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DEPARTMENT OF GENERAL HYGIENE
AND PHYSICAL CULTURE

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INDUSTRIAL POISONS

Methodical recommendations for students

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This training manual contains material that reflects modern hygienic ideas about the main harmful production factors of a chemical nature - industrial poisons and methods of preventing their exposure. The data on the classification of industrial poisons, the ways of their entry and excretion from the body, the factors determining the strength of their toxic effect are presented. Information is provided on the effect of heavy metals on the body of a worker - mercury, lead, cadmium, zinc, organic solvents, toxic gases, etc.

The manual is supplied with tables, test tasks, situational tasks, a list of basic and recommended additional literature that facilitate the assimilation of the material.

Methodological manual "Industrial poisons", prepared according to the discipline "Hygiene" in accordance with the Federal State Educational Standard of Higher Professional Education for students studying in the specialty General Medicine (05.31.01).

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General information

The development of large chemistry has led to the widespread use in many industries and agriculture of various chemicals in the form of raw materials, auxiliary and intermediate products, finished products and waste products. Currently, more than 5 million chemicals are known, of which 60 thousand are widely used. 500-1000 new chemical compounds appear on the international market every year.

Metals occupy the first place among the causes of chronic occupational intoxication and the second - among the pollutants of our planet. Under the influence of the multifaceted development of technology, the number of metals used in production has increased extraordinarily. If previously used no more than half of all elements of the periodic table, now almost all elements of this system have found their place in different industries. The number of occupational poisoning by lead, mercury, chromium, Nickel, arsenic in many countries continues to grow. Workers of small enterprises in Japan for the year revealed 5.5% of cases of intoxication with lead; 7.1% - skin lesions with chromium; 8.1% - arsenic poisoning. In Belgium, an average of 195 cases of occupational lead poisoning are reported annually, and in Finland, 184 cases. The frequency of professional lead poisoning in the United States is also high.

Section of occupational health-industrial toxicology-is engaged in the study of the effects on the body of chemical harmful substances in order to create a harmless and safe working conditions, prevention, diagnosis and treatment of intoxication with industrial poisons.

Relevant specialists are carried out:

1. Hygienic examination of toxic substances.

2. Hygienic standardization of raw materials and products (limiting the content of toxic impurities in industrial raw materials and finished products, taking into account their harmfulness and danger).

3. Hygienic regulation of the content of harmful substances in the objects of the production environment and in biological media: the establishment of

maximum permissible concentrations (MPC) in the air of the working area and on the skin, maximum permissible levels (MPD) in blood, urine, hair.

Toxicological examination provides for the determination of lethal doses and concentrations at different routes of administration, adequate ways of receipt of poisons in production conditions, the calculation of footwear (approximately safe levels of exposure), threshold concentrations.

Hygienic regulation of new chemicals introduced into production is carried out in stages (Annex 1). Initially, the shoes are installed on the physico-chemical constants, indicators of acute toxicity. Then. based on the comprehensive Toxicological study substances substitute EQS. The basis for the justification of MPC values is the determination of threshold concentrations. Macs are subject to adjustment by a comparative study of working conditions in the workplace and the health of workers.

To assess the toxic effect, the following indicators are used:

1. Reflecting the General condition of the body (evaluation of the functional state of the Central nervous system), the study of efficiency, respiratory function, etc.
2. Identifying the functional state of individual organs and systems.
3. Indicators of biochemical systems (activity enzymes)
4. Morphological parameters.

Currently, the maximum permissible concentrations of 646 substances have been developed and approved for the air of the working zone of industrial enterprises. According to the who definition, the maximum permissible concentrations of harmful substances in the air of the working area are concentrations that, with daily (except weekends) work for 8 hours or other duration, but not more than 41 hours per week, during the entire working experience, are not able to im and. diseases or abnormalities in the state of health detected by modern methods of research in the process of bat and long-term life of the present and future generations.

Biological MAC - is the level of harmful substances min products of its

transformation in the body of workers or the level of the biological response of the most affected system of the body, MRI which directly in the process of exposure or in the long term of life of this and subsequent generations will not arise diseases or abnormalities in health, determined by modern methods of research.

Industrial poisons are chemical substances that are in a production environment failure to comply with sanitary norms and rules can cause a disruption of the normal functioning of the body, to cause acute and chronic poisoning, and present a list of industrial poisons has several hundreds of toxic compounds. Some of them are highly toxic. Less toxic are dangerous to human health due to high resistance, ability to accumulate, widespread in the environment. Individual substances can turn into more toxic compounds. Thus, the possibility of environmental pollution by chemicals, including industrial pollution, is increasing.

The main criteria for the classification of industrial poisons

1. Chemical principle:

1.1. Organic.

1.2. Inorganic.

1.3. Organometallic (organometallic).

2. In terms of impact on the body: toxic, irritant, sensitising, carcinogenic, mutagenic, gonadotropic actions.

3. By degree of toxicity:

3.1. Extremely-

3.2. Highly-

3.3. Moderately-

3.4. Low-toxic.

4. According to the degree of danger:

4.1. Extremely —

4.2. Highly

4.3. Moderately-

4.4. Low-risk.

5. Depending on the distribution of poisons in tissues and cell penetration:

5.1. Electrolytes.

5.2. Nonelectrolytes.

6. The degree of interaction with the body:

6.1. Reacting.

6.2. Nonreactive.

Ways of penetration of poisons into an organism:

1. Through the airway.

2. Gastrointestinal tract.

3. Intact skin.

The distribution of poisons in the body varies. Some of them are capable of predominant penetration into certain tissues. Poisons - faster-electrolytes penetrate the cell, as it is better soluble in lipids. Poisons-electrolytes are distributed unevenly, tend to form a depot. Lead is mainly deposited in the bones, manganese in the liver, mercury in the kidneys. Once in the body, all poisons undergo various transformations. All of the organic matter susceptible to oxidation, recovery, hydrolysis, etc. do Not change its structure some inert substance (gasoline). Inorganic substances are deposited in the depot. Turning into various compounds, many poisons are neutralized. In some cases, more toxic products can be formed (methyl alcohol is converted to formaldehyde, formic acid, benzene and phenolic metabolites during oxidation).

Excretion of poisons from the body occurs through the lungs, kidneys, gastrointestinal tract, skin, as part of female milk. On the ways the allocation of can also manifest toxic action of poisons (kidneys are affected in cases of poisoning by corrosive sublimate, with mercury intoxication may occur stomatitis).

The factors that determine the strength of the toxic action of poisons

1. Chemical properties (structure, 'volatility, valence).

2. Physical properties (stability of the electronic structure of the atom, electron-crystal structure, polarizability, ion charge, atomic radius, etc.).

3. Density.

4. Exposure time.

5. Physiological state of the organism, resistance, age, sex, species differences, individual variability of sensitivity, biorhythms.

6. The state of the environment (temperature, relative humidity, barometric pressure, radiant energy, the presence of other combined factors).

7. The severity and intensity of the labor process.

The combined action of poisons is a simultaneous or sequential action on the body of several poisons in the same pathway. There are 3 types of combined action of chemicals: synergy, antagonism, summation.

Complex effects of poisons occurs while the receipt of poisons and the body in several ways (through the respiratory tract and gastrointestinal tract, skin).

Acute industrial poisoning is possible in emergency situations, safety violations and industrial sanitation. Occur in a short time, often instantly when inhaling large concentrations of poisons (hydrocyanic acid, carbon disulfide, methyl alcohol).

Chronic poisoning develops after a systematic long-term exposure to low concentrations or doses of harmful substances. To chronic lead poisoning, the poisons which have the property to cause pecuniary or functional accumulation in the body. Most often, production are chronic poisoning. Adaptation to poisons-a true adaptation of the body to changing environmental conditions, occurring without violations of the biological.

Long-term effects of poisons on the body: carcinogenic, mutagenic, embryotoxic, gerontogenic effects, including acceleration of the aging process of the cardiovascular system, etc.

Prevention *(see Annex 2 "*health *Measures in the workplace"). Including the following activities:*

1. Elimination of highly toxic and dangerous substances, their replacement with less toxic and less dangerous ones (elimination of mercury from the felt production, use of gasoline instead of benzene, exclusion of DDT).

2. Hygienic standardization of chemical raw materials.

3. Planning activities (removal of technological equipment in separate rooms or in the open air with the separation of buildings).

4. Health interventions include:

a) registration and investigation of causes of industrial poisoning;

b) preliminary and periodic medical examinations;

c) systematic control of the air environment and MPC of toxic substances;

d) induction training for employment;

e) rational nutrition;

e) therapeutic and preventive nutrition;

g) drug prevention;

h) compliance with additional benefits for employees.

First aid for acute intoxication is based on etiological, pathogenetic and symptomatic principles.

Determination of industrial poisons in the air of working premises

Chemical study of air production facilities is carried out at:

1. The study of sanitary working conditions.

2. Investigation of the causes of industrial poisoning

3. Check the effectiveness of sanitary measures-ventilation, sealing equipment

The objective of the study in all cases is the qualitative detection and quantitative determination of air pollutants toxic substances.

Currently, the following air sampling methods are used:

1. Suction.
2. One-stage.

Aspiration-methods of sampling, which are based on the stretching of air through the absorbing medium, capable of detaining the substances to be determined.

Vacuum method. In the vessel intended for sampling, a vacuum of air is created and in the place where it is necessary to take a sample, the vessel opens. Used gas pipettes, hermetically sealed on both sides of the bottle.

In recent years, preference is given to the method of sampling in bags of polymer film of any volume or 1 to 1000 liters, equipped with rubber hoses with screw clamps.

Air sampling in the sorbent. Solid sorbents (silica gel, activated carbon), zeolites, polymeric and non-porous sorbents are used. For trapping from the air of fine particulate fumes, mists, dust and apply different filter fiber materials.

Methods of analysis of air samples are divided into qualitative and quantitative.

The qualitative include optical methods:

1. Titrations.
2. Calorimetric.
3. Nephelometric.

To determine the quantitative content of harmful substances in the air, the following methods are used:

1. Optical (spectral, spectrophotometric, luminescent).
2. Electrochemical.
3. Chromatographic.
4. Atomic absorption method neutronactivation, mass-spectrometric, radiometric, laser and other modern methods of analysis.

Express methods are used to quickly solve the issue of the degree of air pollution. They are based on color reactions. Gas analyzers with indicator tubes are used. By changing the color of the indicator tube determine the composition of air samples. Currently, indicator tubes are produced, designed to detect more than 40 pollutants. In addition, devices are used - automatic analyzers, in which air sampling, analysis of the harmful substance content, issuance and recording of the analysis results are carried out automatically.

CONTROL QUESTION

1. The main tasks of industrial toxicology.
2. What is the maximum permissible concentration of harmful substances in the air?
3. Classification of industrial poisons.
4. Ways of penetration and elimination of toxins from the body. Which way is the most dangerous?
5. The fate of poisons in the body.
6. What determines the effect of poisons on the body?
7. Combined effect of poisons.
8. Features of clinical course and prevention of professional intoxication with individual poisons (lead, mercury, carbon monoxide, organic solvents, etc.).
9. To characterize the methods of air sampling for the analysis of toxic substances.
10. What methods of research of toxic substances are qualitative?
11. To transfer quantitative methods for determination of industrial poisons. Which of them are the most sensitive?