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Role and Importance of Ergonomics in Providing Safety of Work

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Abstract: The article examines the analysis of one of the current problems - the causes and consequences of the occurrence of factors that have a negative impact on the health of workers employed in the production process, an idea of the methods and means of ensuring safety and the efficiency of work is given.

Keywords: Ergonomics, safety, optimization, Occupational safety standards system, "man-machine-environment", technology, anthropometric indicators.

INTRODUCTION

Activity is a human-specific type of behaviour that aims to improve and modify the environment around us for the better. Labor is the highest form of activity. Labor can be described as the process of expending human labor power by linking the tools of labor with an object and transforming it into a useful output in an intentional and expedient manner (product). The main function of labor as a system is the production of consumer values. Therefore, any work is essentially productive work. But labor also has other functions related to preparation and organization, organization and optimization, process efficiency, storage and production, environmental protection. Thus, labor is a multifunctional system. This system is the subject of ergonomic research.

In any work, a person carries a muscular, mental and nervous load. But as production develops, labor conditions, the role and place of man in the labor process change, and with them the evolution and physiology of labor change. It is quite obvious that in the design, implementation and operation of systems "man-machine-environment" should take into account the real capabilities of the person who is to work in the system. An ergonomist must clearly understand the amount of permissible physical, intellectual, emotional costs that will be required to work with a specific technical system, and in accordance with this, adjust the actions of its creators: development engineer, designer, technologist.

Work safety is one of the main goals of ergonomics. In accordance with labor law, labor protection is guaranteed by a set of legal norms that establish a system of measures directly aimed at ensuring healthy and safe working conditions. The safety management system includes safety and industrial sanitation services in all sectors of the national economy. Supervision and control over compliance with the rules on labor protection is carried out by specially authorized state bodies: State Municipal Technical Supervision, State Energy Supervision, State Sanitary Inspection and others. In addition to them, this work is carried out by trade unions and the technical labor inspectorate under their jurisdiction. The supervision and control service relies on scientifically grounded, experience-tested technical requirements, which, of course, ensure the safety of workers.

In the process of development of production, the conditions, nature and content of human labor change significantly. On the one hand, wider opportunities open up for facilitating labor, freeing a person from performing monotonous, laborious manual operations. On the other hand, the rapid growth of energy, speed and other parameters of technology, an increase in the level of automation of technological processes (especially with incomplete or incomplete automation) lead to the emergence of new factors that adversely affect the human body. These include limitation of general mobility, uneven muscle load and increased labor intensity, due to the monotony of the actions performed with high requirements for the level of mental activity of a person. The negative impact of new features of the nature of labor is often aggravated by the presence of harmful factors in the working environment - intense noise, vibration, unfavorable microclimate, dust, toxic substances, etc. significant moral and material losses, the more significant, the more complex the technique and the more diverse the relationship of a person with it. Therefore, the achievements of technological progress associated with the intensive re-equipment of production, the creation of new and improvement of old technological processes and equipment, the widespread introduction of complex mechanization and automation into industry can be successfully implemented only with a sufficiently complete account of the nature of the increasingly complex connections between man and machine.

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This makes it necessary to fully take into account the capabilities of a person, his physiological, anthropometric, psychological and other properties both when designing tools of labor and when designing labor activity as a whole. The trends in the development of modern production are such that the main design difficulties are probably related to the search for ways and means of optimal interaction between man and technology. In recent years, the distribution of the causes of accidents in industry has changed. So, among the causes of severe accidents, 22% are caused by violations of the technological process by workers themselves, 19% - by gross violation of safety rules for victims, 16% - by poor organization of the workplace, 7% - by equipment malfunction and 4.3% - by poor training. Subjective causes of injuries in industry (human errors) began to dominate over objective ones (equipment malfunctions). The activity of a human operator has become so complex that it is in its organization and execution that the main causes of dangerous errors leading to injury have been concentrated. In many cases, the actions of a human operator are dangerous due to the impossibility of their correct and timely execution, due to the fact that the human factor was not taken into account in the design of technical devices.

The emergence of complex types of labor activity, especially in recent years, requiring a quick reaction, perception and other mental processes, led to the study of the psychological characteristics of labor. Human activity in the "Man - Machine Environment" system is the same subject of study and design as its technical part. The ergonomist should take into account:

- the ability of human mental processes to receive, process information and make the right decision in the specific conditions of the functioning of the system "man-machine-environment";
- the mental properties and characteristics of the operator, manifested in a tendency to more or less risky behavior;
- their ability to work in states of fatigue, emotional stress, mental tension, monotony, etc.

Materials and Methods

Ergonomics studies the problems of optimal distribution and coordination of functions between a person and a machine, designs the process of human activity, justifies optimal requirements for the means and conditions of activity and develops methods for taking them into account when creating and operating equipment controlled and maintained by a person.

The ergonomic assessment of the "man - machine-environment" system can be carried out by a differentiated method, in which separate ergonomic indicators are used, or by a complex method, in which one generalized ergonomic indicator is determined. The system is evaluated by a differentiated method using group indicators determined one by one for each of the ergonomics sections. Each of the group indicators combines a group of single ones.

There are five groups of ergonomic indicators that form the composition of ergonomics:

- anthropometric;
- hygienic;
- physiological;
- psychophysiological;
- psychological.
- The main goal of ergonomics is focused on:
- efficiency of the "man-machine-environment" system;
- work safety of the "man-machine-environment" system;
- creating conditions that ensure the development of the personality of the human operator.

The composition and structure of ergonomics consists of an anthropometric indicator, which regulates the correspondence of the machine to the size and shape of the working person's body, the distribution of his body weight, the mobility of body parts and other parameters. However, the information given in anthropometric reference books can serve only for the first, rough estimates of the dimensions of the designed product. Moreover, when designing a product, it is unacceptable to use anthropometric data from other countries due to their significant difference. The hygienic indicator characterizes the hygienic conditions of human life and working capacity during its interaction with the "man-machine-environment" system. It involves creating normal meteorological microclimate conditions in the workplace and limiting the impact of harmful environmental factors (light level, ventilation, humidity, dust, temperature, radiation, toxicity, noise and vibration, etc.). Exceeding the permissible limits for these indicators can threaten the life and health of a human operator, cause "difficult" mental states that reduce his performance. It is known, for example, that the optimal ambient temperature for human work is 18°C; when the temperature rises to 25°C, physical fatigue begins and signs of deterioration of the mental state appear (irritability,

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tension, etc.); at Z0°C, mental activity worsens, reactions slow down, errors occur; the temperature is about 50°With the operator can transfer within one hour. [4] Ergonomists distinguish comfortable, relatively uncomfortable, extreme and ultra-extreme external working environments at the operator's workplace.

A comfortable environment ensures optimal dynamics of the operator's performance, good health and preservation of his health. A relatively uncomfortable environment, acting for a certain period of time, ensures a given efficiency and preservation of health, but causes unpleasant subjective sensations and functional changes in the human operator that do not go beyond the norm. Extreme working environment causes a decrease in human performance and causes functional changes that go beyond the norm, but do not lead to pathological disorders. A super-extreme environment leads to the appearance of pathological changes in the human body and (or) to the inability to perform work.

Physiological and psychophysiological indicators characterize those ergonomic requirements that determine the correspondence of the "man-machine-environment" system to power, speed, energy, visual, auditory, tactile, olfactory capabilities and human characteristics. At the same time, in the design process, it is necessary to clearly represent the age, sex, psychological and other characteristics of the operators of a particular system "human-machine-environment". On the basis of numerous experimental data, for example, the ergonomic requirements of Interstate standard 21829-88 "Coding of visual information" were formulated, according to which the minimum permissible brightness of color signs should be 10 cd / m2, the recommended value is 170 cd / m2, the optimal angular value of a color mark, etc.

The ergonomic requirements of Interstate standard 21752-86 "Control handwheels and steering wheels" follow from the experimentally established maximum arm forces at various angles of bend at the elbow. For example, with the extended right hand, the operator can pull the handle with a force of up to 22 kg, push from himself-up to 20 kg, squeeze up - up to 5.5 kg, pull down-up to 7 kg, and etc. During the design process, it is necessary to clearly represent the age, gender, psychological and other characteristics of the operators of a particular "man-machine-environment" system. So, with age, sensitivity to light sharply decreases: the need for illumination in a person of 30 years of age is twice, in a 40-year-old three times, and in a 50-year-old six times more than in a 10-year-old. It follows that if a 30-year-old operator has enough illumination of 1000 lk for the most accurate perception of details, then a 50-year-old needs about 2000 lk to create similar conditions. [6] A psychological indicator that reflects the machine's compliance with the capabilities and features of perception, memory, thinking, psychomotor skills, fixed and newly formed skills of a working person, the degree and nature of group interaction, the mediation of interpersonal relations, the content of joint management activities of the "man - machine-environment"system.

The analysis of many operator errors that lead to stops or accidents of the "man - machine-environment" system shows that 50% of them are based on an underestimation of the psychological group indicator, 22% - psychophysiological, 6% - physiological,19% - hygienic and 3% - anthropometric. This determines the prevailing volume of psychological research in the process of ergonomic study and evaluation of industrial products and their great influence on the composition and structure of ergonomics.

Ergonomic requirements are provided for by relevant regulatory documents, most often standards. Standardization is the best way to effectively implement the results of ergonomic research into production practice, which ensures the breadth and scale of such implementation. The standards have the force of law, and this guarantees that ergonomic requirements must be taken into account when designing buildings, equipment and technological processes.

Standardization in the field of ergonomics is organically connected with the System of Occupational Safety Standards (SOSS). Currently, more than 250 standards of this system have been put into effect. Many of them contain the requirements of ergonomics. Examples are Interstate standard 12.2 009-80, Interstate standard 12.2 031-78, Interstate standard 12.2 046-80, which include requirements for controls and information display tools for metalworking machines, woodworking, printing equipment, as well as equipment for the textile and light industry, foundry production, etc.

Results

It should be noted that ergonomics finds in standardization an effective means of managing the design and creation of equipment and the conditions for its functioning, so that they ensure high efficiency of human activity and at the same time contribute to its comprehensive development, provide comfort and safety, preserve its health and efficiency.

Ergonomics, exploring the relationship between the components of the human-machine system, serves not only

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to increase the productivity, reliability and efficiency of technology, but also contributes to achieving the necessary social results - preserving people's health and personal development in the process of work, increasing the content, efficiency and quality of human activity wherever a person has to come into contact with technology. In other words, ergonomics plays an important and increasing role in ensuring occupational safety by creating convenient and reliable equipment in operation.

As mentioned above, ergonomics is not only influenced by the sciences associated with it, but it has already begun to influence them in the field of theory, methods and practice. The most pronounced influence of ergonomics on those sections of related sciences that relate to human labor activity and mainly to their applied aspects. In this sense, ergonomics is related to the scientific organization of labor, which implements ergonomic requirements in the current production.

Conclusion

The optimal use of technical means by a person in line with their purpose is determined by a sensible combination of human capabilities and machine characteristics, as well as the corresponding distribution of functions within the system. The application of ergonomics data and the completion of the researcher's tasks in the design, creation, and operation of various types of technical systems and machines contribute to the achievement of high production efficiency and the creation of safe conditions for human activity. Ergonomic research and the implementation of their results in various areas of industrial production, construction, transport, energy, agriculture can achieve a tangible socio-economic effect, lead to a significant increase in labor productivity and improve the quality of industrial products at relatively low costs. At the same time, taking into account the human factor turns from a one-time resource into a permanent and significant reserve for increasing the efficiency of social production.

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