Stress Observation and Strata Behavior in Fully-mechanized Coal Face of Shallow Coal Seam

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Abstract: In order to solve the problem of the strong ore pressure in the mining process of a shallow buried coal seam working face, the ore pressure law of a shallow buried coal seam working face was observed. According to the observation results of ore pressure, the law and characteristics of ore pressure on the working face of shallow buried coal seam are analyzed, the basic law and parameters of roof movement and the roof plate falling situation on the end face on the working face are obtained, and the rationality of the support is studied.

1. Geologic mining condition

1.1 Geological situation

The working surface of 51101 is the initial mining face of a mine with a depth of 100m, which is a typical shallow buried coal seam. The main mining layer is 5-1 coal seam. The coal seam dip angle is 0~3°, which average is 2°, the thickness is 1.41~4.70m, and the average is 3.25m. The shape is gentle, and the structure is simple, and only partial of the layer contains a dirt band. The immediate roof coal seam contains sandy mudstone, gray, with a thickness of about 1.2m. The old roof plate is siltstone and gray, and the bottom is rich in plant fossils. It is semi-hard and has a thickness of about 5m. The immediate floor of the coal seam is mainly composed of sandy rocks, muddy gluing, containing plant fossils and coal chips, with an average of 1.83 m; the old base is medium-grain sandstone, gray, containing mica fragments and dark minerals, with a large hardness and a height of 7.37 m.

1.2 Production conditions

The working surface of 51101 has a length of 1500m and a length of 220m. It has a return air duct and a transport slot for ventilation, pedestrians and transportation. The working face adopts comprehensive mechanized longwall and full-height mining method for all-column mining. The MG650/1710-WD coal mining machine falls coal, the drum depth is 800mm, the SGZ800/1050 scraper conveyor transports coal, and the working surface adopts ZY10800/19/38 two-column type shielded hydraulic support roof; maximum mining height of 3.8m, minimum mining height of 1.9m, average of 2.8m, cycle progress of 0.8m.

The mine is a resource-integrated mine. The 51101-working surface basial pressure information, like the basic data such as the immediate roof falling step size, the old roof plate falling step size, and the periodic pressure step size are incomplete, and is not classified to the immediate roof and the old roof plate, On this basis, the selection of hydraulic support in working face is not scientific. Therefore, the 51101 working face is measured by the ore pressure law, and the ore pressure law of the working face is mastered, which has important significance for determining the working condition of the
bracket and rationally selecting and improving the bracket

2. Ore pressure observation program

2.1 Station layout
In order to make the arrangement of the station representative, combined with the actual geological occurrence and production status of the 51101 fully mechanized mining face of Shengxin Coal Industry, a total of 5 stations were arranged, which were set at 8#, 36#, 64#, 92# and 120# bracket.

2.2 Observation content
1) Hydraulic information of the bracket stand column: During the working face advancement process, the hydraulic information of the entire working face support and the hydraulic information of the typical pressure section are collected.
2) The situation of roof falling on the end face: The steel tape measure is used to measure the roof plate falling situation of the end face and the serious roof plate falling situation of the working face.

3. Laws and characteristics of the ore pressure on the work face

3.1 The laws of initial pressure and periodic pressure on the work face
The ore pressure observation began on December 1, 2012 and ended on January 10, 2013. During the period, the working face was propelled by 47 m, and observed the pressure for three times. According to the original data obtained from the underground observation, the advancement degree of the working face is taken as the abscissa, the hydraulic information of the bracket, the height of the roof falling and the depth of the sheet are set as the ordinate, and the characteristic curve of the hydraulic pressure, the height of the roof falling and the change of the rib spalling of each station is promoted with the working surface[1].

It can be seen that the initial caving step size of the immediate roof is 17.15m, and the step size of the initial pressure on old roof plate is about 30.5m. and the step size of the periodic pressure on 8# bracket old roof plate is 11.1m, the step size of the periodic pressure on 36# bracket old roof plate is 10.75m, the step size of the periodic pressure on 64# bracket old roof plate is 10.1m, the step size of the periodic pressure on 92# bracket old roof plate is 10.6m, and the step size of the periodic pressure on 120# bracket old roof plate is 10.4m. In summary, the average step size of the periodic pressure on the 51101 working face of Shengxin Coal Industry is 10.59m[2]..

During the initial pressure of the old roof plate, the hydraulic value of the bracket is significantly increased compared with the future pressure. The dynamic load factor is 1.63, and the compressive strength is large in the middle of the working surface. When the initial pressure is pressed, the average value of the load-carrying coefficient of each station is 1.51. When the second pressure is pressed, the load-carrying coefficient of each station is 1.46, and this pressure is significantly weakened than the initial pressure. The ore pressure law during the working face pressure is shown in Table 1.

| Order           | step(m) | loads/MPa | loads /MPa | coefficients/K |
|-----------------|---------|-----------|------------|----------------|
| First weighting | 30.5    | 44.2      | 27.1       | 1.63           |
| periodic weighting 1 | 10.8    | 39.1      | 25.9       | 1.51           |
| periodic weighting 2 | 10.38   | 36.2      | 24.8       | 1.46           |
| Average         | 10.59   | 37.65     | 25.35      | 1.48           |

3.2 Analysis of working resistance of hydraulic support on working face
According to the hydraulic information of the bracket actually collected under the mine, the distribution characteristics of the hydraulic information of each station and the whole working surface of each station during the ore pressure observation are analyzed, and the data shown in Table 2 is summarized.
It can be seen from the table that the hydraulic pressure value of the support column is mainly distributed in 20~30MPa, accounting for 66.3%, and the hydraulic value in 0~20MPa is 23.2%, indicating that the hydraulic pressure of the lower part of the working face is low. Work resistance has more than needed[3].

In the lower middle area of the working face (30~50#), the hydraulic value distribution of the support column is relatively balanced, wherein the hydraulic value of 20~30MPa accounts for 76.9%, and the hydraulic value distributed in the range of 35~45MPa also rises to 7.4%. The working resistance of most of the brackets in the area is still relatively large, and the working resistance of the brackets can be fully utilized.

In the middle area of the working face (55~80#), the hydraulic value of 20~30MPa accounts for 71%, while the hydraulic value distributed in the range of 30~40MPa rises to 9.7%. The hydraulic value of the bracket is too large in the production process. Strengthen the management of the support in this area.

In the upper part of the working face (85~105#), the hydraulic value ratio of 20~30MPa reaches 65.3%. The hydraulic value of the bracket is low and the working resistance is larger.

The working surface area (110~125#), 0~25MP hydraulic pressure accounted for 82.9%, 20~25MPa hydraulic support accounted for 46.1%, and the 35MPa or higher support column hydraulic pressure only accounted for 3.9%, the roof plate pressure in this area is small, the hydraulic value of the bracket is low and the working resistance is relatively large, and the bracket works normally.

| Range        | Ratio (%) |
|--------------|-----------|
|               | 5~25#     | 30~50#    | 55~80#    | 85~105#   | 110~125#   | Total       |
| 0-20         | 23.2      | 13.7      | 17.5      | 22.1      | 36.8       | 21.7        |
| 20-25        | 44.2      | 35.8      | 36.8      | 29.5      | 46.1       | 38.1        |
| 25-30        | 22.1      | 41.1      | 34.2      | 35.8      | 13.2       | 30.1        |
| 30-35        | 8.4       | 2.1       | 7.9       | 10.5      | 0          | 6.1         |
| 35-40        | 0         | 3.2       | 1.8       | 3.2       | 3.9        | 2.3         |
| 40-45        | 2.1       | 4.2       | 1.8       | 0         | 0          | 1.7         |
| Total        | 100.0     | 100.0     | 100.0     | 100.0     | 100.0      | 100.0       |

In summary, the hydraulic value of the whole working face support is mainly distributed in 20~30MPa, accounting for 68.2%, while the hydraulic value above 35MPa only accounts for 4%. The hydraulic value of the support can basically meet the support of the working face during the pressure. Protection needs.

3.3 Rib spalling and roof falling situation of coal wall on the working face

Statistical analysis of the roof falling data collected on the end face, and draws the distribution histogram of the rib spalling and roof falling. It can be seen that the statistical data of the height of the roof falling on the working face which less than 0.25m is about 87% of the total data, and the partial working face appears serious roof falling, and the maximum height is 0.9m; the roof plate of the end face has fewer rib spalling, and the rib spalling depth is mainly distributed in the 0~0.25m, the maximum depth is 0.3m. In general, although the roof is a low-strength sandy mudstone and its integrity is not good, in general, the roof falling of the working face is well controlled.
4. Conclusion

1) The average value of the initial pressure step of the old roof is 30.5m, and the average value of the pressure step is 10.59m. During the initial pressure, the dynamic load coefficient is 1.63. During the two cycles, the pressure is pressed. The dynamic load coefficients are 1.51 and 1.46, respectively, and the periodic compressive strength is less than the initial compressive strength.

2) The hydraulic value of the whole working face bracket is mainly distributed in 20~30MPa, and the working resistance of the bracket is relatively large, which can meet the needs of the whole working surface support under the pressure; the occurrence of roof falling on the end face of the working surface is frequent, but the falling height is less than 0.25m, and the partial working face appears serious roof falling, There are few cases of rib spalling. In general, the end face of the roof plate is well controlled.

References

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