie). The complex, whose overall parameters are in table no. 1, was (is) developed from:

- ❑ **Shearer Panda** made by firm Sagem – two ranging arm machine for Uni-Di or Bi-Di cutting system in longwalls with high seam thickness. The usage is limited by face gradient in range $\pm 14^\circ$ and by angle of strike in range $\pm 9^\circ$. Shearer started extraction (1993) with chainless haulage system Dynatrac type that composed from vertical chain links $\phi 35 \times 153$ and horizontal links $\phi 48 \times 78$.
- ❑ **Roof support WS 1.7** by firm MFI is 2-leg shield type. It is designed to temporary roof supporting of extracted rooms in flat seams with thickness in range from 2,8 m to 6 m. Roof support is applicable to faces with all types of roof conditions (stable, medium stable or unstable). It can be used in seams with rock bump dangers.
- ❑ **Face conveyor (AFC) 1000-HB 280** by firm Gerlach – Halbach&Braun (just now DBT). The conveyor in first face was with pan width 1000 mm and pan high 280 mm. Conveyor has Dynatrac chain integrated to its pans.
- ❑ **Stage loader** – were used two pan conveyors 4 E74 VS made by firm Gerlach too with shifting gear, coal drum impact crusher SK 1700 C by firm Kllöckner.
- ❑ **Electric accessories** including control system MINAUT by firm SAIT.

Table 1 - Overall parameters of the complex used in first face (138704)

Parameter	Unit	Value
Shearer Panda - Sagem		
Working range	[mm]	2 800 – 5 600
Drum width	[mm]	800
Drum diameter	[mm]	2 500
Speed	[m.min ⁻¹]	0 – 10.5
Haulage force	[kN]	800
Install power	[kW]	2 x 450
Voltage	[V]	1 000
Weight	[kg]	72 000
Roof support WS 1.7 - MFI		
Working range	[mm]	2 800 – 6 000
Roof resistance	[kN.m ⁻²]	1 052
Advance	[mm]	850
Weight	[kg]	26 000
Face conveyor 1000-HB 280 - Gerlach		
Length	[m]	230
Pan width	[mm]	1 000
Capacity	[tph]	1 500
Install power	[kW]	2 x 300
Chain	[mm]	1 x $\phi 42$
Stage loader 4 E74 VS - Gerlach		
Length	[m]	45 – 55
Pan width	[mm]	832
Capacity	[tph]	1 500
Install power	[kW]	1 x 160
Chain	[mm]	2 x $\phi 30$

A guarantee of daily production is conditioned by corresponding parameters of optional facility on the basis of specification given by the firm CdF. The most important parameters guaranteed by the Lazy Mine was follows:

- minimum capacity of the belt conveyor 1500 tph
- pressure of hydraulic emulsion for the support 32 MPa
- capacity of hydraulic emulsion for the support 200 l.min⁻¹
- capacity of cooling and spraying system of shearer 400 l.min⁻¹

The coal mucking to skip pocket was carried out by TP 1201 belt conveyors with belt width of 1200 mm and speed of 2.5 m.s⁻¹.

Maximum proportions were main limitations of transported parts of complex to underground working site. On Lazy mine, all shafts are equipped with a rather old hoisting winch, and therefore the cage dimensions of 3200 x 1500 x 950 mm already influenced the constructional design of the parts. Manufacturers made each part of machines at equivalent parameters. Dismounted were transported by monorail to working chamber near of the face (with parameters 30 x 6 x 6 m, at distance 70 m from tail gate), where they were built up and transport to usage. The transport of the whole complex required loading up to 2000 units of the total weight more than 5000 tons. Most sizable problem was with transporting of assembled roof support with heaviness 26 tons. To this time (start of 1990s) none method was used on the mine. In finally, a special footwall rail made by Scharf firm was used, with width of the rail 800 mm and load capacity up to 30 tons.

The mentioned complex passed from 1993 to 2003 through six longwall faces. As can be seen from facts noted above, mining conditions were not at all simple, but in spite of these problems, the following results were successfully achieved in the duration of operation of the mining complex. Main parameters are showed in table no. 2. Figures no. 1 and no. 2 as below show average raw coal output by the CdF complex per year and per face.

Table 2 - Overall parameters of the complex used in first face (138704)

Parameter	No. of face	138704	139702	138906	138908	138910	138912	In sum
	Unit							
Operating time	years	11/93 - 9/94	8/95 - 1/97	6/97 - 2/99	7/99 - 10/00	3/01 - 12/01	6/02 - 12/02	1993 - 2002
Operating days	no.	192	174,7	281	281	228	126	1283
Overall production	t	1021979	827873	1112168	1237589	807141	384756	5391506
Production per day	tpd	5323	4739	3958	4404	3540	3054	4203
Average face width	m	226,5	173,3	217,7	183,4	216,7	165,1	200,3
Average face thickness	cm	510	516	525	539	528	534	532
Length of stopped out block	m	627,1	675,7	722,4	889,6	564,1	309,2	3788
Advance per day	mpd	3,3	3,9	2,6	3,2	2,5	2,5	3,0
Mined out area	m ²	142013	117081	157436	161933	122492	48743	701264
Mined out area per day	m ² pd	739,7	670,2	560,3	576,3	537,2	386,8	546,7
Overall shifts (manpower)	shift	32101	31321	47773	39035	29613	17574	180152
Production per shift (only in face)	t per shift	58,576	62,115	55,022	54,548	55,451	63,209	60,893
Overall production per shift	t per shift	31,84	26,432	23,280	31,705	27,257	21,893	29,927

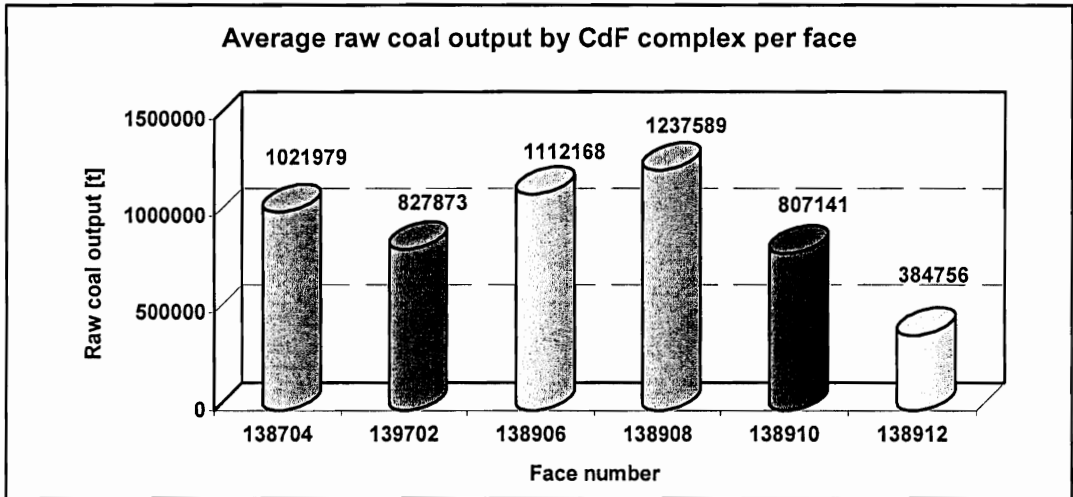


Figure 1 - Average raw coal output by the CdF complex per face

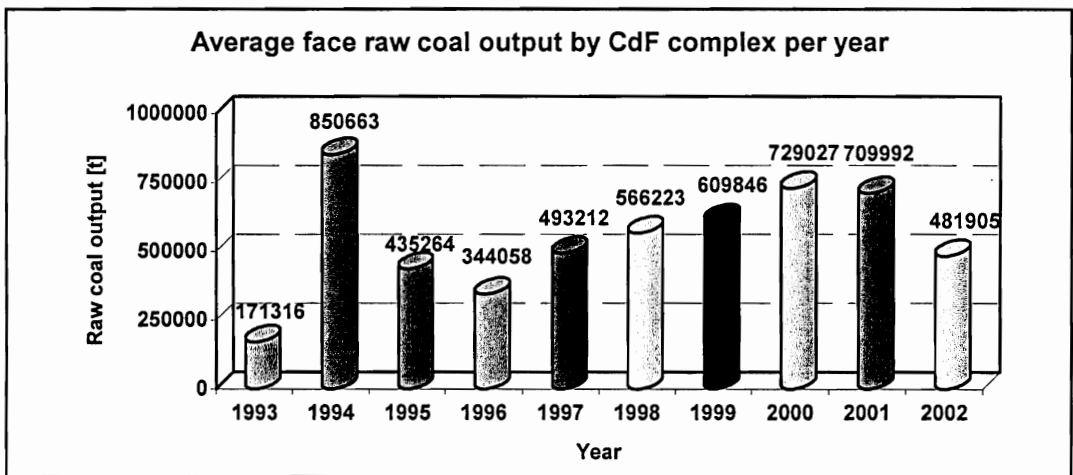


Figure 2 - Average raw coal output by the CdF complex per year

Fall of geological condition

To better understanding of no easy geological conditions in the Lazy district, I would like to describe conditions of only one longwall face (139702) from others. When exploitation of the face No.138704 has been completed, the whole equipment was transferred to the face No.139702 with range thickness from 3,6 m to 6,3 m and average 5,02 m. Shearer started extraction on August 1995. On December 5, 1995 the situation worsened sharply during cubage 77 ppm of CO (carbon monoxide) and higher methane concentration was found, the mined area had to be closed.

The first opening was carried out on April 8, 1996, and on April 12, 1996 the face was put into operation. The operation lasted only to April 20, 1996, when the situation again worsened - in the samples of mine air 170 ppm of CO and higher methane concentration too were again found. Thus the face was closed repeatedly on April 22, 1996. The second opening was made on June 15, 1996 and already extraction was launched.

From September 4 to October 1, 1996 the roof broke, owing to tectonic conditions, within roof support number from 65 to 118. In this time, 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 main and tail gates, pillar sticking and floor rock blasting were performed.

From December 16, 1996 to January 9, 1997 the sliding of the pillar and falling of the roof occurred in roof support number from 33 to 65. After extracting 14 strips (advances) with the artificial roof, the situation was stabilized and mining without any measures was possible.

Conclusion

The article describes period of one high production (in our geological conditions) shearer complex, which is used from 1993 on mine Lazy, Czech Republic (Europe Union). During a few years (about 2 years) the mine bought or redesigned other three shearers to extraction seam thickness up to 6 m. They are SL 500 (Eickhoff), KGE 800 (Famur) and KGS 445 (Famur) with pan conveyors PF 4/932 (Eicotrack) and PF 4/1032 (Dynaride); roof supports MEOS 26/56 and Fazos.

Recenzent: prof. Ing. Josef Jurman, CSc.