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LABOUR SAFETY AND VENTILATION OF UNDERGROUND STRUCTURES

This article deals with the issues connected with finding the most efficient ways of settling problems in the sphere of labour safety and ventilation in underground constructions. The authors suggest solving these problems within the framework of one common trend.

Key words: safety, labour protection, ventilation system, visualization of knowledge, simulator, nerve force

Over past years significant changes have happened in the way how to solve labour safety problems in underground structures. First of all , it is connected with an urgent necessity to solve these problems.

Analyzing the experience of virtual models of mine ventilation systems, pits and underground railways [1], one can claim that their use increases level of employees' qualification who are responsible for ventilation system and reduces significantly manhours for solution of day-to-day tasks in the sphere of ventilation and accident elimination. Moreover, the experience of use of virtual models while teaching has shown that in this case perception of tasks solution on mine airing and people rescuing in emergency operation becomes substantially easier [2,3].

Efficiency of virtual models which use ventilation systems in underground structures while training specialists can be explained by two reasons.

The first reason lies in the process of virtualization of the airing object. At the first stage of training a user (a specialist who is responsible for ventilation system of a section, a student of State Mining Rescue Team) forms independently a mine airing network scheme on the screen of a computer and gets comprehensive understanding of how mining workings and tunnels are connected and finally it helps to identify them together with the flow path of air leak as a "ventilation network".

During the process of visualization database on each of its elements is formed. A user introduces some information about each elements of the ventilation system. At this stage of training elements on their aerodynamic features and their connection with geometric and technological parameters of mining workings are formed. Efficiently of understanding and memorizing is conditioned by connecting some verbal formulas with their visual images or symbols.

This is a key aspect in understanding how efficient mechanism is during the process of self-study with the help of a visual model of an airing object. Just it is forming of a basic symbol (mining working is a branch of a ventilation network) and its virtual stuffing that makes imagination more active and it helps to form a steady image of a real airing object and factors which influence its operative features. This mechanism can be demonstrated by visualization of two notions: «increase» and «decrease» of resistance of a mining working.

Under normal mode of a mine airing increase and decrease of aerodynamic resistance of mine workings can be connected with the necessity of air distribution in a ventilation network. For this reason different ventilation regulators are used. Here we mean ventilation doors (sluice) and crossbars. A ventilation system virtual model enables to connect a verbal formula such as "in order to increase resistance in a mine it is necessary to set a ventilation regulator in it" with a concrete person's actions that stimulate setting a ventilation door or a crossbar in a mine.

In this case a user in order to set up a regulator in a virtual model must increase value of aerodynamic resistance in the database of the concrete mine working and the display of this mine working should be connected with its virtual symbol -a conventional display of a real regulator. Two notions of regulator setting and resistance increase are linked in this situation. The further air distribution is an aftermath of the regulator setting in a mine working. The electronic plan of accidents liquidation is a virtual complex where ventilation and labour protection tasks are brought together. It is formed on the bases of the virtual model the mine ventilation system. In the mine which is called "Shcheglovskay-Glubokaya" over past years a new technology of formation and maintenance of electronic plan of accidents liquidation has been put into practice. For this reason in the «IRS Ventilation − ALP» software it is envisaged to solve different ALP tasks automatically (ALP-Accident Liquidation Plan).

To main advantages of EPAL we can refer its visualization. Setting the accident mine working in colour and forming 'a zone which is full of gas' on the computer's screen makes a user realize an emergency situation. Visual coloured symbols (an emergency mine working is coloured in red, but, mine workings where combustion products can get into are coloured in yellow) contribute to getting instant understanding what a zone with high gas content is like and what the following wording 'making up an optimal route of people's leaving of the zone with high gas content' means. This task can also be performed automatically and in a second a user can see the route he is seeking (all mine workings in this route are coloured in crimson). While teaching students and specialists who are responsible for ventilation network it is important to say that to solve this task subsequently using virtual model it will be enough to do one or two attempts and trainees will get steady understanding about "the zone with high gas content" and "some routs of peoples leaving of such zones".

The experience of Kurbass and Vorkuta (Russian Federation) MMRT members has shown that the process of training including use of programme complex takes 2-3 hours. Representatives of the depressive service can catch a link of virtual and verbal symbols.

In overseas countries virtual simulators of different industrial objects and mechanisms are widely used with the purpose to teach employees some safety regulators and professional skills (simulators for dispatch operator at the nuclear power stations or for air traffic controller at the airport, drivers of different military machines). There are simulators of coal mines as well.

Formation of such a virtual complex where a student can find himself in a three-dimensional virtual world of a coal mine will enable to increase dramatically student's "comprehension" and "memorability" of safety tasks. Depending on the chosen level of complexity and role script (a student, a mine worker, a member of rescue team, an engineer, a technical inspector, a director etc.) a trainee imitates different actions on providing people's safety and simultaneously he is taught some labour safety regulators and professional skills at different jobs both in normal and emergency conditions.

Unfortunately the ongoing system of professional training of specialists of different occupations doesn't provide formation of professional skills in respect to personal safety of future engineers who have to carry out their obligations in full. They will get this experience at the enterprise (a mine) by trial and error method.

Having little work experience and having little experience of decision-making, young engineers can not imagine the ways how the accidental situation can be developed further and what its consequences might be and these engineers can easily become "victims" in 40% of accidents.

In this connection, the most prospective aspect of training efficiency improvement is introducing "virtual worlds" (simulators) into the process of education [4]. These virtual worlds help to visualize a working place, working procedure in operation, which provide labour safety.

Imitation of a person's movement inside a virtual world and imitation of actions providing labour safety increases information perception and contributes to its fast mastering. Such a form of a new material presentation brings in a sort of competitiveness into the process of education, increases dramatically emotional level of issues which are under study and eliminate barriers preventing better information perception. This method should be introduced into the process of education especially whilst a specialist forms his safety culture. A specialist who was trained with the help of this method is much more confident and he works easily and independently without having some prompts and instructions.

The results of initial analysis show that introduction of virtual simulators in the process of education of coal mining specialists enables us to train future mining engineers who will be able to produce their own ways of protection against stress, i.e. psychological stability and without doubts it helps increase efficiency of their professional activity and their personal safety. Such a training provides long-term plan for further professional self-actualization and improves general level of labour safety in the mine.

Elaboration and use of virtual models of different industrial and civil objects in educational process enables us to provide a high quality training on speciality «Labour Safety».

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Безопасность труда и вентиляция подземных сооружений. В статье рассматриваются вопросы, связанные с решением задач безопасности труда и вентиляции подземных сооружений. Авторы показывают возможность решения комплекса этих задач в рамках одного общего направления.

Ключевые слова: безопасность, охрана труда, вентиляционная сеть, визуализация знаний, симуляторы, психическая устойчивость

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Безпека праці та вентиляція підземних споруд. У статті розглядаються питання, пов'язані з рішенням завдань безпеки праці й вентиляції підземних споруджень. Автори показують можливість рішення комплексу цих завдань у рамках одного загального напрямку.

Ключові слова: безпека, охорона праці, вентиляційна мережа, візуалізація знань, сімулятори, психічна стійкість