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STUDY OF CURRENT METHODS FOR IDENTIFICATION AND EVALUATION OF OCCUPATIONAL HAZARD AT THE MINING INDUSTRY ENTERPRISES

Purpose. Analysis and systematization of the existing quantitative and qualitative methods and methodology for risk assessment in the field of occupational health and safety with a view to further justify choice of a method to adapt the calculations for occupational hazard in conditions of mining enterprises.

Research methods. Currently, there is a countrywide need for develop new and improve given methods, means and principles for the protection and promotion of health workers at unhealthy trades , including miners, whose work on existing criterion is applied to the category of high life and health risk.

Thus, to achieve this purpose there was the complex method of scientific research, comprising: a generalization and analysis of the literature and static information on the working conditions in the iron-ore mines; Injury methods of analysis getting injury, the expert assessments, mathematical statistics and probability theory to assess of occupational hazard, which enables further development towards integration of occupational health and safety management system in conditions of underground iron-ore mining.

Originality. The necessity of a unified approach to risk assessment and implementation of the management of occupational hazards (OH) in the occupational health and safety management system in mining enterprises is grounded.

Practical value. A new approach to the procedure for the identification and hazard assessment, which will minimize the probability of accidents, injuries, occupational hazards and, consequently, increase the stability of the performance of production functions is given.

Findings. An overview of the main approaches to improving the effectiveness of occupational safety and health administration at the mining enterprises is done.

Keywords: the system of «human-machine-environment», working-environment factor and working process, working-environment factor and working process, hazardous event , the value of the probability of infringement (injury) to health worker, severity of the consequences of the adverse effects harmful conditions and hazardous job , occupational hazard, criteria for risk acceptance , risk management, occupational health and safety management system.

The problem and its connection with the scientific and practical tasks. The problem for systematization of hazards had involved scientists for a long time, but the criteria to uniquely classify all hazards in the field of occupational health and for the mining enterprises, finally aren't identified yet. In practice, some enterprises and organizations use different risk assessment techniques, which, however, do not account for all the indicators that permit to construct the choice of a risk assessment techniques that are most relevanted the specifics of this enterprise. In addition, at present in Ukraine the regulatory system that would be regulate the risk assessment methodology in the field of occupational health and safety under the conditions in the mining enterprises is absent. There are only scattered recommendations on this subject [1].

Besides isn't taken into account that in some cases, the technique can encompass all existing workspace, it hazards and in other cases, different components can be applied several different techniques to workplace.

Research and publications analysis. The basic scientific contribution to solving the problems were being associated with the assessment and increased social and economic effectiveness of measures for improving working conditions had been made by scientists: Amosha A.I., Belov P.G., Beresnyevych P.V., Bulgakov Yu. F. , Vodyanik A.A., Hohitashvili G.G., Holinko V.I., Gurin A.O., Zaporozhets A.I., Klebanov F.S., Kozlov V.I., Lapshin O.E., Levchenko O.G., Levchenko O.G., Lesenko G.V., Lesenko G.G., Lysyuk M.O., Luchko I.A., Tkachuk K.N., Schwager N.Yu., Shvidkiy M.I. and others. Formation of the concept of risk are associated with domestic and foreign researchers, as Brown D.B., Kachinskiy A.B., Korniychuk M.T., Kumamoto Kh., Marshall W., Henley E.J.. and others [2].

Formulation of the problem. On the basis of a review of existing modern risk assessment techniques in the field of occupational health and safety, it can be concluded that nowadays there is a significant number of techniques and methods as a common risk assessment techniques in the field of occupational health and safety as well as risk assessments from exposure to in certain select process of safety hazard and harmful production factors that were being affected workers during the process of production.

Therefore the purpose of this study is the analysis and systematization of the existing quantitative and qualitative methods and risk assessment techniques in the field of occupational health and safety

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with a view to further study of choosing the method to adapt during calculation of occupational hazards under the conditions of mining enterprises.

Presentation of the material and results. Recently in scientific studies, in practice the formation of the regulatory framework of health and safety and planning of safety arrangements generally risk methodology is used, which task is to identify and objectively assess risks (including quantitative indicators), provide informed choice and application of practicable and economically substantiated measures to minimize the risk of injury at the place of production.

The DSTU OHSAS 18001: 2010 define risk as the combination of the probability of hazardous event or the influence(s) and materiality injury or deterioration of health that can be caused by such an event or the influence(s).

All definitions are reduced to the risks generated by two quantities - the probability of negative events and the amount of its damages.

In risk management terms such as: the risk of the individual and the collective, professional, industrial are used.

The state standard DSTU 2156-93 provides a definition of the risk of an individual - the value of the risk for a particular individual, and risk collective - value of the risk for two or more individuals.

According to the state standard DSTU 2293: 2014 the occupational hazard is defined as the probability of damage to health worker during the performance of employment duties that is due to the degree of hazard and (or) the danger of working conditions and scientific and technical state of production.

In the safety classification of work in terms of hazard and danger environment factors, term professional risk is determined by the probability of damage to worker health with the severity of consequences due to adverse effects of factors of production environment and work processes [4].

According to WHO, a professional risk is a mathematical concept that includes the expected frequency and (or) severity of adverse reactions to this exposure hazards of working environment.

Professional risk is the result of complex causes of different kinds: technological, organizational, social and economic [5].

From the standpoint of health and safety risks in the production it is estimated as the probability of manifestation the dangerous factors system "human-machine-environment" (equipment, technology and type of production environment factors, severity and intensity of work, work organization, workers training) that affect the level of security [4].

However, in theory the risk is distinguished "a priori" (prognostic) and "a posteriori" (real) risks. Assessment of working conditions for hygiene criterion is a priori, preliminary and should reinforce posteriori, the real (actual) risk assessment. The main criterion in the posteriori risk assessment is an occupational illness, so the frequency diseases from influence of specific occupational factors.

The evaluation diagram of risk (fig. 1) involves the actions that result in an informed decision as to the manner of influence the risk [1-5].

Methods of research are integrated into a shown in fig. 1 the scheme and should provide: information on the causes of injury (explicit and implicit), obtaining quantitative estimates of the risk of injury for these reasons, transforming research results into preventive measures.

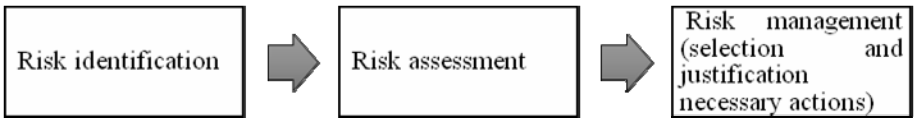

Fig. 1. Scheme of justification of preventive measures to minimize the risk of [1- 3]

According to the international standard OHSAS 18001: 2010 hazard identification is the process of recognizing that danger exists, and determine its characteristics.

Identifying hazards (DSTU 2156-93) provideds the establishment of each of the potential dangers that are initiated now:

events that initiate the dangers and conditions of their implementation;

probability of occurrence;

source;

recipients and exposure to nature;

the character and means of measurement (quantitative expression), the impact (the criticality level to danger);

a combination of factors that increase or decrease the probability of potential danger and factors that reinforce its negative effects [1-5].

The choice of indicators and methods for risk assessment in the field of occupational health and safety under the conditions at mining enterprises depends on various factors. The decision of the risk management are tasked to relate to the of identification the dangers, definition of possible damage to health and life of the employee and the probability of their occurrence, as well as the adequate availability of statistical information for the calculation of the required risk indicator - the basis for the selection of direct risk assessment techniques [1].

The main of them include:

the British Standard BS-8800 (UK);

risk assessment techniques based on the matrix ", the probability of injury" (the UK, France, Latvia, the US, Australia);

the method of building the graph of a risk assessment (Germany, Finland);

methodology of the Research and Development Establishment for occupational health and safety (NatsNIIOT in Ukraine);

methodology Risk assessment code (United Kingdom);

method of verbal functions (European Union) .

The indirect risk assessment techniques to health and life of workers using indicators characterizing the deviation of current (controlled) conditions (parameters) of the rules and have a cause effect related with risk. They don't involve the direct detection and identification of hazards in the workplace and in the performance of production activity.

The main indirect risk assessment techniques in the field of occupational health and safety are:

an occupational risk assessment technique for Elmer method;

risk assessment technique the level of ranking on the basis of a risk requirements (code IAD).

Index iAd as well as the index of Elmer is not directly associated with the presence and assessment of specific risks in the workplace and is based on the assumption that the severity of the consequences related to possible dangers, already accounted for at occupational health and safety requirements by assigning the specific levels of the system of occupational health and safety (government requirements, industry, local).

Nevertheless, in the presence of competent professionals with an employer or with the help of specialized organizations, there is an opportunity to further improve the ISI index [1-15].

It should be considered that risk analysis methods are determined by the selected criteria for acceptable risk. This criterion can be specified in regulatory documentation and determined at the stage of risk analysis planning. In order to emphasize that we are talking about the measured, the concept of "risk score" and "the level of risk" is used.

In this approach, the production is usually divided according to the level of risk into four (or more) groups with high, intermediate, low or negligible risk. In this case, a high level of risk is considered, as a rule, inadmissible, interim requires a program of work to reduce the level of risk, a low level is considered acceptable and insignificant is not considered.

The main requirement for the selection of criteria for risk acceptance in conducting risk analysis is not its austerity and relevance, certainty. The correct choice for acceptable risk and the measures will make and process risk analysis results clear and understandable, which will significantly improve the effectiveness of risk management.

Based on the foregoing, we compared different approaches at the methodology presented in this paper, which allowed establishing the correspondence between the parameters of the risk assessment techniques in the field of occupational health and safety, proposed in the methods discussed above. Table 1 shows the results of this comparison [1].

The above techniques will allow concluding that the effectiveness of a risk assessment depends substantially of the level:

development and precision of calculation methods;

auxiliary agents for practicing (databases, information systems, and so forth.);

qualifications and competence of experts carrying out risk analysis;

risk analysis organization, including questions about the choice of objects for analysis.

Table 1

Comparison of risk assessment techniques parameters in the field of occupational health and safety accepted in modern techniques

Techniques	Risk assessment according to standard "risk assessment in the field of occupational health and safety" [8]		
	low (accepted)	average (accepted)	high (accepted)
The British Standard BS-8800	1 - Very low (acceptance); 2 - Low (acceptance)	3 - Medium (accepted)	4 - High (not accepted); 5 - Very high (not acceptance)
Risk score methodology	R<20 A moderate (no actions are not necessary)	20÷70 Medium (necessary measures)	200≤R<400 High (requires immediate action); R≥400 Very high (must stop the operation)
NatsNIIOT methodology	$R<1,0\div10^{-6}$ Minor (accepted)	$2,17\cdot10^{-5}\div1,0\cdot10^{-6}$ Medium (accepted)	$R>2,17\div10^{-5}$ High (not accepted)
Risk assessment code methodology	1 - The low risk , any measures are not necessary, but it is recommended to monitor dangers	2 – Risk accepted, it is necessary to monitor and control risk; 3 - The undesirable risk , it is necessary to monitor and control risk probability.	4 - The unacceptable risk must be eliminated or controlled guarantee
Techniques of Work Safety Institute (Moscow) ISI index,%	90≤DOH≤100	60<DOH≤90	DOH≥60

Based on the previously mentioned, risk reduction recommendations in manufacturing one can recognize the existing risk acceptable or specify measures to reduce the risk.

Risk mitigation measures could be of technical, operational or organizational nature. A general assessment of the effectiveness of measures in choosing the type of critical measures affect risk is vital importance [8].

In the development of risk reduction measures must take into account:

primarily there were being developed and implemented simple and cost-related recommendations aiming at improving security;

the level of risk reduction that can be achieved through the introduction of a recommendation are usually not known in advance;

the resources directed to risk reduction are limited;

for the development of each recommendation, it's not feasible to spend a lot of time and money;

a significant investment in order to further reduce the more or less "tolerant" risk is unwired.

At the stage of operation of the dangerous object of operational and organizational measures there can be offset the limited possibilities for making major technical measures for risk reduction. It is of great importance in conducting risk analysis of functioning objects [8].

Report on the risk analysis should document risk analysis process. The dimensions of report depend on the risk-analysis purposes, but it should reflect: objectives and targets; baselines and constraints that determine the limits of risk analysis; description of the system being analysed; analysis methodology; identification of hazards; description of used models, their original settings and the ability to use; and input data sources; the results of a risk assessment; the uncertainty analysis; recommendations.

Conclusions. The implementation methodology of risk - management in developing the occupational health and safety management system (HSE-MS) gives an opportunity enterprises to improve occupational health and safety, to prevent financial, material and human losses from injuries , occupational diseases, accidents.

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ВПЛИВ ВІДВАЛІВ ТА ХВОСТОСХОВИЩ ЗБАГАЧУВАЛЬНИХ КОМБІНАТІВ КРИВОРІЖЖЯ НА СТАН ЕКОЛОГІЇ ПРИЛЕГЛИХ ТЕРИТОРІЙ

Актуальність проблеми. Відвали та хвостосховища гірничо – збагачувальних комбінатів (ГЗК) є місцями складування і накопичення відходів відкритого видобутку та збагачення залізорудної сировини. Відвали сучасних ГЗК конструктивно представляють собою величезні за площею та висотою насипи (терикони) із пустих скальних розкривних порід або із гематитових кварцитів (окислених руд) поверхневих шарів залізистих горизонтів кар'єрів. Хвостосховища є місцями накопичення відходів збагачення у формі твердих залишків, що у вигляді водної суспензії (пульпи) транспортуються пульпопроводами від збагачувальних комплексів та намиваються на спеціальні карти намиву (пляжі). Конструктивно хвостосховища можуть бути площинного типу або багатоярусними спорудами, подібні відвалам.

Розміщуючись на поверхні землі, відвали та хвостосховища не тільки докорінно спотворюють ландшафт місцевості, а і стають новими техногенними елементами в структурі екології оточуючого навколишнього середовища [1]. В результаті цього, похідні природні структурні елементи території, а саме: геологічні масиви, ґрунти та гідросфера отримують джерела локального інтенсивного впливу, а не знищені техногенезом живі організми зазвичай вступають у взаємодію з новими абіотичними чинниками техногенного походження. Завдяки цього на ділянках раніше існуючої природної екосистеми виникає нова система змішаного походження **техногенна геоекосистема (**ТГЕС) або сучасний ландшафт. Як відомо, геоекосистема – це керована або підконтрольна людині територіальна система, що являє собою частину ландшафтної сфери із характерними для неї процесами обміну речовин, біогеохімічними кругообігами, певними видами господарської діяльності та соціокультурних стосунків [2]. Техногенна геоекосистема складається із геосистеми (відносно цілісного географічного утворення із елементів

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