Analysis of the dynamic growth of the hazardous industry development index and ways to reduce industrial accidents

A Kostrov, E Staseva, M Molev, I Kokun'ko, N Merenkova, K Kobzev*
Don State Technical University, Rostov-on-Don, Russia

*e-mail: 5976765@mail.ru

Abstract. Labor protection is a system of ensuring the safety of life and health of workers in the process of work, including legal, socio-economic, sanitary and hygienic, psychophysical, treatment and prophylactic, rehabilitation and other measures. The functions of labor protection are the study of sanitation and occupational hygiene, the implementation of measures to reduce the influence of harmful factors on the body of workers in the process of work. The main method of labor protection is the use of safety measures. At the same time, two main tasks are solved: the creation of machines and tools, when working with which the danger to humans is excluded, and the development of special protective equipment that ensures human safety in the labor process, as well as training workers in safe working practices and the use of protective equipment, conditions are created for safe work.

The main goal of improving working conditions is to achieve a social effect, i.e. ensuring labor safety, preserving the life and health of workers, reducing the number of accidents and diseases at work.

Improving working conditions also yields economic results: an increase in profits (due to an increase in labor productivity); reduction of costs associated with compensation for work with harmful and difficult working conditions; reduction of losses associated with injuries, occupational morbidity; decrease in staff turnover, etc. The main document in the normative and technical documentation is the normative act "Occupational safety standards system".

1. Introduction

Initial instruction at the workplace is carried out for all those accepted to the enterprise before the first admission to work (including business travelers, students who arrived for practice, graduate students, interns), as well as when transferring from one department to another.

Initial instruction at the workplace is carried out with each employee individually with a practical demonstration of safe practices and methods of work. It is allowed to conduct such a briefing with a group of workers serving the same type of equipment within a common workplace.

The purpose of such instruction is to study specific requirements and safety rules for specific equipment when performing a specific technological process.

All workers, after the initial instruction at the workplace, must undergo an internship within 2-14 shifts under the guidance of a person appointed by order (order) for the shop (site, etc.). Workers are allowed to work independently after an internship, verification of knowledge and acquired skills in safe ways of working.

Initial briefing at the workplace is carried out according to the program approved by the head of the organization. Re-instruction is carried out at least once every six months, and for high-risk jobs - once
a quarter according to the program of initial instruction at the workplace or according to instructions on labor protection for professions and types of work.

The purpose of this briefing is to restore labor protection rules in the employee's memory, as well as to analyze the violations of safety requirements in the practice of the enterprise.

2. Methods

Unscheduled instruction is carried out when:

- adoption of new regulatory legal, technical acts, standards, rules, instructions, as well as changes and additions to them;
- changes in technological processes, replacement or modernization of equipment and other factors affecting labor protection;
- for work interruptions for 60 calendar days, and for works subject to additional (increased) safety requirements, for more than 30 days;
- in case of violations by employees of normative, technical legal acts on labor protection, which led or could lead to an accident, industrial accident and other serious consequences;
  - during breaks in work by profession (in position) - more than 6 months;
- upon receipt of information materials on accidents and accidents that have occurred in one-profile organizations;
- at the request of the supervisory authorities.

Unscheduled instruction is carried out individually or with a group of people working in the same profession (position).

Target instruction is carried out when:

- performing one-time work not related to direct duties in the specialty (loading and unloading, cleaning the territory, etc.);
- elimination of the consequences of accidents, natural disasters and catastrophes;
- the production of work for which a permit is issued; conducting excursions in the organization; organization of mass events with students (excursions, hikes, sports competitions, etc.) (Fig.1).

![Figure 1. The number of injuries at work (blue graphite - the number per 1000 employees, the red graph - the number of 1000 people)](image)

The briefing ends with a test of knowledge by oral questioning or with the help of technical training aids.
Registration of target instruction in a separate journal is allowed.

Registration of briefings. Primary, repeated, unscheduled and targeted briefings are carried out by the immediate supervisors of the work (foreman, industrial training instructor, teacher). Conducting primary, repeated, unscheduled, targeted briefings and internships is confirmed by the signatures of the persons who conducted and received the instruction (internship), in the register of instruction on labor protection or in the personal training card (if applicable).

Targeted briefing with workers carrying out work on a permit, permit, etc. (provided for certain types of work of increased danger), is recorded without fail in a work permit, permit or other document authorizing the work.

When registering an unscheduled briefing, the reason for its conduct is indicated in the briefing log. The introductory briefing logs and the labor protection briefing log should be numbered, laced and sealed. The register of the introductory briefing is certified by the signature of the head of the organization or a person authorized by him.

The retention period of the named journals is 10 years from the time of the last entry.

The most important factors from the point of view of the psychophysiological capabilities of a person, affecting safety, are the type of work activity, its severity and intensity, as well as the conditions in which work is carried out.

Physical labor is characterized by increased muscular load on the musculoskeletal system, on the cardiovascular, neuromuscular, respiratory systems, etc. It develops the muscular system, stimulates metabolic processes in the body, but at the same time it can have negative consequences, for example, cause diseases of the musculoskeletal system with improper organization and excessive intensification of the work process. Today, purely physical labor is rare.

The modern classification of labor activity identifies the following forms of labor.

Mechanized labor - requires less energy and muscle loads, but is characterized by high speed and monotony of human movements.

After the end of work, the restoration of body functions to normal occurs quite quickly. With a disease of the body or in the absence of skills in work, this recovery slows down.

Labor on a conveyor belt is characterized by an even greater speed and uniformity of movements, the time of the operation is strictly regulated. In combination with significant nervous tension, high speed of work and monotony, work on an assembly line leads to rapid nervous exhaustion and fatigue.

Work on semi-automatic and automatic production consists in periodic maintenance of mechanisms when performing simple operations. It requires less energy and stress compared to working on a conveyor belt.

Mental work is associated with the reception and processing of information, it requires tension of attention, memory, activation of thinking processes, is characterized by increased emotional stress and decreased motor activity. Prolonged mental stress has a negative effect on mental activity - memory, attention, functions of perception of the environment deteriorate (Fig.2).

Forms of intellectual work: operator, managerial, creative, work of teachers, doctors, students.

The work of students is characterized by the tension of the main mental functions - memory, attention, the presence of stressful situations associated with exams, tests, tests.

Creative work (the work of scientists, writers, artists, designers, composers) is the most complex form of mental activity, it requires significant neuro-emotional stress. The solution of labor protection tasks is unthinkable without taking into account the physical capabilities of the employee, his working capacity, the ability to work without injuries and accidents.

A person's performance depends on many factors: on the level of his development, his mood, emotional state, will, work attitudes, motivation, on the organization and working conditions.

A decrease in working capacity resulting from the performance of a particular work, and the complex of sensations associated with this, is called fatigue.

Fatigue is a physiological state of the body, characterized by a number of objective signs: an increase in blood pressure, a decrease in blood sugar, a decrease in labor productivity, a deterioration in subjective sensations (unwillingness to continue working, fatigue, etc.).
If during the time set for rest after work, the ability to work is not fully restored, fatigue sets in. Fatigue occurs most quickly during monotonous work. It is possible to reduce the impact of monotony of work on a person by making each operation more meaningful, combining operations into more complex and varied ones. The duration of the operation should be at least 30 s, the loads on various sensory organs and parts of the body should be alternated. It is advisable to use the free tempo of the conveyor; transfer workers from one production operation to another; establish a variable rhythm of the conveyor during the working day (work shift). The use of optimal modes of work and rest during the working day (work shift), the appointment of short additional breaks, adherence to the aesthetics of production and the implementation of functional musical design of the production process will help reduce the monotony of work and fatigue.

Along with passive rest, to prevent fatigue during labor, active rest is used - industrial gymnastics, physical culture breaks.

The onset of nervous (mental) fatigue, in contrast to physical (muscle) fatigue, does not lead to an automatic cessation of work, but only causes overexcitation, neurotic changes, and sleep disturbance. Activities with a predominance of physical labor require shorter, albeit more frequent rest. The recovery period after physical work is more intensive and ends in a relatively short time. Nervous fatigue occurs mainly due to haste, excessive stress, hearing and vision, memory and mental activity. At the same time, mental work, surprisingly, proceeds very economically, with relatively little energy consumption. By itself, it is not very tiresome.

It follows from this that moderate (not very strenuous) mental work can be performed for quite a long time without a break for rest. However, people who are predominantly engaged in mental work need a longer rest periodically.

The workplace of a person of predominantly mental work should be comfortable in all respects. The microclimate, lighting, coloring of the room must correspond to the optimal conditions. At the same time, it is necessary to eliminate such unfavorable factors as monotony in work, noise, vibration, etc (Fig.3).
3. Results

To create comfortable and safe working conditions, it is necessary to comprehensively study the man-machine-work environment system, which are closely interconnected and affect the safety, productivity and health of a person.

Ergonomics is a scientific discipline that comprehensively studies a person in the specific conditions of his activity in modern production.

Many factors act on a person in the labor process: the type of labor activity, its severity and intensity, the conditions in which it is carried out (harmful substances, radiation, climatic conditions, illumination, etc.), the psychophysiological capabilities of a person (primarily the anthropometric characteristics of a person, the speed of reactions to various stimuli, features of human perception of color, etc.). In order for the human-machine system to function efficiently and not cause damage to human health, it is necessary, first of all, to ensure the compatibility of the characteristics of the machine and the person. A person’s compatibility with a machine is determined by his anthropometric, sensorimotor, energy (biomechanical) and psychophysiological compatibility.

Anthropometric compatibility involves taking into account the size of the human body, the ability to view the external space, the position (posture) of the operator during work.

4. Discussion

Sensomotor compatibility involves taking into account the speed of motor (motor) operations of a person and his sensory reactions to various types of stimuli (light, sound, etc.) when choosing the speed of the machine and giving signals.

Energy (biomechanical) compatibility implies taking into account the power capabilities of a person when determining the efforts applied to the controls.

Psychophysiological compatibility should take into account the human reaction to color, color gamut, frequency range of supplied signals, shape and other aesthetic parameters of the machine.
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