LIFE SAFETY

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MINIMIZATION OF HAZARDOUS AND HARMFUL FACTORS AT MACHINE-BUILDING FACTRIES DURING PRODUCTION PROCESS

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Abstract. An assessment of the state of labor safety at machine-building factories is given. Scientific publications' analysis on this topic is carried out. The methods of empirical material research are proposed. The main causes of occupational injuries are identified and their classification is given. Recommendations for reduction of hazardous and harmful factors during production porcess are given.

Keywords: machine-building factories, occupational injuries, labor safety, hazardous and harmful factors.

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Introduction

Minsk Tractor Works (MTW) – machine-building enterprise in the Republic of Belarus. It is one of the leading enterprises in the country in terms of growth and development, and is the largest exporter of agricultural machinery to the CIS countries.

At MTW most workplaces are automated, which reduces occupational injuries, but it is yet impossible to completely get rid of manual processing.

The purpose of the work is to minimize harmful and hazardous factors of the production process using the aforementioned machine-building enterprise.

To achieve this goal, the following tasks were set and solved:

1. Assessment of the state of labor safety at a machine-building enterprise.
2. Identification of harmful and hazardous factors at a machine-building enterprise.
3. Determination of the main ways to minimize harmful and hazardous factors during production process at a machine-building enterprise.

Research methods: theoretical analysis of scientific publications, a method of generalizing empirical material and applying the information obtained in relation to new material, methods of data classification and comparative analysis.

The most common injuries, that occur at machine-building enterprizes are mechanical (cuts, fractures, chips in the eye, etc.). However, due to the peculiarities of production, thermal, electrical, and chemical injuries are also possible [1–3]. The most harmful and hazardous factors affecting the workers of the mechanized metalworking and assembly shop of a machine-building enterprise are presented in table 1.

Table 1

Analysis of the hazardous factors for a mechanized processing shop employee

Technological operation	The nature of the formation of hazardous production factors	Harmful / hazardous factor
Smelting of a metal blank	Melt formation, combustion of flammable slag, transportation of the ladle pot with melt	High temperature, infrared radiation, carbon and nitrogen oxides, smoke
Blank formation	Operation of a metal rolling machine, transportation of hot metal sheets	Vibration, high temperature, infrared radiation, moving structural elements
Gas welding / gas cutting of rolled sheets	Heating of the weld material, burnout of welding additives, heat sink of the weld, sparks, the possibility of explosion of gas welding cylinders	Smoke, zinc and lead aerosols, high temperature, sparks, carbon monoxide, shock waves
Parts soldering	Melting of the flux, high temperature	Toxic aerosols, high temperature
Mechanical processing of a part on a milling machine	Friction of machine parts, moving machine elements, chip formation	Vibration, noise, moving machine elements
Lathe processing	Rotating parts of the machine and structures, scattering of sparks and chips	Vibration, noise, moving machine elements

As can be seen from table 1, the most dangerous factors are exposure to high temperatures, moving machine elements, noise and vibration.

An analysis of scientific publications in the field of current means of protection against vibration has shown that, first of all, it is necessary to reduce vibration at the source of its occurrence and on the path of its spread. If that is not enough, then the employees must be provided with personal protective equipment [4, 5]: special micropore shoes, mittens and vibration-proof suits. The most common way is to install machines on resilient supports (shock absorption). Based on the analysis of the types and properties of shock absorbers, table 2 was compiled.

Table 2

Advantages and disadvantages of shock absorbers

Advantages	Disadvantages
Maximum mitigation degree of external dynamic loads	Effectivness only in a certain temperature range
Cost-effectiveness in manufacturing and operation	High frequency of intrinsic vibrations
Minimal size and weight	Insufficient internal damping
Some types of shock absorbers can be used to protect against both low and high frequencies	Quick material deterioration

Considering the data presented in the table 2, one is ought to choose shock absorbers based on specifics of work.

Analysis of the impact of noise on workers of machine-building enterprises has shown that the main source of noise in machine assembly shops are hand tools, pneumatic tools, ventilation systems and moving parts of pipelines. One of the ways to reduce the noise level is the use of personal protective equipment [4, 5]. A simple and low-cost, but very effective way is to conduct periodic inspections in order to identify tools that require repair and regulation. If it is impossible to reduce the noise directly, the energy of reflected waves should be reduced instead by using acoustic padding: separate sound absorbers are installed in the room and sound-absorbing cladding is placed on the inner surfaces.

The study of scientific publications, as well as work experience at a machine-building enterprise, allowed us to identify the following main causes of injuries [1–5]:

1. Organizational causes:

– absence or poor-quality training on occupational safety, lack of supervision, violation of the requirements of instructions, rules, norms, standards;

– failure to comply with labor safety measures, violation of technological regulations, rules of vehicles, tools and equipment operation, insufficient technical supervision of work;

– the unintended use of equipment, mechanisms and tools.

2. Technical causes:

– malfunction of equipment, mechanisms and tools;

– technological processes imperfections, equipment design flaws.

3. Sanitary and hygienic causes:

– high concentration of hazardous substances in the air, insufficient or irrational lighting;

– high level of noise and vibrations;

– dangerous amounts of dust in the air;

– poor microclimatic conditions.

4. Economical causes:

– irregular salary;

– low income;

– irregular work, the tendency to do overtime.

5. Psychophysiological causes:

– work intencity and excessive severity, that leads to erroneous actions due to employees' fatigue;

– monotoneous labor;

– the sickly state of employees;

– carelessness;

– dissatisfaction with work;

– unfavorable psychological microclimate in the team.

Conclusion

1. Based on the scientific publications analysis, an assessment of labor safety at a machine-building enterprise was carried out. Organizational, technical, sanitary, hygienic, economic and psychophysiological causes of injuries at machine-building enterprises o were described. The main causes of injuries are mechanical damage (cuts, fractures, bruises, chips, etc.), exposure to high temperatures, noise and vibration.

2. The most common causes of accidents at a machine-building enterprise have been identified: violation of labor safety requirements, negligent handling of manufacturing facilities and disregard for safety regulations.

3. The use personal protective equipment is proposed, as well as integration of other measures of noise and vibration reduction, in order to minimize harmful and hazardous factors during the production process at a machine-building enterprise.

4. The implementaion of new approaches in the organizing a system of employee training and labor safety knowledge verification was recommended.

5. Taking into account the trends of scientific research in the field of occupational safety, it is advisable to use modern methods of mathematical and statistical modeling [8], as well as neural network modeling [9].

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