

The aim of the described research is an assessment of the current level of safety in the underground mines, by verification of the obligatory regulations in the scope of self-propelled mining machine operators safety and by taking into consideration many others phenomena occurring inside the rock mass, that cause the accident situations. The actual norms and standards, which encompass the operators safety field, are limited. They concern protective structures in all types of heavy duty machines. However, conditions and accident situations prevailing in the underground mines are significantly different than in case of civil engineering or even of the opencast mining. Operators of the machines in underground mines spends a lot of time in a very harmful to health environment, where dominate elevated temperature and constant threat of the accident situations caused by the different phenomena occurring inside the rock mass. Intensive deep working on the ever larger depth additionally increases the possibility of the various accident situations, caused by escalation of the dangerous effects growing with the depth of the exploitation. Accidents are getting more severe and dangerous. There are starting to act rare till now phenomena in the underground mines, not included in the current regulations.

Every protective structure of the self-propelled mining machines destined for working in the underground mines needs to fulfil before implementation requirements given by the obligatory Machine Directive 2006/42/EC. Mentioned Directive provide for examinations in range of the operators safety in terms of the rollover of the machine and of the falling objects. There are not mentioned any phenomena related to typical environment of the underground mines, such as rock bursts evoking various effects leading to accident situation like thill uplift, lateral rock tosses, cover cavings or strew of the work side. In many cases they may result in severe or even fatal injuries

of the mining machine operator. This all prompt the author to verify the currently obligatory tests conducted in regard to the underground mining machines operators. Examinations that are carried out nowadays use deflection-limiting volume (DLV), which depicts approximate living space of a large, seating male operator wearing normal clothing and a protective helmet. Tests are considered positive, when DLV remains intact. They do not take into consideration forces acting on the human body during the accident situations or injuries that he sustain. There is no guarantee that machine operator will survive the accident while being inside the protective structure that is considered safe by current regulations. Analysis of the underground mining accidents shows situations when protective structure would be still considered safe for the machine operator after the accident, nevertheless the operator died. Situations like this should be accurately examined and the conclusion should be drawn. Precise analysis of the phenomena occurring inside the rock mass, causing different types of accident will contribute to the operators safety enhancement. Definition of the proper boundary conditions and dynamic tests of various accident situations should be implemented. Additionally, there is a need to substitute human model represented by DLV during analysis with a full-size dummy. It will allow the accurate assessment of the nature and the severity of the injuries. The author is planning to improve the self-propelled mining machine operators safety by more accurate, than in current obligatory Machine Directive 2006/42/EC, analysis of the phenomena occurring in the active environment inside the rock mass. These effects have a great influence on accident situations in the underground mines. Perusing of the mining accidents statistics within last couple of years will indicate main factors leading to the accident situations in the underground mines, causing severe and fatal injuries of the operators being inside the protective structure during the incident. After determining the potential threats, boundary conditions of every of this dangerous phenomenon will be formulated. Author will use them for the computer simulation of this threatening effects regarding to the self-propelled underground mining machine operators.

High-tech numerical methods will be used for all of the computer simulations, combining finite element method with multibody models (coupling) and thereby mechanics and bioengineering. Analysis will be carried out in the most advanced programs dedicated to the static and dynamic numerical calculations such as Abaqus CAE and LS-DYNA. Deflection-limiting volume described in the regulation ISO 3164:2009, will be substituted with the full-size validated dummy. It will enable to identify dynamic loads acting on the mining machine operators and will facilitate definition of the injuries that human body sustain while being in the protective structure, during the accident situations caused by the various phenomena occurring in the rock mass after the rock bursts. It will be possible by analysing the biomechanical parameters of the numerical dummy.

New research methodology will allow the assessment of the protective structures strength and the level of safety that they assure with the numerical methods, even at the designing stage. Results that will be obtained from the simulation carried out with the use of high-tech, validated programs, will be accurately approximate to the reality. Verification of the currently obligatory norms, through including many other phenomena occurring in the underground mines inducing accidents and thereby significantly affecting the operators safety, will indicate factors having considerable influence during accident and allow to enhance the protection of the underground mining machine operators. Additionally, application of the full-size dummy to the simulations considering operators safety allows to analyse the biomechanical parameters. Mentioned elements decide about interdisciplinary and innovative character of the examinations.

Research will significantly extend the knowledge in the subject of mining machine operators safety. It will assess the influence of the phenomena like thill uplift, lateral rock tosses, cover cavings or strew of the work side occurring in the rock mass during rock bursts, on the severity of the injuries which the operator sustains. These effects have never been analysed in the aspect of the protective structures safety, while amount of this type of dangerous phenomena is increasing with deep working on the ever larger depth of the exploitation.

Expected results will have significant influence on the safety enhancement in the underground mines by pointing out the direction for further examinations, striving to improvement of the safety systems and operators protective structures. Identification of the forces acting on the human body during different accident situations and injuries that the machine operator will sustain may contribute to the new trends in the designing of the safety systems and protective structures of the machines working in the underground mines. The results will significantly extend the knowledge in the scope of the operators safety and the phenomena occurring underground that leads to the accidents in mines. They will also significantly contribute to the development of the further research in this subject.