

Method of selection of the steel arch support for coal mine roadways driven in the geological and mining conditions of the Cam Pha region in Vietnam

Summary

In recent years, Vietnamese coal mining has observed a dynamic increase in extraction and production efficiency. Underground coal extraction in the Cam Pha region is gradually increasing and is expected to reach approximately 75 % of the country's total coal production in 2030. It also involves an increase in the number and length of driven underground workings. According to statistics from the last ten years, the yearly length of the driven roadways was approx. 100 km. About 84 % of these roadways is supported by the steel arch support made of SWP profile. However, over 30 % of the total length required reparation. The main cause was loss of stability. This entails significant material costs and labor costs to replace damaged elements. Consequently, it disrupts the continuity of mining operations. In order to increase the progress and improve the efficiency of the coal mine roadways driving, it is necessary to develop a new method for selecting the support for the roadways driven in the geological and mining conditions of hard coal mines located in the Cam Pha basin in Vietnam. This is also the main aim of the thesis. To achieve this goal, the following research methods were used: underground tests and observations (convergence measurements), numerical modelling of the rock mass, numerical modelling of the steel arch support and statistical analysis.

The thesis first presents a detailed description of the geological and mining conditions of the Cam Pha coal basin, with remarks on the thickness and inclination angle of the coal seams, which makes the driving and ensuring the stability of roadways difficult. As a result of the conducted analyses, the causes of the loss of stability of the roadways in the typical geological and mining conditions of the Cam Pha basin were identified. It is related to the driving method using explosives and/or method of assembling of the steel arch support, as well as the low mechanical parameters of the materials used, mainly steel St5 and relatively large spacing of the steel arch support. Subsequently, the current methods of designing and selecting the support for coal mine roadways were reviewed. An attempt was made to adapt the methods of support selection applied in Poland. However, the large discrepancies in the results did not allow the application of those methods in the Cam Pha mine conditions. In the next step, a series of analyses was carried out to determine the impact of selected rock mass and support parameters on the roadway stability in the geological and mining conditions in the Cam Pha region. In these analyses, the FLAC2D program, based on the finite difference

method, and extensive underground measurements were used. Based on the outcomes, an algorithm for the selection of the support for roadways driven in the geological and mining conditions of the Cam Pha region was proposed. The key element of the presented algorithm is to determine the correlation of the in-situ displacement values with the values obtained from numerical modelling. At the same time, a reduction coefficient (WR) of rock mass mechanical parameters was adopted, which was related to the lifespan of roadway. As a result of the presented selection method, maps of the overload index of the steel arch support made of various profiles and different grades of steel were obtained with variable spacing that can be used in the geological and mining conditions of the Cam Pha region. Despite the successful application of the presented algorithm for two selected cases in the Khe Cham mine, it is necessary to verify the method in order to improve its accuracy and reliability and extend the scope of application.