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RESEARCH ON LEARNING SAFETY AND HYGIENE IN A MINING COMPANY[2]

Training and improving employee knowledge plays an important role in every company. The process of personnel development is perceived as an investment and a basic management tool in the organization. The development of the training system and the selection of appropriate methods of their transfer in the field of occupational health and safety is a fundamental task of personnel departments. The issues in the safety areas are dealt with by specialists in such fields of science as philosophy, psychology, sociology, history, law, pedagogy, medicine and ergonomics.

In a mining company, the employee is exposed to natural, technical and personal hazards. The most frequent causes of accidents are personal hazards, the cause of which is in the uncontrolled muscular power and the gravity of the organism. However, the most serious consequences for the health and life of the employee are natural and technical hazards. Such accidents are connected with uncontrolled rock formation or worker's contact with machines during the movement as well as electric shock. A separate group of threats is harmful factors occurring at workplaces that may cause occupational diseases.

The article attempts to assess the effectiveness of knowledge acquisition by employees for three different training methods. The analysis was based on the results of questionnaire surveys obtained during periodic training. Surveys were prepared for a group of workers employed at the position of a worker. It was proposed to compare the effectiveness of different training methods of employees by determining the percentage absorption rate of knowledge W_W and the outflow rate of means of protection of individual W_R. Test results and index values for individual measurement days are presented in tabular and graphical form.

Keywords: employee training, work safety, safety culture, mining.

1. INTRODUCTION

Occupational health and safety training is carried out in mining companies by various methods[3]. Most often, employees training is based on traditional didactic school methods in the form of lectures (e.g. for periodic training). However, electronic means of transfer of

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[3] S. Zhang, X.Z. Shi, Wu. Chao, *Measuring the effects of external factor on leadership safety behavior, Case study of mine enterprises in China*. Saf.Sci. 2017, 93, p. 241–255, DOI: 1016/j.ssci. 2016.12.2017.

information and knowledge are being used at an ever-increasing rate. Computer animations and websites addressed individually to employees significantly enhance and enrich the traditional methods of training in the area of occupational safety. Visualizations aimed at the reconstruction of accidents and the presented statistics on the incidences of occupational diseases bring the expected effects in the form of improved safety. Still, about 80% of all accidents in mines are caused by human factors. Due to such high influence of employees on the number of accidents, there is a need to continue to search for new methods of employee training to prepare them for the reliable and safe performance of work[4].

Employee training is an important part of building the safety culture in the organization[5]. The need for conducting training results directly from the legal regulations and the requirements set for occupational health and safety management systems. All employees of an organization must be competent in the functions they perform within the company[6]. Their proven competence should be appropriate to the requirements set for them by the company. In the case of an occupational health and safety management system, employees should have knowledge and awareness of how to perform their duties in a safe manner for themselves and their colleagues[7].

Equipped with modern methods of training consisting in the presentation of information by means of multimedia, instructional and training materials, animations or computer simulations etc., we can shape the awareness of employees and consequently their pro-safety attitudes and behaviors. The information provided during training in occupational health and safety in the mining industry concern both correct and incorrect ways to perform work activities. Therefore, they perform both educational and warning functions. Raising the awareness of employees is largely based on a retrospective analysis of past events[8,9]. It is possible to present accidents in an illustrative way by using the didactic equipment available at the time of technological development for training purposes. Between 2012 and 2016, as many as 77.1% of mining accidents occurred in hard coal mines. Although it is possible to see an improvement in accident rates, individual events may disrupt the observed trend (Fig. 1). In 2014, a methane ignition and explosion occurred in the Mysłowice-Wesoła mine, resulting in the death of 5 miners[10]. Supervisors should, therefore, take all necessary actions on an ongoing basis and have a direct impact on the improvement of the health and safety conditions in the company[11].

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[4] C.D.B. Burt, B. Sepie, G. Mcfadden, *The development of a considerete and responsible safety attitude in work teams*, Saf.Sci. 2008, 46(1), p. 79–91, DOI: 10.1016/j.ssci.2006.10.005.

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[7] Geological and Mining Law – Act of 9 June 2011 (Journal of Laws, no. 163. item 981).

[8] M. Sari, H.S.B. Duzgun, C. Karpus et al., *Accident analysis of two Turkish underground coal mines*, Saf.Sci. 2004, 42(8), 675-690; DOI: 10.1016/j.ssci.2003.11.002.

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[11] M. Kapusta, *Wpływ osób dozoru górniczego na poprawę warunków bhp*, Inżynieria Mineralna" – "Journal of the Polish Mineral Engineering Society", 2017, Yearly No. 2(40), p. 183–194.

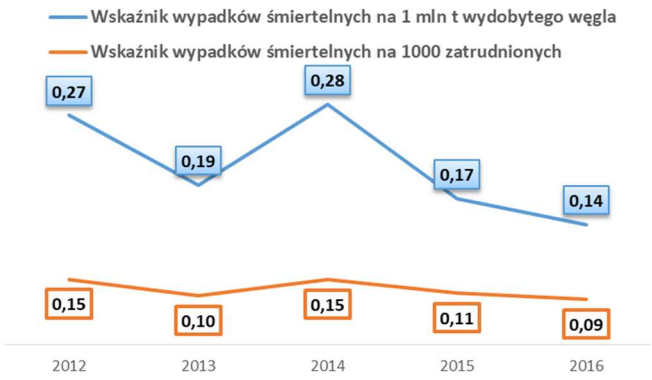

Fig. 1. Fatal accident rate per 1000 employees and 1 million tons in hard coal mines in 2012–2016

2. EMPLOYEES' CONSCIOUSNESS AND IMPACT OF TRAINING ON THE OCCUPATIONAL SAFETY CULTURE

Consciousness is a very capacious term which appears in many social sciences. These include philosophy, psychology, sociology, history, law, and pedagogy, as well. The most complete knowledge about consciousness is given to us by philosophy and psychology[12]. Initially in philosophy, consciousness meant a subjective sense of the current experience, direct sensation, a feeling of being present within the field of internal perception – the field of consciousness. The notion of consciousness is defined in a similar way in psychology, which describes it – in the broadest sense – as a state of consciousness, vigilance, the perception of stimuli from the surrounding world. In a narrower, stricter sense that is specific exclusively to humans, it is the highest level of mental development for which it is essential to be aware of one's own reflection of the reality and the fact of acting upon it. The reflection of the reality depends on the structure and functioning of the sensory organs, through which humans receive information about what is happening in the external world as well as within humans themselves and on the structure and functioning of the brain, in which the information received by the senses undergoes complex processes of analysis and synthesis. In pedagogical terms, consciousness is defined as follows:

- a human-specific ability to be aware of one's own behavior, its conditions and consequences,
- a human psyche, as a specific function of the central nervous system and the highest form of regulation of his or her behavior, which distinguishes humans from animals,
- processes for receiving information and controlling human behavior,
- a state of consciousness, unlike the state of being asleep or the disappearance of consciousness (the so-called loss of consciousness); psychoanalysis also distinguishes the state of unconsciousness and subconsciousness, an ability to experience emotional states, otherwise – the self.

[12] J. Graham, BA Nosek, J. Haidt et al., *Mapping the moral domain*, "Journal of Personality and Social Psychology" 2011, 101(2), p. 366–385, DOI: 10.1037/a0021847.

Employee consciousness of occupational safety has an impact on the way they think and act in the workplace environment[13]. The greatest impact on raising consciousness is exerted by all kinds of educational activities, from the knowledge gained in schools, to training in the workplace, to all forms of media education (television, radio, and press), to popularization projects[14]. We prepare our employees to exhibit the desired behaviors and take appropriate actions by raising the level of their consciousness in combination with the provision of relevant knowledge. These measures will be considered a success if the employee is conscious of the purpose and sense of their activity and of the consequences that it may have for others. Legislation requires supervising bodies and companies to train crews in occupational health and safety[15]. An organization should establish and maintain procedures to raise the consciousness of its employees about:

- types of hazards occurring in the whole organization and at individual workstations and the professional risk related to them,
- benefits for employees and organizations resulting from the elimination of hazards and reduction of occupational risk,
- their tasks and responsibilities in achieving compliance with the occupational health and safety policy and with the procedures and requirements of the occupational health and safety management system, including the requirements concerning preparation for and response to accidents at work and serious breakdowns,
- the potential consequences of non-compliance with established procedures.

The active involvement of employees in the occupational health and safety management processes helps achieve the general and specific objectives[16].

Culture is defined as the totality of principles, rules, and manners of human activity, the creations of human work and artistic output, and is a collective achievement of a society. It is created on the basis of specific biological and social characteristics of humans and their living conditions and develops and transforms as part of a historical process. The relation between the number of accidents and potential accidents occurring in an organization and the occupational health and safety culture has been the subject of many investigations and analyses on multiple occasions[17]. The part of the culture that relates to risk and safety at work is referred to as the organization's safety culture. This culture is a set of organization--specific norms, values, and beliefs which employees adhere to and which determines the way individuals and groups live within an organization[18].

One of the most important factors shaping the safety culture is the education and training of employees. A high safety culture is a characteristic of an organization with a high level of safety[19]. Therefore, it can be stated that we observe a high safety culture in companies

[13] T.A. Saurin, C.T. Formoso, F.B. Cambraia, *An analysis of construction safety best practices from a cognitive systems engineering perspective*, "Safety Science" 2008, Vol. 46, No. 8, p. 1169–1183.

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[18] E. McKenna, N. Beech, *Zarządzanie zasobami ludzkimi*, Felberg SJA, Warszawa 1999.

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where a high level of education of employees has been introduced based on modern training methods. An occupational health and safety management system, which is part of the organization's management system, includes: the organizational structure, planning, responsibilities, rules of conduct, procedures, processes, and resources necessary to develop, implement, realize, review and maintain the occupational health and safety policy. Particular attention is paid to the appropriate design and implementation of the following elements in order to foster and strengthen the safety culture:

- setting occupational health and safety objectives,
- management's commitment to health and safety policy,
- competence and training,
- motivation,
- communication,
- monitoring.

The functioning of the above-mentioned elements has a great impact on the shaping of attitudes and behaviors of employees towards occupational health and safety[20].

3. RESEARCH METHODOLOGY

The first step in organizing training is to precisely define its objectives. The objectives should be formulated for behavior, activities, and operations which an employee must perform in order to ensure high productivity and safety at work. It is not possible to define the content of a training program until the organization knows the objectives it wants to achieve. In other words, one must answer the question of what knowledge, skills, and abilities are necessary for the good and safe performance of work. Training objectives should be based on the needs of the organization and its employees. It is, therefore, necessary to assess the training needs in order to define the organizational objectives on an individual basis and consider how the training program will contribute to their achievement. The recognition of training needs, more postulated than performed in reality, is done by examining the components of work and the skills needed to perform the tasks[21].

An organization-wide analysis can identify general needs, which then need to be translated into the needs of employees or working groups. The next step is to evaluate the tasks performed at work and the knowledge, skills, and abilities needed to perform them. The analysis at the individual level is intended to answer the question which employees need training and what kind of training it is. This information can be obtained through a job analysis, critical incident techniques, employee assessment systems or questionnaire surveys. A job analysis is most often used to identify training needs and define training objectives. It contains a list of properties needed for the job to be done well and a sequence of necessary operations for a particular workstation. On the basis of a job analysis, the company can determine whether the training will bring the expected results.

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[20] M. Kapusta, P. Bąk, M. Sukiennik, *Rola kultury bezpieczeństwa i higieny pracy w przedsiębiorstwie wydobywczym*, „Przegląd Górniczy" 2016, t. 72, nr 8, p. 11–15.

[21] R. Zhang, *The interaction mechanism between the safety attitude and safety perfmance*. International Conference on Economics, Social Science, Arts, Education and Management Engineering, Xian, China, 12–13 Dec 2015, Published by Atlantis Press, p. 634–638.

One of the oldest and most frequently used methods of preparing an employee to perform tasks is training at the workstation where the job will be performed. The trainee learns while working under the direction of an experienced employee or instructor. Advantages of this method include the economic aspect, since the organization does not need to create, equip or maintain special training equipment in this case. Another advantage of this method is that there are no costs associated with the employment of external instructors. However, it should be stressed that during this time the trainer has to devote time at the expense of their own responsibilities, which has a negative impact on the overall productivity. Additional costs include the slowness of the trainee's work and the losses caused by their lack of experience.

Another method is training away from the workstation – in a location specially prepared for this purpose. Unlike the previous case, such training is usually based on qualified instructors rather than employees or supervisors. This type of training has several advantages. There is no pressure to achieve some level of productivity since the training is the sole objective. Trainees do not have to worry about making costly and troublesome mistakes or damaging equipment. They can focus on learning the skills needed to perform tasks well. A disadvantage is the high cost of such training. The organization must equip the training facilities with appropriate devices and pay instructor fees. These costs are particularly high when there are too few new employees to take full advantage of all the equipment.

Multimedia training is the last of the methods presented. The degree of sophistication and complexity varies greatly from printed books to be filled in by employees, to interactive audio-video presentations, to complex computer software. All the forms of transferring information are based on self-study at an individual pace. Carefully prepared information is presented to the trainee in a specific sequence. The difficulty level increases gradually so that the trainee can cope with the material and thus achieve the goal of the training. This form of training is often addressed to a large group of employees. The speed of learning largely depends on the motivation and commitment of the trainee.

Irrespective of the impressions caused by the training and the care taken in the preparation of particular methods, their results should be systematically and quantitatively evaluated. The degree of success of the training can be checked through the following:

- cognitive results – the amount of knowledge gained,
- practical results – improving the quantity and quality of production,
- emotional results – changing attitudes or motivation to work safely.

Conducting research and evaluating the effects in a company makes it possible to effectively determine the direction and selection of appropriate training methods.

4. CHOICE OF EMPLOYEE SURVEY METHODS

In order to determine the effectiveness of employee training in the field of occupational health and safety, three methods of training were selected. The research was carried out in parallel in one of the underground hard coal mines over a period of four consecutive weeks using various methods. Figure 2 shows the employee training methods chosen to carry out the research.

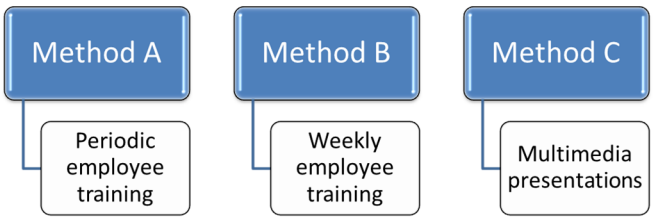

Fig. 2. Training methods used in research

Periodic training of employees takes place on a regular basis, and during the course of the survey, it was conducted outside the workplace. The form of the absorption of knowledge consisted in a direct contact and transfer of knowledge in a trainer–employee relation. This type of training and its program are adapted for groups of employees with similar professional qualifications. The verification of the knowledge acquired by the trainees takes place by obtaining a positive result from the examination conducted in the form of a verification test.

The weekly employee training was carried out every Monday. In this case, the training was carried out by supervisors immediately before each work shift. The topics covered the description and analysis of the causes and circumstances of current accidents as well as the rules and principles of safe work. Such materials are prepared and supported by the supervisors from the mine's Occupational Health and Safety Department. These materials were handed over to the supervising employees during Friday's weekly training conducted for them by an employee of the OHS Department.

Multimedia presentations for employees were conducted in weekly cycles. The presentations were displayed in the waiting hall, which gathers the largest number of employees before each work shift begins. Multimedia animations included content about multiple areas of occupational safety. The topics covered, among others, accidents at work, occupational diseases, personal and collective protective equipment, legal regulations, risks and first aid. Attractive forms of presentation with computer animations included, for example, the reconstruction of dangerous events and factual accidents at work. Instructional videos and photographs presented exercises in administering first aid and the correct use of personal protective equipment. PowerPoint presentations complemented employees' knowledge of OSH regulations and procedures for reporting potential accidents.

In order to evaluate the proposed training methods, it would be necessary to examine the effectiveness of knowledge absorption and determine their acceptance by the employees. For this purpose, one can conduct an anonymous survey by asking a question: "*Which training method suits you best?*". However, in such a case, respondents are likely to choose the method that does not require much involvement in the training process and a need to learn. Therefore, a more reliable solution was to carry out a test to check the absorption of knowledge by employees using three different methods of information transfer.

The effectiveness of individual training methods was verified on the basis of questionnaire responses. The examination which the employees took in the form of a test at the end of the periodic training was extended to include additional questions. Thus, the test included 15 questions aimed at obtaining information on individual forms of training. Employees were not informed what method of transfer of information (method A, B, C) they should

use to correctly answer their questions. The main objective of the survey was to determine which information transfer method is the most effective for the recipient. An attempt was made to find the answer to the question which method made the greatest impression and allows for the absorption of the largest amount of information.

The employees were not informed about the survey and the individual questions covered the following areas of methods:

- Questions 1–5 (for method A) concerned the materials discussed only during the periodical training, such as accidents at work, responding to accidents, post-accident proceedings, and first aid.
- Questions 6–10 (for method B) concerned the topics raised by the weekly training, such as the use of personal protective equipment, performing safe transport underground, and reporting potential accidents.
- Questions 11–15 (for method C) concerned the scope of multimedia materials presented in the mine's waiting hall, such as hazards occurring in the mine, exposure to harmful and onerous factors and occupational diseases.

The questionnaire with additional questions was filled in by 100 randomly selected people from a group of workers employed underground on worker positions. A total of 1500 responses were thus received, consisting of 500 responses for each of the three methods.

One of the indicators of employees' pro-safety attitude is the use of personal protective equipment. Current statistics on the use of basic personal protective equipment were also carried out during the survey. This made it possible to determine the amount of equipment collected during the 24-hour period in relation to the number of employees who could use them (employed within 24 hours). According to the report on safety in mines, pneumoconiosis is the largest group of occupational diseases[22]. The prevention of the risk of pneumoconiosis is largely based on the use of personal protective equipment.

5. ANALYSIS OF THE SURVEY RESULTS

As a consequence of the research, 1098 correctly selected answers were obtained, which constituted 73.2%. However, when we analyze individual questions, we notice that the number of correct answers ranges from 53 to 94. Figure 3 shows the correct answers given by employees to each question.

The result of the test on the contents of the training was the determination of an indicator that determines the ***percentage rate of the absorption of knowledge*** **W**w for method n. The indicator was calculated according to formula 1 (in relation to method n), and the obtained values were presented in Table 1 and shown graphically in Figure 4.

$$\boldsymbol{W_{W(n)} = \frac{Px(n)}{500} \times 100\%} \tag{1}$$

where: $\boldsymbol{W_W}$ – knowledge absorption rate,
P_X – number of correct answers for method *n*,
n – test methods A, B, C.

[22] *The assessment of work safety...*

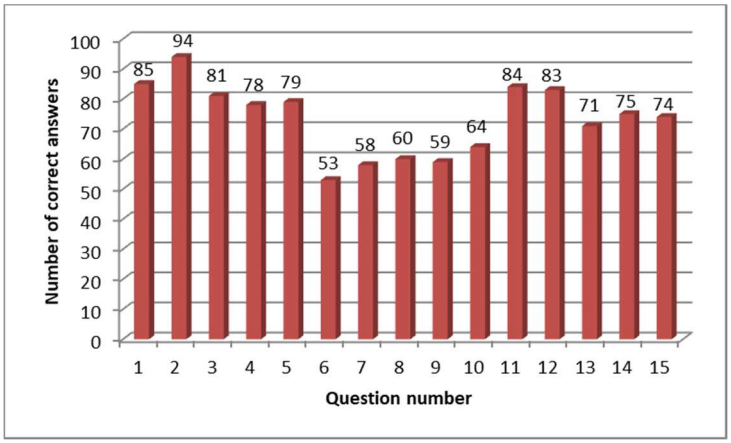

Fig. 3. The correct answers of the workers

Table 1. Values of learning indicators for training methods.

Method of training	**A**	**B**	**C**
W_W rate	**83.4**	**58.8**	**77.4**

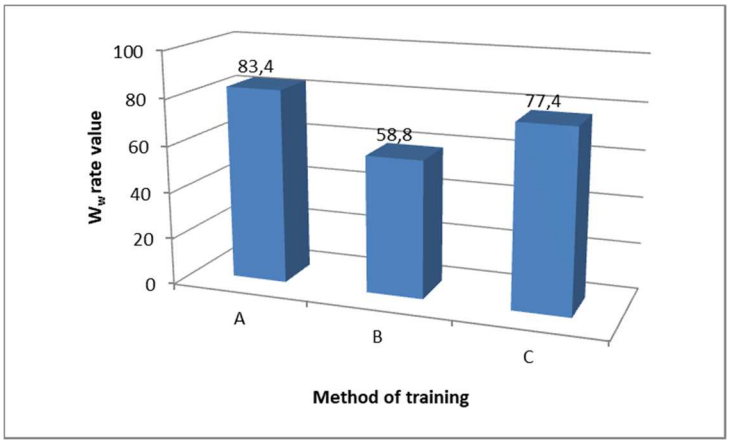

Fig. 4. Learning indicators for different training methods

As can be seen above, the knowledge absorption rate W_W is significantly different for individual methods n. The highest value of the indicator was obtained for method A, whose questions concerned the area of subjects discussed during periodical training. The lowest value was achieved for method B, which was based on weekly training. In the case of method A, the high value of the indicator can be explained by the employees' awareness

that they were required to pass an exam immediately after the completion of the training. The need to achieve a positive result caused stress and motivation to focus the employees' attention and actively participate in the training. A relatively low value of the method B indicator may suggest a low level of employees' involvement in this form of learning. The lack of verification of the knowledge being conveyed, e.g. through an exam, means that this form does not arouse emotions among the listeners. The place of training, which is an underground excavation, also plays an important role. Not without significance is also the authority and commitment of the supervisor who conducts the training.

A high value was also achieved by the indicator $\boldsymbol{W_W}$ used for method C, which took advantage of multimedia-based transfer of knowledge. The number of correct answers suggests that this is an appropriate and effective form of providing information. The presented videos and multimedia materials appeal to viewer's senses of sight and hearing, often evoking an emotional response. An attractive form of animations and realistic films motivates employees to encode information and memorize details. Visualizations of accidents, occupational diseases, and the prevention through the use of personal protective equipment arouse great interest.

One of the determinants of pro-safety attitudes is the application of protective equipment by employees. The analysis of the statistics on the use of personal protective equipment was based on the respiratory protective equipment used at the plant, i.e. removable filters for dust masks and disposable dust masks.

The statistics on the use of personal protective equipment by the mine's employees made it possible to prepare a diagram of the amount of collected personal protective equipment on particular days and calculate the daily ***dispatch rate*** of this equipment – $\boldsymbol{W_R}$. The values of the calculated dispatch rate are presented in Table 2 and shown graphically in Figure 5.

$$\boldsymbol{W_{R(n)} = \frac{I_m(n)}{P(n)}} \tag{2}$$

where: $I_m(n)$ – number of dust masks and filters taken by the crew,
$P(n)$ – number of employed underground workers,
n – day of the week.

Table 2. Number of dust masks and removable filters taken.

	Number of employed underground workers **(P)**				Number of collected masks and replaceable filters **(I_m)**				Dispatch rate **(W_R)**			
Week / Day	I	II	III	IV	I	II	III	IV	I	II	III	IV
Monday	1636	1566	1616	1564	777	716	762	690	0.474	0.457	0.472	0.441
Tuesday	1690	1635	1683	1601	762	1153	756	740	0.451	0.705	0.449	0.462
Wednesday	1666	1619	1685	1627	720	1077	725	775	0.432	0.665	0.430	0.476
Thursday	1678	1609	1645	1623	735	983	720	740	0.438	0.611	0.438	0.456
Friday	1553	1532	1515	1600	660	910	670	728	0.425	0.594	0.442	0.455
Saturday	298	305	289	336	69	75	45	81	0.231	0.245	0.156	0.241
Sunday	309	347	173	322	67	77	21	76	0.218	0.221	0.121	0.236

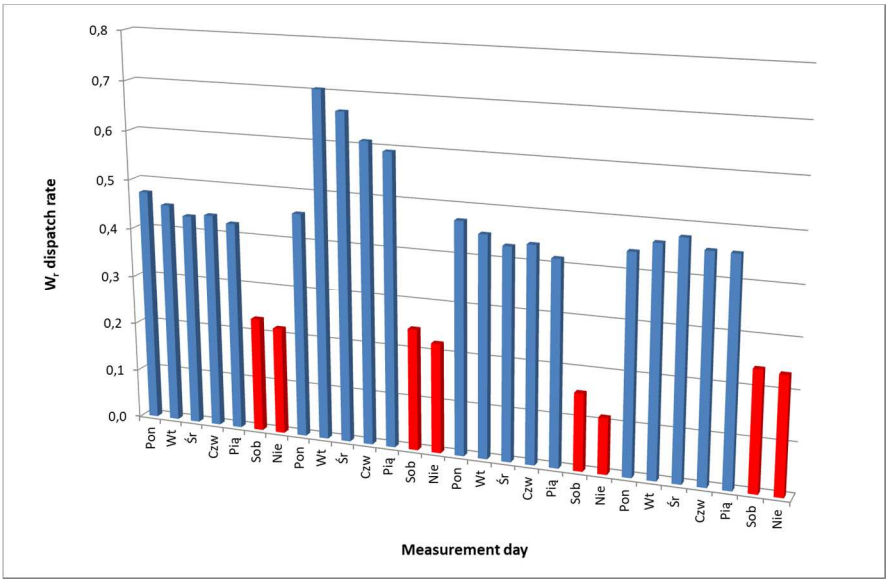

Fig. 5. Dispatch indicator for dust masks and replaceable filters

The analysis of the dispatch rate makes it possible to conclude that its value varies strongly and reaches values from 0.121 to 0.705. It can be clearly seen that this variability is strongly correlated with weekdays. Low values of the indicators appear on Saturdays and Sundays. In these periods, there are fewer employees at work and only works on excavation control and the maintenance of necessary devices are carried out. The highest air dustiness values occur at workstations during excavation drilling and coal extraction. Therefore, it can be assumed that the awareness of employees shaped in this way motivates them not to use personal protective equipment. The results of the study indicate that only about 20% use protective masks on weekend days.

The dispatch rate is much higher on business days, i.e. from Monday to Friday. The value of the rates oscillates between 0.4 and 0.5 and the second week of the study is an exception confirmed by much higher values. The maximum indicator value was obtained on Tuesday, the ninth day of the study, and reached 0.705. The day before (on Monday), the program of weekly training for employees focused on the use of filter masks. On the following day, multimedia presentations in the waiting hall contained predominantly content about pneumoconiosis. The materials informed employees about the harmful effects of dust on the human body. The presentations were enriched with films depicting the suffering of miners suffering from pneumoconiosis. It can, therefore, be concluded that the multimedia presentations had an impact on the employees' behavior, resulting in them taking up larger quantities of dust masks.

To sum up, it can be concluded that multimedia evoking strong emotions in the recipient has a greater influence on their attitude and behavior than a message of a strictly instructional nature, such as standard training. The right choice and selection of training methods undoubtedly make it possible to increase the quality and effectiveness of training in the field of occupational health and safety.

6. SUMMARY

The attitudes and competencies of mine workers in the area of occupational health and safety can be shaped by the proper selection of training methods. The purpose of the survey was to assess the effectiveness of knowledge absorption by three different methods. The conducted research and analysis show that training methods have an impact on shaping employees' awareness and attitudes. Multimedia presentations arouse the greatest interest in recipients. The capabilities of computer methods of visualization and simulation of events allow for a visual reconstruction of accidents that took place in reality, among others. This form of transfer of information strongly stimulates the emotions of the recipient and consequently motivates them to take positive action. Motivation has a major impact on the effectiveness of training, as well. Employees who take an active part in periodic training are aware of the fact that they will take an examination at the end of the training. Being aware of the requirement to demonstrate the acquired knowledge, they are able to assimilate more information. In the case of weekly training, the effectiveness of training is much lower. Often the effectiveness of this method is closely related to the characteristics and authority of the trainer. In extreme cases, it can be limited to one-sided communication by the trainer.

Undoubtedly, an advantage of the multimedia-based method is its emotional character. The other methods are dominated by a message of a logical nature. The transfer of information using instructional and documentary materials does not arouse such great interest and emotions in employees. It is, therefore, necessary to look for better solutions and methods of education. To this end, there is a need to find solutions aimed at preparing employees to perform their tasks and duties in a reliable, conscious and safe manner. Proper and reliable evaluation of training methods in the company will improve accident and occupational disease indicators.

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LEGAL ACT

1. Geological and Mining Law – Act of 9 June 2011 (Journal of Laws, No. 163. item 981).
2. Regulation of the Minister of Environment of 2 August 2016 on Mining and Mining Rescue Qualifications (Journal of Laws, item 1229).
3. Ustawa z dnia 26 czerwca 1974 r. – Kodeks pracy (Dz.U. z 1974 r, nr 24, poz. 141 ze zm.).

BADANIA NA TEMAT BEZPIECZEŃSTWA I HIGIENY NAUCZANIA W PRZEDSIĘBIORSTWIE

Szkolenie i doskonalenie wiedzy pracowników odgrywa ważną rolę w każdej firmie. Proces rozwoju personelu postrzegany jest jako inwestycja i podstawowe narzędzie zarządzania w organizacji. Opracowanie systemu szkolenia i dobór odpowiednich metod ich transferu w zakresie bezpieczeństwa i higieny pracy jest podstawowym zadaniem działów personalnych. Problemami w obszarach bezpieczeństwa zajmują się specjaliści z takich dziedzin nauki jak: filozofia, psychologia, socjologia, historia, prawo, pedagogika, medycyna i ergonomia.
W firmie wydobywczej pracownik jest narażony na zagrożenia naturalne, techniczne i osobiste. Najczęstszymi przyczynami wypadków są osobiste zagrożenia, których przyczyną jest niekontrolowana siła mięśni i grawitacja organizmu. Jednak najpoważniejsze konsekwencje dla zdrowia i życia pracownika są naturalne i techniczne. Takie wypadki są związane z niekontrolowanym formowaniem się skał lub kontaktem pracownika z maszynami podczas ruchu, jak również z porażeniem elektrycznym. Odrębną grupę zagrożeń stanowią szkodliwe czynniki występujące w miejscach pracy, które mogą powodować choroby zawodowe.
W artykule podjęto próbę oceny skuteczności pozyskiwania wiedzy przez pracowników dla trzech różnych metod szkoleniowych. Analiza została oparta na wynikach badań ankietowych uzyskanych podczas okresowego szkolenia. Przygotowano ankiety dla grupy badanych zatrudnionych na stanowisku pracownika. Zaproponowano porównanie skuteczności różnych metod szkoleniowych pracowników poprzez określenie procentowego stopnia absorpcji wiedzy W_W oraz wskaźnika wypływu środków ochrony poszczególnych W_R. Wyniki badań

i wartości indeksu dla poszczególnych dni pomiaru przedstawiono w formie tabelarycznej i graficznej.

Słowa kluczowe: szkolenie pracowników, bezpieczeństwo pracy, kultura bezpieczeństwa, górnictwo.

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