A complex method for an evaluation of the effect of underground coal gasification

Abstract

This dissertation presents a method for the study of rock masses subjected to mining based on underground coal gasification (UCG). The developed UCG process effect determining method is based on the results of research work performed following a gasification process conducted under actual hard coal mine conditions.

This research problem has been chosen for the dissertation due to the need for complex UCG mining effect identification, particularly georeactor cavity geometric parameter determining and the evaluation of the process-induced changes resulting in the coal bed and adjacent strata. The limitations concerning this scope of research arise primarily from the underground coal gasification method principles, while the few attempts to realise the research thus far have not yielded exhaustive information. Furthermore, the need to conduct the research in this direction is supported by the study results presented in Polish and foreign publications. Therefore, the UCG effect determining research method, whose development is the goal of this dissertation, is a vital element required to meet these demands and open the way for the advancement of research in this field.

The research realisation method proposed in the dissertation is directed at georeactor cavity shape and location determining, as well as the evaluation of changes occurring in its environment. To meet these goals, research methods have first been chosen based on a literature review and then subjected to aggregation, which resulted in the formation of complementary solution groups, simultaneously constituting mining research performance variants. The problem of selecting one of these variants was solved by applying a multiple-criteria decision analysis methodology, where the accepted criteria were characterised by research, economic and technical considerations of the proposed solutions, which at the same time guaranteed an objective selection process.

Acting in accordance with the proposed procedure, test wells were drilled into the UCG georeactor cavity area, followed by an observation of these wells by applying the selected research methods and techniques. The material acquired from the well drilling work and the georeactor cavity interior was then studied in terms of changes to its characteristics, resulting from the influence of factors generated by the UCG process. Drilled well course measurements, followed by coordinate determining of the changes identified by the research and the conversion of the data to a dedicated software made it possible to generate a UCG georeactor cavity shape spatial representation. In turn, the transformation of geodesic data acquired from characteristic points in the research area into a uniform coordinate system made it possible to locate the cavity in the coal bed and determine the range of the coal gasification process influence zone.

The developed research method should be useful during UCG technology work realisation and design. The practical effects attained through the application of this method include first and foremost the evaluation possibility of applied technical and technological solutions, as well as UCG process numerical model calibration and verification, particularly in terms of coal bed post-mining cavern expansion and determination of the gasification-influenced zone of change in its environment. From the perspective of the UCG method development, this knowledge will make it possible to correctly plan the location of georeactors in a coal bed and evaluate the influence of gasification-based coal mining in an underground environment within the area of the deposits intended for this kind of mining approach.