一般講演
開発機械/岩盤工学/資源開発技術
2020年3月15日(日) 13:00 ～ 17:20 第4会場 (6号館 2階 625講義室)

[1K62507-18-12] 長壁上炭採掘における支持の採掘圧力に対する緩い上炭の影響 (発表者：博士課程)
The effects of loose top-coal on the mining pressure of support in longwall top-coal caving mining

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キーワード：トップ石炭、動的負荷
Loose top-coal, Top-coal caving mining, Dynamic load

The peak value of mining pressure on hydraulic support is supposed to increase with the mining height in the longwall top-coal caving mining. The supporting pressure of hydraulic support is therefore selected based on the mining height. However, it is also known that the pressure may not significantly increase as expected. This study mainly aims to clarify the effects of the loose top-coal on the reduction of the mining pressure of the hydraulic support for the geological conditions of Jiaozuo Coal Mine in Henan Province, China. A series of dynamic loading tests for loose top-coal, which was simulated by particles having different types and sizes, with different thicknesses, was carried out. It was found that the buffering effect became more prominent for softer or larger particles, or with the thickness within a certain value. The interaction model between the support and loose top-coal was built and the constitutive equations between them were derived. In the analysis using the constitutive equations, it was confirmed that the top-coal became more stable with the stiffness of the support. It was found from the numerical analysis using ANSYS software that the stratification of stress occurred during the propagation of loading in the top-coal and that the buffering effect became better with the thickness within a certain value.

1. Introduction

The longwall top-coal caving mining method is employed in Jiaozuo Coal Mine in Henan Province, China. The main roof is unstable and often falls under the mining generated dynamic load. The top-coal is easily fragmented into particles. The supporting pressure of the hydraulic support is usually selected according to the mining height based on the traditional view in which the peak value of mining pressure on the hydraulic support is assumed to increase with the mining height in the longwall top-coal caving mining. However, it is also known that the mining pressure may not significantly increase as expected. To clarify the effects of the loose top-coal on the reduction of the mining pressure on the hydraulic support in the longwall top-coal caving mining, a series of dynamic load impact tests for loose top-coal was carried out.

2. Dynamic load impact test

The dynamic load impact test device consists of a hammer, load cells and supports (Fig. 1). The 25 kg hammer, 30 cm in diameter and 10 cm thick was dropped by 10 - 20 cm to simulate the impact load. The load of the load cells was recorded at 25 Hz.

The fragments of the soft coal are round with a high packing density. On the other hand, the fragments of the hard coal are angular with a low packing density. To clarify the effects of the differences in the fragment shape, two types of specimens were selected, namely marble (round) and limestone (angular). The packing density of the round particles and the angular particles were 1940 kg/m^3 and 1250 kg/m^3 respectively. The packing density of the mixture of the two rocks at 1:1 was 1500 kg/m^3. The size of the particles was 1-2 cm and the layer thickness was 10 cm. The maximum load for the round particle was slightly lower than the others (Fig. 2) and the buffering effect of the round particles was the highest.

The tests carried out for 3-4 cm round particles showed that the maximum load for the larger particles was lower (Figs. 3 and 4) and the buffering effect of the larger particle is higher.

The tests also carried out for different thicknesses of 5, 10, 15 or 20 cm limestone layer showed that the maximum load decreased with thickness and then almost converged for the thickness more than 15 cm (Figs. 5 and 6).

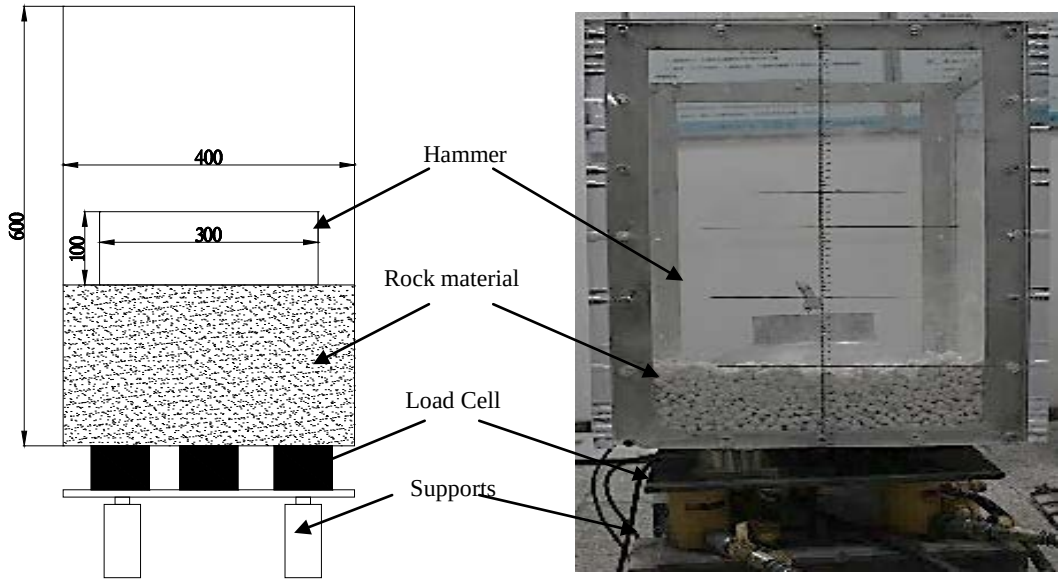

Fig. 1 Dynamic load impact test.

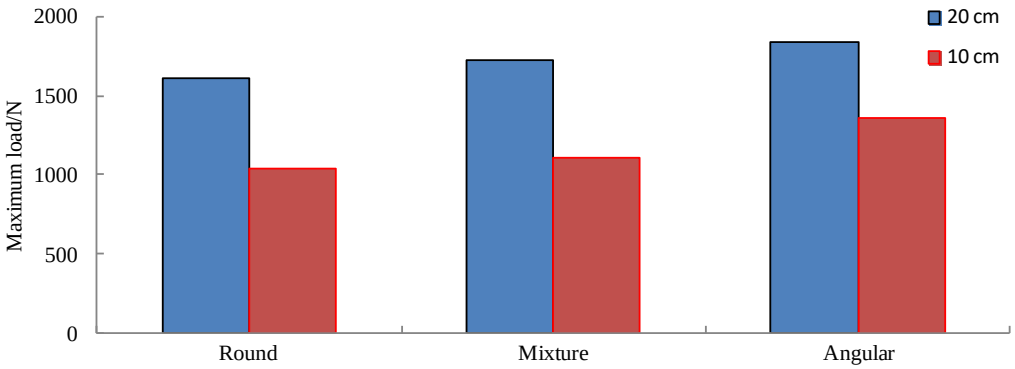

Fig. 2 Effect of particle shape on the maximum load.

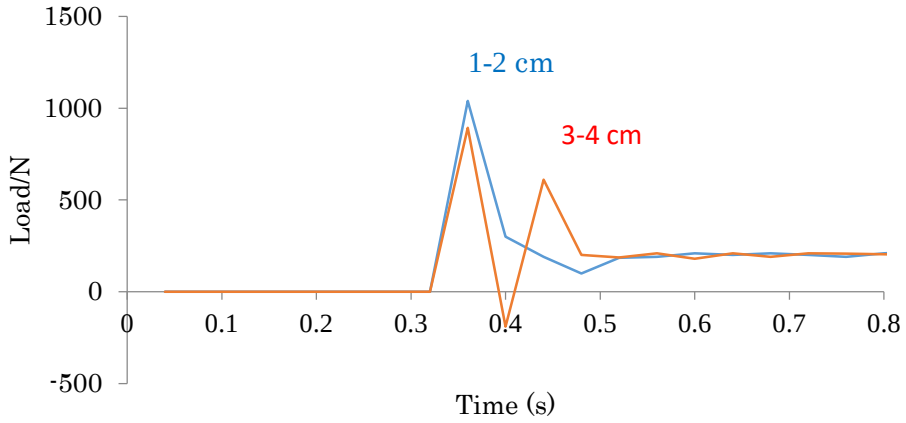

Fig. 3 Effect of particle diameter on the load for 10 cm drop.

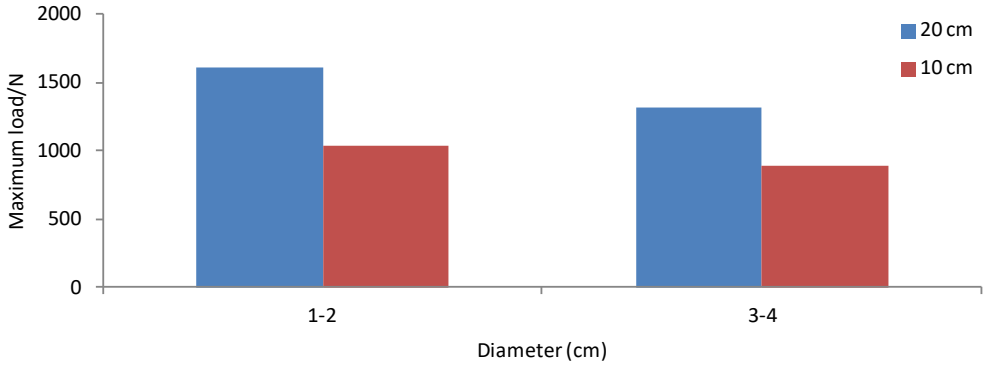

Fig. 4 Effect of particle diameter on the maximum load.

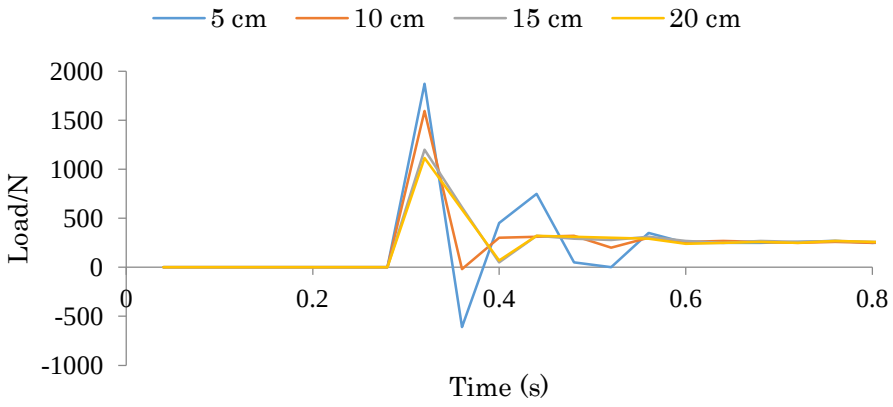

Fig. 5 Effect of layer thickness on the load for 10 cm drop.

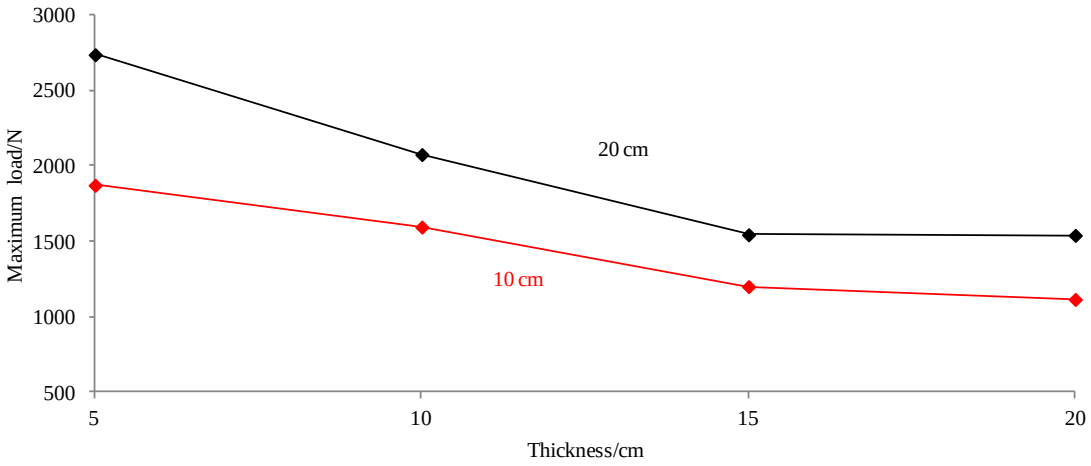

Fig. 6 Effect of layer thickness on the maximum load.

3. Concluding remarks

A series of dynamic loading tests for loose top-coal, which was simulated by a layer of rock particles with different particle types, sizes or layer thickness, was carried out. It was found that the buffering effect became more prominent for round or larger particles, or with the layer thickness. It is important to find a suitable size of top coal particle to reduce the mining pressure and to keep the stability of the working face in the real process of coal mining. The suitable caving ratio, which not only reduces the mining pressure but also increases the efficiency of recovery, should also be investigated.