SCIENTIFIC METHODS AIMED AT IMPROVING WORKING CONDITIONS AND WORKPLACES IN ECONOMIC SECTORS

Yuldashev Orunbay Rakhmonberdievich[1], Abdullaeva Surayyo Munirovna[2], Abdurakhmanova Sayyorakhon Ruzalievna[3], Qodirov Fazliddin Misliddinovich[4]

[1]Professor of the Department of the Institute of Civil Protection of the Ministry of Emergency Situations of the Republic of Uzbekistan Candidate of Technical Sciences, Associate Professor

[2]Senior Lecturer at the Department of Energy Supply Systems, Tashkent University of Information Technology named after Muhammad Al-Khwarizmi

[3]Teacher at the training center “BZD” of the Fergana region, Ministry of Emergency Situations of the Republic of Uzbekistan

[4]Leading specialist of the department of educational organization at the University of Management and Future Technologies

https://doi.org/10.5281/zenodo.10897986

Abstract*. This article is devoted to the analysis of the results of the research work carried out in the framework of innovative research. The article presents the role of mobile applications in the life of a modern person and a variety of socio-economic issues in the field of labor protection. As well as the use of mathematical modeling methods to evaluate individual aspects of human interactions with the production environment and to study the dependencies between parameters in laboratory semi-industrial installations.*

Keywords*: safety, noise, vibration, dust, gas, heat exchange, research, software, creation, labor protection.*

Recently, mathematical modeling methods have been used to solve occupational safety problems. This method allows you to determine ways to improve various technological processes, analyze operating modes and select among them the optimal ones according to safety criteria. In addition, it becomes possible to predict trends in changes in indicators of interest over time and test put forward hypotheses about the structure and mechanism of processes.

Occupational safety is characterized by a variety of tasks to be solved and the presence of areas related to fundamental natural sciences. Thus, issues of thermal protection are closely related to the classical theory of mass and heat transfer, in solving which the equations of the theory of convective and radiant heat transfer (1) are successfully used. When organizing protection against vibration and noise, methods of classical mechanics, vibration theory and acoustics are used.

The study of ventilation of industrial premises is closely related to aerodynamic or hydro aeromechanics.

The basis for solving issues of protection against electric shock are the laws of electrical engineering and electromagnetism.

The creation of the physical aspects of collecting dust and gases is based on the laws of classical hydro-aeromechanics, statistical and molecular physics (2). And finally, ergonomics is based on the achievements of medical, psychological, and biological sciences.

Thus, the specificity of occupational safety measures, which are characterized by a significant amount of experimental work at the stage of laboratory, industrial, and research, determines the prospects of using, firstly, analytical, and secondly, experimental statistical modeling methods.

In the first case, equations of dynamics and statics are compiled based on an analysis of the physical and chemical essence of the processes occurring in the object and the application of the laws of conservation of energy and matter. In the second case, with incomplete knowledge of the mechanism of processes and the essence of the internal structure, when the values of the output quantity are not in a unique relationship with the input influences, the study of processes is carried out using statistical and probabilistic methods. The most rational research scheme is when a general mathematical description is found using analytical methods that make it possible, based on the physical essence of the process, to obtain a general solution to the problem. In this case, experimental-statistical methods help to establish for a specific object the range of variation of constants, the limits of variation of control parameters, the admissibility of variation zones to ensure safety, etc.

The ultimate goal of mathematical modeling is to determine the functional dependencies of input and output parameters, decision-making objects of models, predicting the values of output values of a process over time, and developing recommendations (or systems) for its safe management.

Based on the above, in research in the field of labor protection, the following directions can be outlined for the effective application of the mentioned methods:

1. Use of mathematical modeling methods to assess individual aspects of human interaction with the production environment and to study dependencies between parameters in laboratory, semi-industrial and industrial installations.

2. Mathematical description and optimization of complex processes being designed or in operation, which are characterized by factors that negatively affect humans.

3. Creation of automated occupational safety management and control systems using a counting and solving algorithm mechanism.

Each of these areas includes certain groups of tasks. The solution of which is provided by appropriate methods of mathematical modeling.

At the stage of preliminary study of the object of study, when the most important ones need to be identified from a large number of factors, and opinions about their importance in the literature are contradictory, the method of a priori ranking of factors, or the rank correlation method, is used (3). This method is used in cases. when variable quality characteristics cannot be indicators. At the next stage, with a relatively large number of factors (more than 5-7) influencing the process. the problem of their reduction is solved by the random balance method (3). Work (4) illustrates the use of the rank correlation method in identifying the degree of influence of the energy characteristics of vibration (level of vibration speed, nature and duration of exposure, etc.) and the diseases it causes.

At the stages of preliminary research of objects, when the characteristics of individual parameters are studied. there arises the finding of the distribution of random variables. In this case, knowledge of distribution laws contributes to the correct choice of methods for statistical processing and assessment of the characteristics of the parameters being studied. This makes it possible to predict the occurrence of dangerous situations and develop measures to prevent the causes of occupational morbidity and injury.

Finding distribution laws in the field of occupational safety research is often an independent task. Knowledge of these laws leads to the direct determination of safe operating modes of equipment. For example, failures of technological equipment that are directly related to

injuries are distributed according to Poisson's law, therefore the safety of equipment is assessed on the basis of this distribution (5). The distribution of accidents by severity is well approximated with the (p)-distribution (6).

It is most convenient to present various types of distributions in the form of equations. From this point of view, the distribution of accidents in production as a whole by individual profession is well described by multiple nonlinear regression equations (7).

When performing work related to solving problems of the first direction, when determining: the dependence of injuries and occupational diseases on technological, psychophysiological, organizational reasons and social and hygienic working conditions (8); the nature of the influence of lighting, noise, dust and other factors on labor productivity (9); connection between and operational reliability of equipment (10); the influence of technological factors on the vibration and noise activity of machines and mechanisms under normal operating conditions and during the diagnosis of their malfunctions (11); installation coordinates of air condition sensors (12); successfully used in the method of correlation analysis, which makes it possible to obtain paired cause-and-effect factors.

When determining the totality of the assessment of the influence of causal factors on the working conditions of workers, methods of multivariate dispersion and regression analyzes are used with an assessment of the reliability of the data obtained according to the relevant statistical criteria. Here, the problems of determining the significance levels of calculating confidence limits for testing hypotheses are solved using the apparatus of the probability theory of applied statistics (13). The use of these methods allows them to use static material obtained from a passive experiment to build a model reflecting the simultaneity of the influence of a complex of input factors, evaluate the influence of each factor separately, analyze and interpret the models in accordance with the physical essence of the process under study.

In the practice of occupational safety and health work, problems of determining the probability of events that are difficult to test experimentally are often solved. Typically, such an assessment is made to identify the most rational design parameters of elements of technology that is safe in the long term. Such works are based on theorems on the addition and multiplication of probabilities, the concept of total probability and the HYPOTHESIS THEOREM (Bayes formula) (14).

Examples of the use of a probabilistic approach are solving problems of modeling and analytical scenario of labor safety conditions (15) assessing the level of safety of developments (16), and predicting the likelihood of industrial injuries (17).

When assessing the safety of equipment in industrial complexes with a complex structure and various operating conditions, preference is given to the statistical Monte Carlo method (18) (based on the law of large numbers and limit theorems).

An integral part of most laboratory and semi-industrial research in the field of occupational safety and health is the solution of complex multifactorial problems. This solution is based on experimental studies with the possibility of active influence on the control parameters. Such problems occur, for example, in ergonomics, gas and dust collection, and ventilation, where studies are often carried out on model or full-scale installations that allow active influence on control parameters.

Traditional research methods used for these purposes involve labor-intensive experiments based on alternately varying individual independent variables while holding other variables constant.

These problems are most effectively solved by using mathematical methods for planning and analyzing experiments (19), which make it possible to sharply reduce the number of experiments. However, these methods, unfortunately, have not yet found wide application in the field of occupational safety research.

When solving problems of the second direction, it is often necessary to determine the maximum or minimum values of output parameters. Finding the ratio of the values of the output parameters is achieved by optimization methods. Optimization can be carried out on the basis of a mathematical model or by directly searching for optimal conditions at the site, depending on the chosen method.

According to the classification of optimization methods given in work (20), the following methods of searching for the optimum are distinguished; analytical, mathematical, automatic, automatic with self-adjusting models.

These methods also include the automation of engineering work processes, the purpose of which is to reduce the labor intensity of work when searching for optimal design solutions. Such problems arise, for example, when calculating ventilation systems, when it is necessary to take into account the lowest and highest permissible values of air velocities, the range and configuration of equipment, the actual resistance of tees, crosses, etc. (21). Characteristic in this area are works on the creation of systems for automated optimal design and analysis of a complex of heat exchangers (22), as well as on design in the field of vibration protection (23).

The solution to problems in this direction is provided by methods of the theory of linear and nonlinear programming systems, with the help of which processes are described by a system of algebraic equations of inequalities-constraints, minimized by a nonlinear functional-objective function and coupling equations (24).

In recent years, work on the creation of automated occupational safety management and control systems at the level of enterprises, industries and regions, based on the great technical capabilities of computers, has become widespread. The third direction was directly reflected in solving the problem of improving occupational safety management methods.

In the field of labor protection, local automated air control systems have already been created. The purpose of their organization is gas monitoring of air at chemical enterprises (25) and issuing reference information to consumers on the quantitative composition of substances that pollute the atmosphere (26). There are technical solutions for the development of industry-specific automated systems for recording, analyzing and preventing industrial injuries (27).

When performing work in the third direction, it is necessary to establish possible information flows, determine samples, frequency of data collection and integration time. For this purpose, methods of static dynamics and spectral analysis can be successfully used (28).

According to the objectives of the study, this can also include the erotic system, in which the role of the manager is performed by a person. The process of building such a system includes the stages of forming a psychophysical portrait of the operator, coordinating the flow of information coming to him and the characteristics of the controlled process, respectively, with the throughput and indicators of the human body. The procedure for finding a multifactor operator model is carried out using correlation and factor analyzes (29).

To harmonize the characteristics of the operator and the controlled process, a method is used to describe the operator's activities with transfer functions, which will allow a quantitative analysis of the psychophysiological characteristics of the operator using the gain factor, time constants and pure delay (29).

To study the information capabilities of a human operator in an ergonomic system, the most preferable methods are the methods of static information theory, which made it possible to establish that a person, as a consumer of information, functions similarly to a channel with limited capacity (30).

The process of solving the class of problems under consideration involves the processing of static material, which requires the use of computers. According to the given methods of following and calculating in the mathematical software of computer centers, there are developed standard programs that can be used to perform the necessary calculations on the machine.

Thus, methods of mathematical modeling can be successfully applied at various stages of research when solving problems of labor protection; they will be able to use greater capabilities of computer technology and will ensure the identification of research work.

REFERENCES

1. Карагодин Л.Н. Журавлев В.П. О создании физических основ уравнения пыли.- «Безопасность труда в промышленности», 2001 № 5.
2. Тихомиров В.Б Планирование и анализ эксперимента. М. «Легкая индустрия», 2004.
3. Шакирзянова Л.Г. Пасынкеев А.А. Бобылев М.Б. К вопросу об оценке безопасности прокатного оборудования. -В кн: Охрана труда и техника безопасности в черной металлурги. Вып 4.М. 2006.
4. Шихов В.Н. и др. О статистической оценке распределения несчастных случаев по тяжести. -В кн: Проблемы охраны труда. Казань, 2014.
5. Сенчишев И.А. и др . Моделирование процесса травматизма для задач прогнозирования в прокатном производстве –В кн: Охрана труда и техника безопасности в черной металлургии. Вып 1. М. 2002.
6. Гамхаршивили А.Г. Вероятностный подход к анализу некоторых причин производственного травматизма. -«Безопасность труда в промышленность» 2009.
7. Траносов А.М. и др . Условия труда и его производительность. - «Безопасность труда в промышленности» 2003.
8. Супаков Н.К Общая методика оценки безопасности оборудования и преизводства. -В кн: Проблемы охраны труда. Казань 2004.
9. Пиаревский Н.Н. Корреляционные методы при исследовании шумов и вибрации/ -В кн: Труды симпозиума «Статистические методы в теоретических экспериментальных исследованиях шумов и вибраций» 2009.
10. Шербень А.Н и др. Определение мест установки датчиков состояние воздушной среды. -«Безопасность труда в промышленности» 2009.
11. Вентцель Е.С. Теория вероятностей М. «Наука»1969.
12. Бондаренко В.М. Моделирование и аналитическая оценка условий безопасности труда. -«Безопасность труда в промышленности» 2008 № 3.
13. Кауфман Л.А. и др. Оценка уровня безопасности разработки. «Безопаность труда в промышленности» 2005. №5.

14. Гребняк В.П. Прогнозирование вероятности производственных травм по психологическим показателям - «Вопросы психология» 2009№1.
15. Засядко А.А. Автоматизация проектирования и расчета вибрационных систем. -В кн: Тезисы докладов «Влияние вибраций на организм человек и проблемы виброзащиты». М 2007.
16. Карпелевич Ф.И. Садовский Л.Е. Элементы линейной алгебры и линейного программирования. М. «Наука» 2001.
17. Егоров А.М. Козлов Ю.В. Комаров В.С. Система автоматизированного контроля загрязнения воздушного бассейна. «Безопасность труда в промышленности» 2008.
18. Солодовников В.В Статистическая динамика линейных систем автоматического управления. М. 2000