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## Fire safety training for future teachers in the context of health and safety compliance

VOLODYMYR SHEVCHENKO, YULIYA SHEVCHENKO. **Fire safety training for future teachers in the context of health and safety compliance.** *One of the most important activities of the state as an object of management is to ensure the protection of life and health of its citizens, national wealth and the environment. The fifth article of the Constitution of Ukraine states. Health protection is a common duty of society and the state". Among the factors that cause significant damage to human health and enormous material damage, the fire element takes a special place. Despite significant achievements in the field of scientific and technological development, people have not yet been able to invent reliable means of ensuring fire safety, and the result - the constant human and material losses. Code of Civil Protection of Ukraine defines fire safety as the absence of risk of fires and the possibility of damage to living organisms, property or the environment.*

**Key words:** labor protection, labor safety, information support, fire safety, technologies, future teacher, educational institution.

Problems of improving the training of teaching staff are among the most pressing and urgent issues in our country. The quality of training of the younger generation, and consequently the further all-round development of our country depends on the level of quality of pedagogical activity of teachers. At the same time, objective globalization changes are vectoring in the direction of transition of all processes of human activity from the post-industrial stage of their development to the stage of comprehensive Informatization and technologization. The specifics of this stage in the development of our society requires radical optimization of the training of the younger generation adapted to effective life in modern conditions. A priority in these conditions is the training of students in the use of modern information and production technologies. A teacher of technology carries out such training in the modern practice of domestic education. It would be fair to say that the quality of technology teacher training will determine the quality of the younger generation, and consequently the potential development of modern high-tech economy of Ukraine.

Technological training is been implemented by studying the subjects "Technology" and "Labor training". It should been noted that these subjects are characterized by an increased level of danger for both pupils and teachers, owing to the extensive use of hand and mechanized tools and technological equipment. In addition, the law regulates the teacher's full responsibility for preserving the health and performance of the student during the teaching and production process. The above-mentioned state of teachers' working conditions and safety requirements demonstrates the importance of improving the training of technology teachers, especially in the area of occupational safety and health. Furthermore, it is the responsibility of the technology teacher, while introducing students to different types of technology, to make them aware of different types of risks and hazards, thereby developing in them clear and profound beliefs of responsibility for their own safety and the safety of others, knowledge and skills for their own safe work.

A necessary and timely task for the scientific-pedagogical community is to find, develop and justify new modern approaches to improve the training of future teachers of technology. It is advisable to develop new methodological approaches, substantiate the content and implement modern innovative means of teaching occupational safety and health to future teachers of technology. It is necessary that occupational safety training should be practical, i.e. it should correspond

to real conditions of future professional and pedagogical activity of a technology teacher.

The national fire safety standard DSTU 8828-2019, which entered into force only at the beginning of 2020, contains conceptual requirements for fire safety management and standardized terms and concepts in this area. The focus of fire safety is the elimination of factors that can cause fires and the minimization of their consequences. Objects must comply with procedure of subjects of management of fire safety and management measures to meet the technical requirements of the fire protection system and ensure the fire regime of the object of protection [2].

In the legislative and regulatory field of Ukraine there is no clear definition of the term "fire safety", so the study of approaches to formulate this concept became very relevant. Analyzing scientific sources, we find different approaches to definition of concept "fire safety". V. K. Oknyan in his dissertation study defines fire safety as ensuring the system of fulfilling the requirements of normative-legal acts, regulating human activity in the field of safe use of combustible substances and materials [3, p. 10]. In the work of I. G. Kutz fire safety is a state of protection of people, property, society and state from fires [4, p. 52]. V. V. Kolesnikov understands fire safety as "a set of the social relations regulated by normative-legal acts, directed on prevention of possibility of fire, prevention of possibility of influence of dangerous factors of fire on people and property" [5, p. 23]. V. A. Domansky defines fire safety as a state of protection of people, objects, material values and the state from fires. In addition, the scientist attributes fire safety to the system of national security of the state, with which it is difficult to disagree [5, p. 116]. G. Ponomarenko, analyzing the concept of fire safety, reveals its multifaceted nature socio-economic importance, legal and technical principles, environmental consequences and much more. There is a lot of information in literature about technical features of fire safety, economic and legal problems connected with non-compliance with fire safety rules. According to the researcher, fire safety is one of the areas of national security, which "is to protect human life and health, property and other values of physical and legal persons, national wealth and the environment, which ensures timely prevention, detection, termination and neutralization of fires and their consequences"[7, p. 49].

Fire safety of an object is been defined by its condition, which with a regulated probability excludes the possibility of occurrence and development of fire and influence on people of its dangerous factors, and provides protection of property. We find here a definition of fire risk,

which reflects the possibility of the appearance and development of fire. The purpose of fire safety of an object is to prevent fire at the level set by the current regulations and in case of fire occurrence to detect and extinguish the fire in time, to limit its spread, to protect people and property [8, p. 23].

Fire hazards can be different - posing a direct threat to people's homes and health or causing damage to the environment and leading to significant material losses. In addition, fire hazard includes the action of the following indirectly dangerous and harmful factors: toxic products of combustion; fire; increased ambient temperature; smoke; lack of oxygen; destruction of building structures; explosions, leakage of hazardous substances due to fire; panic. Therefore, when considering the main issues of fire safety it is important to define the key concepts of the issue.

A fire is a combustion outside a specific hearth that is uncontrolled, spreads in space and time and poses a threat to human life and health, the environment and results in material damage. Fire is one of the hazards of fire, because the temperature of the flame can reach 1200-1400 °C and people in the radiation zone of fire flame can get burns of varying degrees of severity, which can lead to death [9, p. 6].

The danger of high temperatures caused by fire is that inhalation of heated air together with products of combustion can lead to respiratory damage and death. An increase in ambient temperature of up to 60 °C during a fire is already life threatening.

Toxic combustion products, the main sources of which are a large number of synthetic materials in modern industrial, domestic and office buildings, pose the biggest threat to human life. On burning polyurethane foam and nylon produces hydrogen cyanide (hydrocyanic acid), on burning vinyl - hydrogen chloride and carbon monoxide, on burning linoleum - hydrogen sulphide and sulphur dioxide, etc., inhalation of which at a concentration of 0.4% is fatal for humans. For example in cellars, mines, tunnels and warehouses, its content may vary from 0.15 to 1.5% and in rooms from 0.1 to 0.6% [9, p. 9].

One of the causes of fires is smoke, a large amount of fine particulate matter in the air, which can irritate mucous membranes and respiratory organs. In addition, smoke in a room impairs visibility, which slows down evacuation. For example, if a room is very smoky, the visibility of objects illuminated by a 20 W light bulb is no more than 2.5 m.

Lack of oxygen is also life threatening due to the chemical oxidation reaction of combustibles and materials during combustion. When the

oxygen content in the air drops, to 14% (the normal rate is 21%), people lose coordination of their movements, and weakness, dizziness and mental confusion occur [10, p. 22].

Explosions during fires increase the burning area and may lead to the formation of new ones. Explosions of hazardous substances can be caused by heating when exposed to fire, by the depressurization of tanks and pipelines with hazardous liquids and gases. Persons in the vicinity may be exposed to the blast wave and be injured by debris.

Destruction of building structures is one of the indirect hazards caused by fire and is characterized by the loss of load-bearing capacity of structures due to high temperatures and explosions. The danger to people lies in the possibility of significant mechanical injuries under the debris of collapsed structures and the inability to evacuate due to blocked exits or collapsed escape routes.

Improving the extinguishing effect can be achieved by spraying water over the seat of fire. A single jet of water can be used to deliver water over long distances if the fire is large enough, but in this case, the extinguishing mechanism will be to cool the combustible materials or substances, or to suppress the flames. The use of a mixture of water and soapy substances, which reduce surface tension, allows a more effective wetting of the surface of combustible materials during a fire and therefore a better cooling of them.

The main disadvantages of water as an extinguishing agent are: violent chemical reactivity with some substances (acids, alkali metals, metal carbides and hydrides); water's ability to conduct electricity; water freezing at temperatures below freezing; negative effects on some materials that it can damage (e.g. paper, so use in archives or libraries is not advisable). Systems are not effective in areas where there is a fire risk from explosions; insufficient wetting power and sticking it should be remembered that when extinguishing oil and petroleum products with water jets, it is possible for them to be ejected or sprayed, which increases the burning area.

Some countries have developed recommendations for extinguishing fires with hot water. According to these recommendations, the area of rooms controlled by a single system should not exceed 250 square meters. If the room is larger, it should be divided into sections with partitions that reduce the possible combustion area. The sprayed water jets must cover the entire area of the section at the specified flow rate.

It is more effective to apply the water horizontally to the floor or at a certain angle to the floor. In the latter case, the diameter of the water spray is no more than 700 mm, if the diameter of the water supply nozzle is 4-8 mm. With horizontal irrigation, it is advisable to position the pipeline 0.3-0.5 m above the floor. With this method, the effective irrigation area is 5-6 metres in diameter, provided the nozzle diameter is 5-6 mm. The use of such systems is possible in rooms with low air tightness, but the intensity of the extinguishing agents must be increased by a factor of three. Calculations determine the amount of water needed to extinguish the fire in a particular room, its temperature and supply pressure. The distance between sprinkler nozzles must not exceed 0.6 m. The greatest disadvantage of using heated water to extinguish fires is the high-energy costs of maintaining its temperature [4, pp. 11-69].

According to DSTU 8828: 2019, fire safety of a facility shall be provided by fire prevention system, fire protection system and fire safety management system of the facility. Fire safety systems aim at preventing fires and exposing people to their hazards at the required level. The probability of fire occurring in a facility is determined during the design, construction and operation phases. In order to assess the probability of fire occurrence in existing plants or facilities or buildings under construction it is necessary to have statistics of various fires and explosions. The probability of occurrence of a fire in the designed objects is determined based on the reliability indicators of the components of the object, which allows calculating the probability of occurrence of situations that can lead to the realization of fire and explosion events [2].

The basis of the fire safety system is fire protection, i.e. a set of mandatory rules for the conduct of people and employees, rules types of work and the operation of a facility or product, aimed at ensuring its fire safety.

Fire protection systems also includes: lightning protection, fire lifts, fire doors, fire hydrant kits, air valves, gates, fire screens and more. Today, these SPZs are installed at all modern facilities, but still the old systems, which cannot differ in principle from the new ones in terms of functionality and perform their functions well with proper maintenance.

Automatic fire extinguishing systems (AFS) play an extremely important role in protecting against fires and their consequences. They are fire-extinguishing systems that are capable of detecting signs of burning, warning of the presence of a fire and delivering certain extinguishing agents to the points of fire without human intervention [4, p. 48]. These systems must operate for less time than the time of the initial phase of the

fire, provide the necessary amount or volume of extinguishing agent and prevent the fire from spreading for the time necessary for the application of operational forces and resources. At the same time, they act as fire alarms.

Automatic water fire extinguishing systems remain the most common means of extinguishing class A, B, C fires. An automatic water suppression system is a system of technical means capable of extinguishing a fire by forcing a certain amount of water into the seat of fire. It is able to detect, localize and extinguish fires with water when signals of fire breaking are available [10, p. 97].

Water fire extinguishing systems are been used in a variety of applications. It should be used in all cases where the use of water is effective and will not cause harm. When selecting water fire extinguishing systems to provide fire protection for facilities, one should consider the level of fire risk, the properties of the materials stored indoors and analyses the hazards of the technological processes used in the facility.

According to the method of water supply, such systems are been divided into sprinkler systems, drainage systems and fire extinguishing systems. Sprinkler systems are been used in rooms where the minimum air temperature is at least 5°C. Pre-extinguishing systems are equipment that can be triggered by several detection systems. That is, it requires the operation of several fire protection equipment to activate it.

A distinction is been made between the following systems for the storage of extinguishing agents: centralized storage, which is located outdoors and modular storage, which is located directly indoors.

The classification division of automatic gas fire extinguishing systems (AGFES) is been based on the design features and physical and chemical characteristics of extinguishing agents. A distinction is been made between centralized and decentralized storage depending on the installation process. Centralized storages for gas fire extinguishing systems have a separate room from where the substances are been fed to the source of ignition in different rooms of the facility.

Decentralized storage facilities contain a stockpile of extinguishing agent where it is located. Centralized storage facilities are often capable of protecting a much larger area of rooms and even the entire building against fire. ASGP extinguishing agent storage systems are structurally been divided into: modular gas fire extinguishing units, automatic gas fire extinguishing units and isothermal units. Modular automatic systems are ASGPs, which have one or more modules filled with gaseous extinguishing agents and located in a particular room that needs fire protection

or at the entrance. The modules are cylinders filled with a specific gas-extinguishing agent and equipped with a locking and triggering device.

Automatic gas fire extinguishing systems are a system of modules connected by common manifold, manual and automatic starting devices, which make it possible to control the release of extinguishing agents only from the required modules. Isothermal gas fire extinguishing systems are been used to protect large volume fires and can store about 25 tons of extinguishing gases [3].

Powder fire extinguishing systems (PFS) are a set of technical means that are been designed to extinguish fires with extinguishing powders. The scheme of operation of such fire-extinguishing systems is been based on the phenomenon of pseudo-capture of the powder layer when the working gas enters the enclosure tank and the extinguishing powder is released into the fire zone.

Aerosol fire-extinguishing systems (SAPS) are been used for three-dimensional containment and suppression of fire in the premises. SAPS are most effective for extinguishing fires caused by inflammable substances or flammable liquids (class B fires), some solid combustibles such as plastics or rubber, live electrical equipment, electrical insulation, for containment and extinguishing fires. Combustion of LLW and HLW (petrol, paraffin, diesel fuel, organic solvents, i.e. class B fires); some solid combustible materials (plastics, rubber - fires of subclass A2); electrical equipment (including live ones), electrical insulation materials [4, p. 113].

Fire extinguishers cannot provide absolute fire suppression and must not be used to extinguish: fibrous, porous, loose and other combustible materials capable of self-ignition and shouldering within the materials (firewood, cotton, grass meal); chemicals, mixtures thereof, polymers prone to decomposition, self-ignition or combustion without oxygen access; metal wires and pyrophoric substances; certain metal powders (magnesium, zirconium, titanium).

Facilities where fires can lead to mass casualties of the public by fire hazards and their secondary manifestations or to significant material damage are required to have fire safety systems that ensure the lowest possible probability of a fire occurring. The designers and technologists determine the values of this probability and the main input data for the development of the set of technical and organizational solutions for the required fire safety level in each individual case are the current fire safety regulations, the explosive properties of the materials and substances used. In the production cycle, the amounts of explosive and flammable

materials and substances and the production characteristics. Based on that information the explosion- and fire hazard criteria as well as explosion- and fire hazard classes of rooms and buildings are determined.

The process of development and implementation of effective measures aimed at minimizing the risk of fire and reducing the amount of possible damage in case of fire is been carried out by solving the tasks of formation and implementation of the mechanism of state management of fire safety.

The functional responsibilities of a teacher of technology, which we defined earlier, indicate that one of his/her tasks is to identify and eliminate the causes of possible injuries to students and to maintain working tools and equipment in good working order. The content component of the model EOP programmer "State management of labor protection, state and public control" is important for the reason that the responsibility for unsatisfactory organization of safe conditions of educational process is borne by a teacher of technology. This is justified by the fact that, as a rule, he/she is the head of the labor training room. A future teacher should be clearly aware of the control procedure, understand his/her duties and responsibilities of the state supervisory bodies' employees, such information should be included in the content of the EOP course. The functioning of occupational safety and health system in an educational institution is a prerequisite for its activities, so a future specialist in technological education must understand his/her responsibilities in the field of occupational safety and health.

The section "Labor protection training" is been designed to form those knowledge and skills that a future teacher will most often apply in his/her professional activity. This statement is been unreasonable, because the teacher provides direct training in the safe performance of certain types of technological operations. His or her task is to identify and explain the hazards and introduce methods of prevention. The next step is to check them and record the control in the logbook. It is worth noting that the teacher should understand their health and hygiene competence in extracurricular activities (excursions, visits to production facilities), so the question of instruction in the content of this section should been designed for the organization of labor training and technology, not for the production process, as it usually is.

Promoting the prevention of injuries and occupational diseases is the task of any professional. In this context, the dangers of the technology teacher's job are multifactorial, since potential injury threatens not only the students, but also the teacher in particular. It is the teacher's task to monitor the correct performance of the various operations by the students and to acquaint them with the safe ways of performing these operations.

Injury prevention is a preventive component of occupational health and safety for technology teachers. Since the task of labor education is to provide vocational guidance to students, which consists in familiarizing them with different types of occupations, the teacher is obliged to form knowledge of students about the nature of work of workers in different branches of the national economy and possible dangers threatening a specialist. The most complete information about the conditions and specifics of a worker's work will enable the pupil to make the right choice - to ensure the pro-orientation purpose of the lesson. General rules of injury prevention do not fully provide the teacher of technology of education, because the teacher must be aware of potential hazards that threaten not only the student, but also him or her personally.

It is the teacher's responsibility to create normal (optimum) conditions of microclimate, sanitation and hygiene and to monitor their observance.

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*Abstracts*

ВОЛОДИМИР ШЕВЧЕНКО, ЮЛІЯ ШЕВЧЕНКО. **Зміст навчання пожежної безпеки майбутніх учителів в контексті дотримання правил охорони праці.** Одним із найважливіших напрямків діяльності держави як об'єкту управління є забезпечення охорони життя і здоров'я своїх громадян, національних багатств та оточуючого середовища. Стаття 5 Конституції України говорить, що «охорона здоров'я – загальний обов'язок суспільства та держави». Розглядаючи чинники, що завдають значної шкоди як здоров'ю людей і колосальних матеріальних збитків, особливе місце займає пожежна стихія. Попри значні здобутки у сфері науково-технічного розвитку, люди досі не змогли винайти надійних засобів пожежної безпеки, а результат – постійні людські і матеріальні втрати. Кодексом цивільного захисту України пожежна безпека визначається як відсутність ризику виникнення та розвитку пожеж й можливості завдання ними шкоди живим організмам, матеріальним цінностям або довкіллю.

**Ключові слова:** охорона праці, безпека праці, інформаційне забезпечення, пожежна безпека, технології, майбутній учитель, заклад освіти.

ВЛАДИМИР ШЕВЧЕНКО, ЮЛИЯ ШЕВЧЕНКО. **Содержание обучения пожарной безопасности будущих учителей в контексте соблюдения правил охраны труда.** Одним из важнейших направлений деятельности государства как объекта управления является обеспечение охраны жизни и здоровья своих граждан, национальных богатств и окружающей среды. Статья 5 Конституции Украины гласит, что «здравоохранение - общий долг общества и государства». Рассматривая факторы, которые наносят значительный ущерб как здоровью людей так и колоссальных материальных убытков, особое место занимает пожарная стихия. Несмотря на значительные достижения в области научно-технического развития, люди до сих пор не смогли изобрести надежных средств пожарной безопасности, а результат - постоянные человеческие и материальные потери. Кодексом гражданской защиты Украины пожарная безопасность определяется как отсутствие риска возникновения и развития пожаров и возможности нанесения ими вреда живым организмам, материальным ценностям или окружающей среде.

**Ключевые слова:** охрана труда, безопасность труда, информационное обеспечение, пожарная безопасность, технологии, будущий учитель, учебное заведение.

WOŁODYMYR SZEWCZENKO, JULIJA SZEWCZENKO. **Treść nauki bezpieczeństwa przeciwpożarowego przyszłych nauczycieli w kontekście przestrzegania zasad ochrony pracy.** Jednym z najważniejszych kierunków działań państwa jako podmiotu zarządzania jest zapewnienie ochrony życia i zdrowia swoich obywateli, bogactwa narodowego i środowiska. Artykuł 5 Konstytucji Ukrainy stanowi, że „opieka zdrowotna jest ogólnym obowiązkiem społeczeństwa i państwa”. Biorąc pod uwagę czynniki powodujące znaczne szkody dla zdrowia ludzkiego i ogromne szkody materialne, szczególnie miejsce zajmuje ogień. Pomimo znaczących osiągnięć w dziedzinie rozwoju naukowego i technologicznego, ludzie wciąż nie byli w stanie wymyślić niezawodnych środków bezpieczeństwa przeciwpożarowego, a rezultatem są ciągle straty ludzkie i materialne. Kodeks Ochrony Cywilnej Ukrainy definiuje bezpieczeństwo przeciwpożarowe jako brak ryzyka wystąpienia i rozwoju pożarów oraz możliwość wyrażenia przez nie krzywdy żywym organizmom, mieniu lub środowisku. **Słowa kluczowe:** ochrona pracy, bezpieczeństwo pracy, zabezpieczenie informacyjne, bezpieczeństwo przeciwpożarowe, technologie, przyszły nauczyciel, instytucja edukacyjna.