POL-VIET 2023

7TH INTERNATIONAL CONFERENCE
Scientific and Research Cooperation between Vietnam and Poland
18–20 October 2023, Kraków, Poland

SOLUTION TO IMPROVEMENT OF TOP-COAL RECOVERY EFFICIENCY IN MECHANIZED LONGWALL OF SEAM 7 HA LAM COAL MINE

Pham DUC HUNG1, Le TIEN DUNG[1], Vu THAI TIEN DUNG[1], Pham VAN QUAN[2]*

[1*)] Department of Underground Mining, Hanoi University of Mining and Geology, 18 Vien street, Hanoi, 100000, Vietnam; email: phamduchung@humg.edu.vn

[2)] Department of Investment Consultancy, Institute of Mining Science and Technology-Vinacomin, 03 Phan Dinh Giot street, 100000, Hanoi, Vietnam; email: pvquan.imsat@gmail.com

1. Status of exploitation at seam 11 HaLam coal mine

Seam 7 has an average thickness of 18.56 m and dip angle of 2–25 degrees. The longwall uses the equipment combination of shield support ZF8400/20/32, shearer MG300/730WD and conveyor SGZ630/264. At the study site the longwall has a panel width of 154 m (corresponding to 102 shield supports), panel length of 750 m, cutting height of 3.0 m, caving height of 15.07 m, and caving span of 0.63 m. The actual production shows that the above diagram and chart have not maximized the advantages of the equipment combination. The production organization chart has frequently been broken down due to the problems regarding top-coal recovery. The problems must be completely resolved to improve the mining efficiency of Seam 7 Ha Lam coal mine

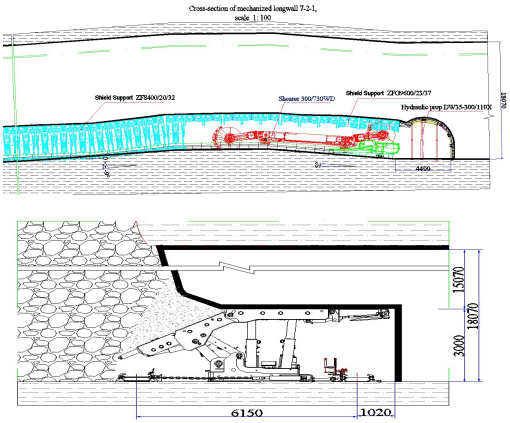


Fig.1. Technological diagram of LTCC at Seam 7 Ha Lam coal mine

2. Technical parameters affecting mining efficiency of LTCC Seam 7 Ha Lam coal mine

2.1. Sequence of top coal drawing

At present the longwalls using LTCC in the world follow some sequence to draw top coal caving: multiple drawing of top coal in continuous order of shield support; multiple drawing of top coal in staggered order of shield support; single drawing of top coal in continuous order of shield support; and single drawing of top coal in staggered order of shield support.

2.2. Ratio of cutting height to caving height

The ratio of cutting height (h1) to caving height (h2) is also known as the cutting-caving ratio. The ratio being used in practice includes 1:1, 1:2 and 1:3. In the past, the ratio was mostly determined based on the bulking factor of rock. It is believed that in exploitation of thick to extra-thick seams, greater cutting height should benefit the caving and drawing of top coal, resulting in high coal recovery rate. However, due to the limitation in longwall equipment size (support, shearer), the determination of optimal heights for cutting and caving for a specific geo-mining condition remains a problem to be solved.

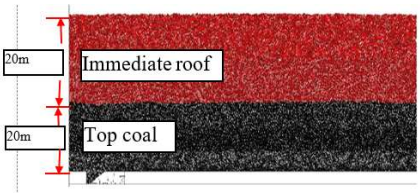


Figure 2. PFC model

Table 1. Model parameters of LTCC face at Seam 7 Ha Lam coal mine

Order	Seam thickness; m	Cutting height; m	Top coal caving height; m	Cutting-caving ratio; m
Option 1 (P.A1)	20	2.8	17.2	1: 6.14
Option 2 (P.A2)	20	3.2	16.8	1: 5.25

4. Solution to improving mining efficiency of Seam 7 Ha Lam coal mine

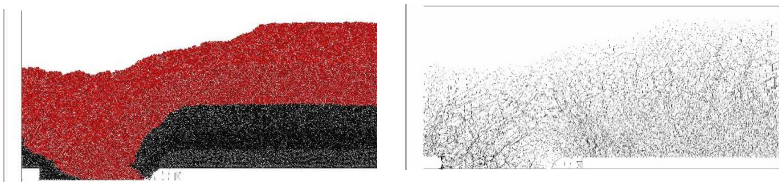
4.1. Analysis tool

This paper uses the numerical program PFC 3.1 as the main analysis tool. The program is suitable for discontinuum medium such as rock mass. It represents an object in two dimensions and under static or dynamic load through particles. For mining area and especially LTCC, PFC 3.1 is an efficient tool to study the caving process of top coal and roof rock during exploitation. In this paper, the authors use PFC 3.1 to build models with different cutting heights to investigate the mining process at face and loss rate during top coal recovery. The input parameters for modelling LTCC face of Seam 7 Ha Lam

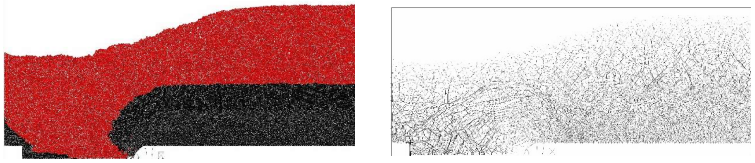
Table 2. Physical-mechanical parameters of coal and rock at Seam 7 Ha Lam coal mine

Layer	Normal stiffness /Gpa	Shear stiffness /Gpa	Unit weight /N/m3	Particle radius /m	Porosity	Friction factor
Bottom coal layer	4	4	1400	0.08	0.35	0.5
Middle coal layer	4	4	1400	0.09	0.35	0.5
Upper coal layer	4	4	1400	0.10	0.35	0.5
Upper immediate layer	12	12	2550	0.14	0.35	0.7
Lower immediate layer	12	12	2550	0.16	0.35	0.7

4.2. Discussion of numerical results



a) Caving status and Contact stress zone of coal and rock for cutting-caving ratio of 1:6.14



b) Caving status and Contact stress zone of coal and rock for cutting-caving ratio of 1:5.25

Figure 3. Status of LTCC face at Seam 7 according to two exploitation options with 0.6 m and 1.2m caving span

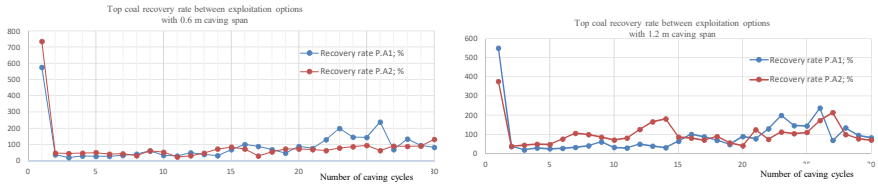


Figure 4. Top coal recovery rate between exploitation options with 0.6 m; 1,2m caving span

The results from Figure 4 indicate that the exploitation option of 3.2 m cutting height and caving span of 1.2 m per cycle gives the maximum recovery rate compared to other exploitation options. The actual production of the LTCC face at Seam 7 Ha Lam coal mine uses a cutting height of 3.0 m and caving span of 0.6 m per cycle. The actual recovery rate of the face is reported as 85–87% . The low caving span of 0.6 m can be considered as the main reason for the low reported recovery rate. The paper recommends Ha Lam coal mine to re-organize the operation with a cutting height of 3.0 m and a caving span of 1.2m per cycle for maximum efficiency of LTCC exploitation.