OCCUPATIONAL HYGIENE

(COURSE OF LECTURES FOR MEDICAL STUDENTS)

Ministry of Education and Science of Ukraine

Sumy State University

Medical Institute

Halushko N. A.

Occupational Hygiene

(Course of lectures for medical students)

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Approved at the meeting
of the Department of Public Health
as Course of lectures.
(minutes № 10 of 15.04.2023)

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Occupational Hygiene: course of lectures / compiler N. A. Halushko. – Sumy: Sumy State University, 2023 – 61 p.

Department of Public Health of Medical Institute

The course of lectures deals with the problems of health of employees of production enterprises, the hygienic basis of creating favorable working conditions, as well as the principles and methods of prevention of occupational diseases and overfatigue were considered.

Made in accordance with the Program on Hygiene and Ecology, approved by the Ministry of Education of Ukraine.

У курсі лекцій розглянуто проблеми стану здоров'я працівників виробничих підприємств, гігієнічні основи створення сприятливих умов праці, а також принципи й методи профілактики професійних захворювань та попередження перевтоми.

Укладено відповідно до програми з гігієни та екології, затвердженої Міністерством освіти і науки України

Content

Occupational health and safety

Index of development of human potential is the basic criterion of work conditions and life quality. In developed countries laborer's health is considered as an indispensable condition of production, quantity and quality of made production. Health of the work and services producer is economic potential of the country. Expenses for indemnification and insurance payments are huge and not effective, in a morbid society there cannot be a healthy economy and business. Primary prophylaxis of a professional pathology is not only humane, but also the most economical way of society development.

Occupational health and safety is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goal of all occupational health and safety programs is to foster a safe work environment. As a secondary effect, it may also protect co-workers, family members, employers, customers, suppliers, nearby communities, and other members of the public who are impacted by the workplace environment. It may involve interactions among many subject areas, including occupational medicine, occupational (or industrial) hygiene, public health, safety engineering, chemistry, health physics, ergonomics, toxicology, epidemiology, environmental health, industrial relations, public policy, industrial sociology, medical sociology, social law, labour law and occupational health psychology.

The International Labour Organization (ILO) and the World Health Organization (WHO) have shared a common definition of occupational health. The definition reads: "Occupational health should aim at: the promotion and maintenance of the highest degree of physical, mental and social well -being of workers in all occupations; the prevention amongst workers of departures from health caused by their working conditions; the protection of workers in their employment from risks resulting from factors adverse to health; the placing and maintenance of the worker in an occupational environment adapted to.

Workers represent half the world's population and are the major contributors to economic and social development. Their health is determined not only by workplace hazards but also by social and individual factors and access to health services. Despite the availability of effective interventions to prevent occupational hazards and to protect and promote health at the workplace, large gaps exist between and within countries with regard to the health status of workers and their exposure to occupational risks. Still only a small minority of the global workforce has access to occupational health services. Increasing international movement of jobs, products and technologies can help to spread innovative solutions for prevention of occupational hazards, but can also lead to a shift of that risk to less advantaged groups. The growing informal economy is often associated with hazardous working conditions and involves such vulnerable groups as children, pregnant women, older persons and migrant workers.

"Plan of Action on Workers' Health" for the period 2015-2025 by WHO deals with all aspects of workers' health, including primary prevention of occupational hazards, protection and promotion of health at work, employment conditions, and a better response from health systems to workers' health. It is underpinned by certain common principles. All workers should be able to enjoy the highest attainable standard of physical and mental health and favorable working conditions. The workplace should not be detrimental to health and wellbeing. Primary prevention of occupational health hazards should be given priority. All components of health systems should be involved in an integrated response to the specific health needs of working populations. The workplace can also serve as a setting for delivery of other essential public-health interventions, and for health promotion. Activities related to workers' health should be planned, implemented and evaluated with a view to reducing inequalities in workers' health within and between countries. Workers and employers and their representatives should also participate in such activities.

The main objectives of the "Plan of Action on Workers' Health**"** are to:

- Strengthen the governance and leadership function of national health systems to respond to the specific health needs of working populations.

- Establish basic levels of health protection at all workplaces to decrease inequalities in workers' health between and within countries and strengthen the promotion of health at work.

- Ensure access of all workers to preventive health services and link occupational health to primary health care.

- Improve the knowledge base for action on protecting and promoting the health of workers and establish linkages between health and work.

- Stimulate incorporation of actions on workers' health into other policies, such as sustainable development, poverty reduction, trade liberalization, environmental protection and employment.

The physiology and hygiene of work are integrated into one concept – occupational hygiene.

Occupational hygiene is a science about population health maintenance, methods and ways of its improvement, prolongation of the active period of live ability and life quality. It concerns to preventive medicine. Realization of these positions is making through system of nation-wide, public, individual actions on the basis of legislative support of the State. A subject of studying in occupational medicine – conditions of work process, and object of supervision – human organism in interrelation with working conditions, character of work. Worker's health, changes in functional systems, workability is studied. Questions of somatic and mental health in different modes of work, processes of tiredness and their prophylaxis are considered.

The purpose of studying – to promote an efficient use of physical and mental opportunities of the person, modern methods and technologies of work for increase of work productivity, quality of production at the least economic expenses and social loss.

Tasks of occupational medicine: a qualitative and quantitative assessment of influence of concrete conditions and work kinds on physiological, mental functions of human organism; development of improving and preventive actions.

The medicine of work is conditionally subdivided into the general and particular. The general medicine of work studies the general laws of influence of negative industrial environment and work process factors, their combinations on an organism. Large, independent sections of the general occupational medicine are physiology of work, psychology of work, hygiene of work, industrial sanitary, a work safety. The particular medicine of work in a complex study influence of conditions and character of work process on worker's health, their work capacity and workability in separate sector of the national economy. Methods of research in occupational medicine are subdivided on subjective, objective and complex. Subjective methods are visual supervision, descriptions of objects, questionings, materials and reports of public organizations. Objective methods: tool measurements of industrial environmental parameters; timing of day and operations; work productivity; changes of physiological reactions; physical and mental tiredness; studying of common and professional sickness rate; traumatism; temporary and long-term effects; mathematical methods of medical statistic; results of experimental researches; clinical supervision; the data of medical periodic surveys; mathematical modelling and forecasting on the basis of computer programs; databank of monitoring.

Workload types, fatigue, and overfatigue. Work depending on size of muscular and nervous loading is classified in to light, moderate, heavy and very heavy (table 1).

Fatigue is defined as a physiological state of reduced mental or physical capability, which may develop as a result of increased workload. Fatigue (tiredness) is the physiological process based on protective inhibition. It develops in central nerve's system and reflects the ratio of the processes of excitation and inhibition in brain cortex (dominance of protective inhibition). It is subjectively perceived as weariness with deterioration of state of health, attention decrease, infringement of coordination of movements, phenomena of palpitation, dyspnea, pains in muscles.

Tiredness is not only physiological process, but also social-and-biological ones, interrelated with factors of the industrial environment, work motivation.

Table 1 – Workload types

Workload	Examples
Light	Sitting with light manual work with hands or hands and arms, and driving; standing with some light arm work and occasional Walking
Moderate	Sustained moderate hard and arm work, moderate arm and leg work, moderate arm and trunk work, or light pushing and pulling; normal walking
Heavy	Intense arm and trunk work, carrying, shoveling, manual sawing; pushing and pulling heavy loads; and walking at a fast Pace
Very heavy	Very intense activity at fast to maximum pace

Overfatigue is a pathological condition characterized by persistent decline of working capacity. Overfatigue is regarded as risk factors of diseases of various systems of organism. Immunity activity is reduced (risk factors of development of industrial caused disease with temporal disability). Finally, these are reasons of a professional pathology of the basic four systems: musculoskeletal, peripheral nervous system, visual system and vocal apparatus.

Unlike the tiredness in overfatigue the rest period does not restore the functions. Over fatigue is a base of general and professional morbidity.

Fatigue prevention:

- rational organization of work and rest;
- mechanization and automation of productions;
- scientific organization of work;
- engineering psychology;
- an industrial design;
- industrial music;
- benevolent relations in collective.

Engineers, physiologists, psychologists, hygienists develop new kinds of machines, technological processes, improve workplaces, furniture with the purpose of production optimization, increase of its efficiency, tiredness, overfatigue and occupational diseases prophylaxis. All these changes are based on the scientifically-grounded measurements, parameters and concern to the scientific work organization (SWO). The design of the industrial equipment and the workplace organization should take into account such social factors as height and development, the nutrition status, anthropometrical and psychological features worker and youth.

Modern kinds of work are accompanied by the small mobility, the compelled body inclinations and the fixed working poses at conveyor work, at control panels, at students, doctors, teachers, at economic and bank workers. Biomechanical features of muscular skeleton system, vision and hearing are studied. The optimal pose of the person provides long, unfatiguing work, change of a pose during work is recommended for static
tension removal, positive effect give sitting - standing position changes. Long standing work with inclination of the case also is tiresome, for tension removal are entered 5–7 minutes breaks within shift. The ratio sizes of workplaces for men and women are not identical, zones of reach at them are different, according to data of anthropometrical measurements. In a modern social and economic society, the deviation from these laws is observed.

The correct organization of work process is a construction of working movements on physiologically favorable use of force, speed, harmony of the movements, the most favorable and not very exhausting working pose. Skilled qualified workers in the beginning take faster rate, then it slows down, distribute force and rate according to muscular-articulate sensation. The beginner tries to support the same rhythm, force, makes many superfluous movements with the greater amplitude, get tired faster. Change of body position at work with the help of specially designed chair is not only overstrain prophylaxis, but prophylaxis of musculoskeletal and vascular diseases also. It is offered in SWO system not only microbreaks, and two or three breaks for 20–30 minutes with use of additional means and methods for functions restoration. For example, at work with vibroacoustic subjects, machines in these breaks are used warm trays for hands for angiospasm elimination. Application of functional music not always gives a positive effect in all workers by virtue of different types of nervous system.

Besides shift breaks under the legislation daily, week, monthly, annual regimes of work and rest are established also. At a daily mode the worker should suit rationally to himself the periods of rest, high-grade sleep, with the purpose of functions restoration to the beginning of shift. During a week are allocated days with the greatest workability. It's basically Wednesday-Thursday at six- day working week. It is necessary to include purposeful physical exercises, industrial gymnastics in elements of rational work and rest.

Rather effective means of tiresomeness work reduction are industrial aesthetics, a combination of color, light, architectural and sound appearance of shops, sites, places of rest. All colors depend on influence character on human nervous system shared on three groups: stimulating, calming, neutral. The colors are used as alarm.

The essential factor is the moral and psychological climate of work collective. It is defined as satisfaction of collective members by interpersonal relations, mood, emotions. The social essence of a healthy microclimate is shown by collective stability, its solidarity, reduction of working hour's loss.

Working conditions and their classification. *Working conditions* are set of production factors influencing health and working capacity of person in the course of work.

Working conditions:

- chemical, physical, biological and psychophysiological factors of industrial environment;
- character and work organization;
- planning and sanitary-technical accomplishment of premises;
- household maintenance of workers;
- psychological climate in collective, etc.

Classification of working conditions:

Optimum (workers' health remains and preconditions for maintenance of high level of working capacity are created).

Admissible (levels of environment factors and labour process do not exceed the established hygienic norms on workplaces, possible functional changes of organism are restored to the beginning of following change and do not render adverse influence on a state of workers health and their posterity).

Harmful (presence of harmful production factors exceeding hygienic norms and having adverse effect on an organism of workers and its posterity).

Class 3.1 is the least harmful, functional changes in an organism are restored, but for longer term, instead of to the beginning of shift and increases risk of health damage.

Class 3.2 causes more stable functional changes, increases industrial-caused morbidity, easy forms of occupational diseases during work more than 15 years.

Class 3.3 is characterized by conditions which promote occupational diseases of easy and average degree with loss of professional working capacity, increase of chronic diseases caused by industrial pathology.

Class 3.4 promote heavy forms of occupational diseases with loss of the total working capacity, increase of number of chronic diseases and high level of disease with temporal loss of workability.

Dangerous (presence of dangerous production factors, which influence during a labour shift creates threat to life, high risk of development of acute professional defeats, including heavy forms). Dangerous production factor – the factor which influence for worker in certain conditions can lead to trauma, acute poisoning or other sudden impairment of health or death.

Morbidity resulting from manufacturing activity is morbidity which includes common diseases of various origin, not considered as professional. It tends to increase with the longer working experience and remains higher than in professional groups, not contacting with harmful factors.

Professional diseases (acute or chronic) are diseases of a staff member resulting from effects of harmful and/or dangerous factor of working environment and causes damage to health.

Manufacturing (production) factors classification:

Physical (temperature extremes, barometric pressure, noise, ultrasound, infrasound, vibration, infra-red, ultra-violet, laser and ionizing radiations, insufficient or blinding illumination, radio-waves, electrically charged air particles - air ions).

Chemical (organic solvents, mineral acids, caustic alkalis, formaldehyde, oxide of nitrogen, sulphur and carbon, iodine, chlorine and other industrial poisons).

Biological (insects, molds, yeasts, fungi, microorganisms-producers, live cages and disputes in preparations, activators of infectious diseases of bacterial, virus and parasitic nature, antibiotics, protein-vitamin drugs, enzymes).

Psychophysiological (weight of work (workload) and intensity of work (work tension).

The leading manufacturing factor is the factor which effect on organism is the most prominent in a case of combined influence. Harmful manufacturing factor is the factor which effect on working person may result in professional disease, decreased working efficiency or affect negatively the descendants. Dangerous manufacturing factor is the factor which effect on working person results in injury, acute poisoning other sudden abrupt health deterioration or death.

Dependently on the level of concentration and duration of exposure, harmful manufacturing factor may become dangerous.

Hygienic regulation of working condition is provided according to making of ***maximal permissible concentration*** (MPC) and ***maximal permissible level*** (MPL) that are an amounts of harmful manufacturing factors which in case of daily work for no more than 40 h per week (maximal working week) do not cause any diseases or disorders in state of health detected by modern methods of investigation throughout all working experience during work or in a far future of the present and next generations.

Health services of workers

Typical establishment on health services of workers are **medical-sanitary unit** of industrial, building and transport enterprises. They closely co-operate with the centers of hygiene, epidemiology and public health.

Structure of medical-sanitary unit:

- hospital;
- polyclinic;
- medical and medical assistant's health centers;
- children's day kindergartens;
- sanatorium-dispensary.

Medical-sanitary unit can have ground area and can be also in enterprise territory. Unlike incorporated hospital, in structure of medical-sanitary unit hospital there is department of professional pathology.

Sanitary-technical accomplishment of medical-sanitary unit includes presence of illumination, heating, ventilation, water supply and disposal.

Premises of medical-sanitary unit should be kept clean and regularly be exposed to wet cleaning with washing solutions and disinfectants. Personnel of medical-sanitary unit should observe rules of personal hygiene, safety precautions and industrial sanitation.

At the heart of health services of workers in medical-sanitary units the sectorial principal lays. A sectorial doctor serves to 1000 workers at enterprises of petroleum-refining industry and to 2000 workers at other enterprises.

Duties of sectorial doctor:

- qualified medical assistance for workers;
- organization and making of preliminary and periodic medical inspections;
- realization of dispensary supervision over a state of patients' health;
- participation in making of against-epidemic work;
- hygienic training and education.

Obligatory medical inspections are made for purpose of conservation and strengthening of workers' health, prolongation of their awake longevity.

Tasks of medical inspections:

- definition of suitability of workers and employees to work;
- maintenance of safety of work and prevention of distribution of infectious and parasitic diseases;
- revealing of persons with professional diseases or suspicion on it;
- recognition of general diseases at which work in contact to industrial harm can worsen their current;
- working out of individual medical-improving actions concerning patients or suspects on occupational disease;

- estimation of working conditions and working out of sanitary-hygienic actions directed on liquidation of reasons, causing professional disease.

Obligatory medical surveys include preliminary and periodic surveys.

To ***preliminary inspection*** are exposed all again acting on work, connected with influence of harmful substances and adverse production factors. The basic task of preliminary medical inspection is revealing of diseases, which serve as contraindication to work in conditions of the given manufacture.

Further workers in harmful conditions pass ***periodic medical inspections***. They are directed on:

- duly revealing of early stages of diseases;
- prevention of professional pathology;
- definition of professional suitability;
- realization of effective treatment-preventive measures.

Times of periodic inspections realization depend on kind of manufacture, trade and professional harms. Realization of periodic medical inspections requires participation of qualified doctor- therapist and all necessary experts and also realization of instrumental and laboratory researches should be supplied.

Hygienic characteristic of industrial enterprises

Industrial area of enterprises should have a sufficient size, range on dry, well winded and insolation field with low standing of subsoil waters. It should be located at the distance of 50-1000 m from residential area (table 2). Building density should be 20-65% of total area, gardening area – not less than 15 % of all field.

Table 2 - Sanitary classification of enterprises and sizes of sanitary-protective zones for them

Enterprises Class	Sizes of sanitary-protective zone, m	Manufactured products
I	1000	Connected nitrogen, arsenic, aniline, synthetic medical drug, cement, asbestos
II	500	Sulfuric acid, hydrochloric acid, benzene, toluene, planes, plaster, antibiotics
III	300	Ammoniac saltpeter, polystyrene, oxygen, zinc, roofing material, vaccines and serum
IV	100	Glycerin, papers, drying oils, alkaline accumulators, brick, albumen
V	50	Ready medical drugs, matches, pneumoautomatics, furniture, wall-paper, macaroni

Zones of industrial enterprise:

- area for industrial buildings;
- office buildings area;
- warehouse;

- rest zone;
- economic (household).

Enterprises required panel and sufficient areas of industrial, auxiliary and sanitary-household premises is projected. Volume of industrial premise per one worker should not be less than 15 m^3, area – not less than 4.5 m^2 at height 3.2 m. Other required premises: wardrobe; washroom; shower; rooms of personal hygiene of women; health centers; inhalator; arrangement of drinking; water supply; premises for drying and clearing of clothes and footwear; specialized laundries for washing and neutralization of overalls and footwear.

The lighting of various industrial facilities (production halls, workshops, warehouses, garages, trading floors, gas stations, construction sites, etc.) is subjected to special requirements. At industrial premises *natural* (upper, lateral and combined) and *artificial illumination* (local, general and combined) by the incandescent, fluorescent, sodium-vapour, mercury-vapour and LED lamps are arranged.

Incandescent lamps: filaments of refractory material based on tungsten emit the luminescence when an electric current passes through them. Their advantages - low cost, instant glow when turned on, do not interfere with the operation of the equipment. But nowadays the incandescent lamps are almost not used at creation of modern industrial lighting systems at all due to the number of their negative sides. They are low energy efficiency first of all (95% of the electricity is converted into heat), quick failure in conditions of heightened humidity and industrial dust, small operational potential (1 thousand hours) and, last but not least, sensitivity to voltage surges.

Mercury-vapor lamps: arc phosphor light sources. Their advantages are moderate cost, compact size. The level of their light output also intensifies in comparison to conventional incandescent lightbulbs. Disadvantages: a prolonged ignition process (attaining a maximum power in 10-15 minutes), having a monotonous, fairly loud buzz during operation, the inability to use it in lighting systems with sensors, and the use of mercury in production.

Sodium-vapor lamps: industrial arc gas-discharge sodium-based lamp. They demonstrate a relatively long services life (up to 25 thousand hours) and a high level of light output. Practically not used in modern industry because of long ignition, flicker effect, mercury content, low quality of color rendering.

Fluorescent lamps: mercury-vapor arc gas-discharge lamps. They have an affordable price, heat up insignificantly, have a high level of light output and a long service life (2–20 thousand hours). Among the disadvantages - increased chemical danger because of the mercury content, poor light quality, flickering, decreased light output in course of time. Mainly were used to create industrial ceiling light fixtures.

LED lamps are used to create a modern industrial lighting. LED lights have the following benefits:

High level of energy efficiency: Coefficient of performance of modern LED lamps is approaching 100%. When talking about the lighting conditions of large industrial zones, energy efficiency matters a lot, since the use of LED lamps will noticeably reduce spendings. Despite the low power consumption, LED lights provide a powerful light stream.

Versatility in application: LED industrial luminaires can be used in any production environment, including premises with high explosion and fire risk, high levels of humidity, dustiness, presence of temperature changes.

Safety: industrial LED luminaires are supplied with effective heat dissipation systems, which makes them firesafe. They can be used in any spaces and premises.

Comfortable and pleasing light: Depending on the light-emitting diodes used, LED lamps can produce light of different color temperatures. This allows you to create comfortable and safe lighting that contributes to boosting of work productivity and maintaining the health of the eyes.

Light sources are arranged by fixtures of direct, dispersed and reflected light. General artificial illumination of industrial premises should be dispersed.

For heating of buildings and constructions of industrial enterprises it is arranged central water supply, radiant, steam or warm-air heating. It is necessary to give preference to water or radiant heating.

Industrial ventilation. Ventilation is the act of bringing in "fresh" outdoor air or exchanging the air. Ventilation can be thought of as controlling the environment by using airflow.

General or natural ventilation is referred to as "dilution ventilation". Dilution ventilation is used to control exposure to airborne contaminants. It is commonly used to remove contaminants such as fumes, dusts, and vapours in order to provide a healthy and safe working environment. Dilution ventilation can be accomplished by natural means (e.g., opening a window) or mechanical means (e.g., fans or blowers that clear a general space).

Industrial ventilation systems are designed to move out (exhaust) and bring in (intake) a specific amount of air at a specific speed (velocity), which results in the removal of undesirable contaminants in a specific area or space. While all ventilation systems follow the same basic principles, each system is designed specifically to match the type of work and the rate of contaminant release by an industrial process.

Ventilation is considered an "engineering control" to remove or control contaminants released in indoor work environments. It is one of the preferred and more effective ways to control employee exposure to contaminants released by a process into the air.

Other ways to control contaminants include: eliminate the use of the hazardous product, substitute with less toxic products, process change, or work practice change.

There are four purposes of ventilation:

- provide a continuous supply of fresh outside air;
- remove or dilute airborne contaminants;
- reduce potential fire or explosion hazards;
- maintain temperature and humidity at comfortable levels.

An industrial ventilation system has two main parts: a fresh air supply system and an exhaust system.

In general, the supply system is a heating, ventilation, and air-conditioning system (HVAC) and consists of:

- air inlet
- air filtering equipment
- heating/cooling equipment
- fan
- ducts
- air distribution registers

The exhaust system consists of:

- an "air intake" area
- ducts to move air from one area to another
- air cleaning device(s)
- fan(s) to bring in outside air and exhaust the indoor contaminated air
- discharge stacks

There are two types of mechanical ventilation systems used in industrial settings:

- *Dilution ventilation* (general ventilation) reduces the concentration of air contaminants by mixing (diluting) the contaminated air with fresh, clean, uncontaminated air. It may also help regulate the temperature and humidity of the working environment.
- *Local exhaust* ventilation captures contaminants at, or very near, the source.

Dilution ventilation. Dilution ventilation supplies and exhausts large amounts of air to and from an area or building. It usually involves large exhaust fans placed in the walls or roof of a building. It is used to help prevent the buildup of nuisance odours, carbon dioxide, etc.

Dilution ventilation controls pollutants generated at a worksite by ventilating the entire workplace. The use of dilution ventilation distributes pollutants, to some degree, throughout the entire worksite and could therefore affect persons who are far from the source of contamination.

Dilution ventilation can be made more effective if the exhaust fan is located close to exposed workers and the makeup air is located behind the worker so that the contaminated air is drawn away from the worker's breathing zone. See Figures 1 to 4 for examples of better ventilation system layouts and Figure 5 for poor dilution ventilation design.

When used to control chemical pollutants, dilution may be limited to situations where:

- the amounts of pollutants generated are not very high,
- their toxicity is moderate,
- workers do not carry out their tasks in the immediate vicinity of the source of contamination, and
- the emission rate of contaminants is relatively uniform.

It is, therefore unusual to recommend the use of dilution ventilation for the control of chemical substances except in specific cases.

As a method for protecting workers, it is important to know that dilution ventilation:

- does not completely remove contaminants;
- cannot be used for highly toxic products;
- is not effective for dusts or metal fumes or large amounts of gases or vapours;
- -requires large amounts of makeup air to be heated or cooled;
- is not effective for handling surges of gases or vapours or irregular emissions.

As a general note, the air or "volumetric" flow rate of dilution ventilation depends largely on how fast the contaminant enters the air as well as the efficiency of the fresh air and workroom air mixing process.

It is common to use "floor" or "desk" fans as a method of ventilation or to provide comfort. Be aware that these fans typically blow the contaminant around the work area without effectively controlling it. Opening doors or windows can be used as dilution ventilation, but again, this method is not reliable since air movement is not controlled.

Local exhaust systems are used to control air contaminants by trapping them at or near the source, in contrast to dilution ventilation which lets the contaminant spread throughout the workplace. Local exhaust is generally a far more effective way of controlling toxic contaminants before they reach the worker's breathing zones. This type of system is usually the preferred control method if:

- air contaminants pose a serious health risk;
- large amounts of contaminants are generated;
- increased heating costs from ventilation in cold weather are a concern;
- emission sources are few in number;
- emission sources are near the workers' breathing zones;

In a general way, a local exhaust system operates similar to a household vacuum cleaner with the hose as close as possible to the place where dirt would be created.

A local exhaust system has five basic elements (Fig. 1):

- The "hood" or opening that captures the contaminant at the source;
- Ducts that transport the airborne chemicals through the system (exhaust air) and the air that is recirculated;
- An air cleaning device that removes the contaminant from the moving air in the system (not always required);
- fans that move the contaminated air through the system and discharges the exhaust air outdoors;
- an exhaust stack through which the contaminated air is discharged.

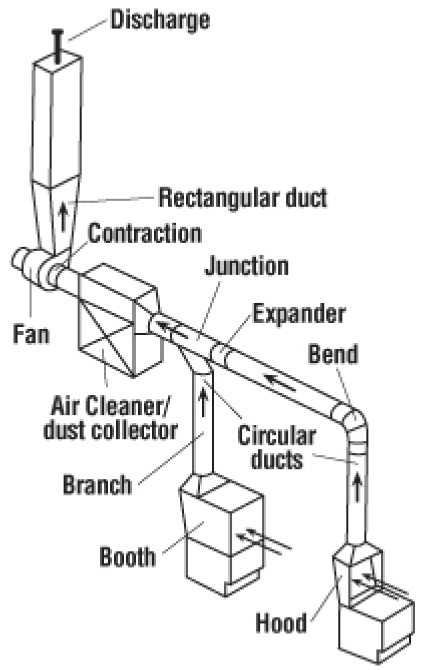

Figure 1. Structure of local exhaust ventilation

At industrial enterprises natural and artificial ventilation is applied**.** Natural ventilation is made through transoms, window leaves, exhaust canals. In industrial premises mechanical ventilation is equipped affluent, exhaust, forced-exhaust local and general (fig. 2). Delivering of outside air of 20-30 m^3/h per one worker should be organized.

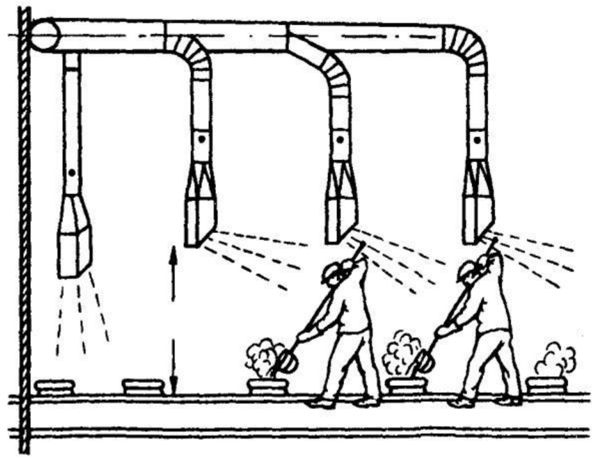

Figure 2. Ventilation system in workshop.

In some premises *air conditioning*, allowing to frame and to maintain of optimum temperature, humidity, pressure, gas and ionic composition, speed of air is recommended.

In industrial enterprises *centralized water supply* is arranged. For maintenance of optimum sanitary-hygienic and drinking regimen provide rational propagation of cold water in all premises, and hot - in all industrial, auxiliary and sanitary-household premises.

Disposal of liquid waste products of industrial premises is made according to water drain system. The sewage keeping toxicant and radioactive substances, before draining off in water drain should be exposed to pretreatment and neutralization. Solid waste products collect in metal, hermetically occluded waste containers, and regularly take out on dumps or waste process factories.

For floors, walls, ceilings and other surfaces, the materials preventing sorption and supposing regular damp and vacuum cleaning, disinfection are provided.

Equipment of industrial enterprises should have smooth surface, to be stable against chemical, medicinal and disinfectant materials, serviceable and safe. Premises and equipment should be kept clean, be exposed to regular cleaning and disinfection.

Professional diseases associated with exposure to the occupational dust

Professional diseases – diseases arising as a result of influence on an organism of harmful production factors. There are acute and chronic professional diseases.

Hygienic value of *dust* is related with its ability to render fibrogenic, toxic, irritating, allergenic, cancerogenic, radioactive actions.

Classification of dust associated professional diseases:

- pneumoconiosis (silicosis, silicatosis, pneumoconiosis from the mixed and organic dust);
- chronic bronchitis;
- diseases of top respiratory ways;
- anthracosilicosis;
- anthracotalcosis, etc.

Pneumoconiosis is a chronic lung disease caused due to the inhalation of various forms of dust particles, particularly in industrial workplaces, for an extended period of time. Symptoms are:

- shortness of breath, particularly on exertion;
- wheezing;
- chronic coughing, which may or may not be accompanied by mucus;
- fibrosis of the lungs;
- swelling in the legs due to excessive strain on the heart.

Depending upon the type of dust, the disease is given different names:

- coal worker’s pneumoconiosis (also known as "black lung" or anthracosis) - coal, carbon;
- asbestosis – asbestos;
- silicosis (also known as "grinder's disease" or Potter's rot) – silica (fig. 3, 4);
- berylliosis – beryllium;
- siderosis – iron;

- byssinosis – cotton;
- silicosiderosis - mixed dust containing silica and iron.

Figure 3. Chest radiograph at silicosis

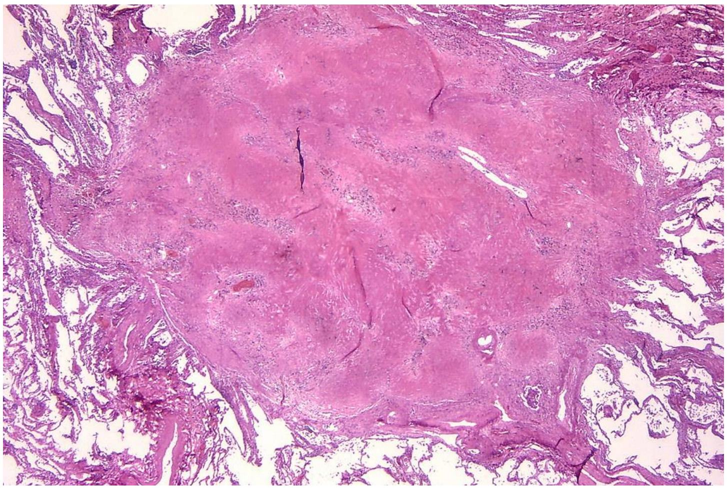

Figure 4. Silicotic nodule in lungs

In recent years, research reports on the pathogenesis of coal workers' pneumoconiosis have emerged one after another. There are several hypotheses. First, the direct toxic effect of dust on the lungs. Second, the oxidation products of pulmonary phagocytes exceed the role of antioxidants, leading to lipid peroxidation and protein nitrosylation, resulting in cell damage and finally pulmonary fibrosis. Third, alveolar macrophages and epithelial cells release active mediators, which cause the aggregation of leukocytes and phagocytes, aggravate the increase and release of inflammatory factors, and lead to lung injury. Fourth, transforming growth factors released by alveolar macrophages and epithelial cells stimulate fibroblast proliferation, which leads to pulmonary fibrosis. Researchers have found that tumor necrosis factor and transforming growth factor are related to the pathogenesis of coal workers' pneumoconiosis. In addition, the incidence rate of coal worker pneumoconiosis is related to the bioavailability of iron in coal dust. Iron activates epithelial cells, activating proteins and t-nuclear factors, which leads to inflammation and cell proliferation. Other studies have shown that silica can induce macrophages to express Fas Ligand, induce apoptosis, produce reactive oxygen species mediators and release a variety of chemical stimulating factors.

The best way to prevent pneumoconiosis is to identify work-place activities that produce respirable crystalline dust and then to eliminate or control the dust. Water spray is often used where dust emanates. Dust can also be controlled through dry air filtering.

Professional diseases associated with exposure to physical production factors

Hygienic value of *noise* – can cause defeats of an ear, nervous, cardiovascular and some other systems. Exposure to excessive noise can be unpleasant and can impair working efficiency, defeats of CNS, increase of blood pressure, decrease of pulse rate, easing of resistance of an organism. Slowing of all neural responses, shortening of the active attention duration, changes in respirations and cardiac contractions rhythm, hyper secretion of some endocrine glands, increase in sweating particularly of palms and feet, changes in motor and secretion activity of the digestive system are characterizes. Metabolism disorders, particularly in lipid metabolism, raise of cholesterol levels due to endogenous hypercholesterolemia.

Temporary or permanent hearing loss may also occur, depending on the loudness or intensity of the noise, its pitch or frequency, the length and pattern of exposure, and the vulnerability of the individual. Prolonged exposure to sound energy of intensity above 80 to 90 decibels is likely to result in noise-induced hearing loss, developing first for high frequencies and progressing downward.

Hearing disorders are included the following stages:

1st stage – hearing adaptation: hearing threshold increases by 10-15 decibels under the noise influence. Hearing threshold returns back to normal after finishing of noise in 3-5 minutes.

2nd stage – hearing fatigue: adaptation time is prolonged.

3rd stage – cochlear neuritis or occupational deafness: persistent decrease of sensitivity to different tones and whistling.

4th stage – occupational hearing loss: constant capillary spasm results in acoustic papilla atrophy.

The condition can be prevented by enclosing noisy machinery and by providing effective ear protection. There are several points to decrease the noise:

1. Hygienic regulation of noise levels (admissible level of sound and equivalent noise level of supervising, creative, scientific, pedagogical, doctor's work should be no more than 50 decibels, measuring and analytical work in laboratory – 60 decibels, dispatching work - 65

decibels, remote control by production cycles – 75 decibels, other kinds of works – 80 decibels).
2. Acoustic isolation of equipment and instruments.
3. Acoustic isolation of protecting construction, special coating of walls and ceilings.
4. Usage of silencers in ventilating systems.
5. Diminishing of noise from technique and hygienic equipment of buildings (elevators, water supply).
6. Usage of the cabins with acoustic isolation and remote control.
7. Properly arranged working pattern to limit the duration of noise exposure.
8. Usage of personal protective equipment (headphones, earplugs and helmets).

Ultrasound – bumping oscillations and waves with frequency of over 20 kHz, non -detectable by human ear. In medicine are uses low-frequency (up to 100 kHz) ultrasound waves for ultrasonic surgical equipment, sterilization of instruments. High-frequency (100 kHz – 100 MHz and higher) ultrasound are uses in medicine for diagnostics and treatment.

Biological effects of ultrasound of specialists in ultrasound diagnostic, physiotherapists and surgeons are exposed to effects of ultrasound with a frequency of 18 kHz – 20 MHz and intensity of 50-160 decibels. Hygienic value of ultrasound is ability to get into tissue of person’s body. Functional changes of central and peripheral nervous and cardiovascular systems and acoustic analyzer are characterized due to influence of ultrasound.

Health effects of ultrasound:

- effects on vestibular apparatus;
- peripheral neurovascular disorders;
- hand paresthesia;
- increased cold sensitivity;
- hands weakness and aches at night;
- decrease in tactile sensation;
- palm sweating;
- headaches;
- dizziness;
- tinnitus;
- general fatigue;
- palpitations;
- chest pain;
- sleep frustration.

In accordance with ДСН 3.3.6.037-99 «Санітарні норми виробничого шуму, ультразвуку та інфразвуку» maximum permissible levels on workplaces» the following normal values must be provided (table 3).

Table 3 — Maximum permissible levels of ultrasound in working zone

Contact ultrasouud		Air ultrasound	
Medium geometric frequencies, kHz	Levels of sound pressure, decibels	Medium geometric frequencies, kHz	Levels of sound pressure, decibels
8-63	100	12.5	80
125-500	105	16	90
>500	110	20	100
		25	105
		31-100	110

For the prevention of ultrasound negative effects needed to use personal protective equipment – two pairs of thick cotton gloves or pair of thick rubber gloves over a pair of cotton gloves.

Infrasound – acoustic vibration in the range of up to 20 Hz frequency not detectable by human ear.

*Natural Sources***.** Infrasound is generated by thunder, earthquakes, large waterfalls, ocean waves (< 1 Hz), wind (up to 135 dB at 100 km/h; up to 110 dB at 25 km/h), fluctuations in atmospheric pressure (< 1 Hz at 100 dB), and volcanos. Running generates infrasound at frequencies below 2 Hz at levels up to 90 dB; swimming also generates infrasound below 2 Hz, but the pressure is more intense (up to 140 dB).

Vehicles. Riding in automobiles exposes drivers and passengers to 1 to 20 Hz at up to 120 dB. Exposures while riding in helicopters, other aircraft, submarines, and rockets range from 1 to 20 Hz at 120 to 145 dB. In a free field, diesel engines generate frequencies of 10 to 20 Hz at sound pressure levels up to 110 dB. Jet engines, helicopters, and large rockets generate frequencies of 1 to 20 Hz at 115 to 150 dB. Infrasound levels exceeding 120 dB were found in cars and railway engines. The usual range in vehicles with closed windows was 90 to 110 dB. Infrasound sound pressure levels in aircraft cockpits and cabins ranged from 80 to 100 dB. Ships and aircraft sonic booms are other vehicular sources. In Japan, measured infrasound at 83 dB at 20 m from a running truck and 100 dB at 20 m from a running railroad carriage. Thus, persons may be subjected frequently to the annoyance of infrasound exposure if they reside in the vicinity of heavily trafficked areas, railways, airports, or rocket launch sites. Drivers, pilots, and other transportation workers are among those occupations with considerable exposure.

Therapeutic Devices. Several Russian and European publications report on therapeutic applications of infrasound. Infrasound pneumomassage at 4 Hz (daily 10-minute sessions for 10 days) stabilized the progression of myopia in school children. Infrasound phonopheresis (frequency and sound pressure level not provided) of antibacterial drugs in the treatment of patients with bacterial keratitis was as effective as local instillation of the same drugs. Thermovibration massage at 10 Hz was a useful adjunct in combined treatment of patients with chronic cholecystitis and opisthorchiasis, improving motor-evacuation function of the biliary system.

Industrial Sources. Infrasound exposure is not uncommon in the vicinity of operating heavy machinery. In a survey of industrial work sites, infrasound pressure levels usually ranged from 80 to 100 dB, significantly higher than in the vicinity of the workplace. Highest infrasound levels were produced by blowers, pumps, oil burners, air compressors, drying towers, and heavy rotating machinery. The highest level (127 dB) was measured 100 m from a crusher at a mine. Manufacturing infrasound varies in frequency from 1.6 to 20 Hz and has four octave stripes with average geometric frequencies of 2, 4, 8 and 16 Hz.

Nonlethal Weapons. The U.S. Army has an infrasound weapons program, and infrasound is being considered for riot control and other police actions. Little evidence was found that infrasound weapons are currently used beyond testing. The use of infrasound-generating nonlethal weapons is based on the assumption that high-power infrasound will incapacitate those subjected to it with nausea and other gastrointestinal disturbances. Transmission of infrasound energy through the air is not as efficient as transmission through mechanical vibrations at infrasound frequencies. One argument against the feasibility of the use of infrasound in nonlethal weapons is that infrasound's wavelengths (17 m and above) are so long that they spread out too rapidly to be focused. A device that can aim parametric infrasound without affecting the user could generate infrasound by mixing two ultrasonic acoustic waves. Such a method has been tested in Great Britain. Other infrasound-generation devices may have been used for riot control in Northern Ireland.

Other Sources. Other sources include explosions, bridge vibration, and air heating and cooling equipment. Infrasound sound pressure levels of predominantly single frequencies (i.e. tones) were low under a bridge, inside an automobile, and beside a cooling tower. Sound pressure levels were also low beside a refrigerator and inside a computer room. A washing machine in the spin cycle (dehydration process) emitted infrasound at 81 dB. Wooden houses have higher sound pressure levels (highest level > 100 dB) than concrete structures.

Ultrasound classification. According to time characteristics, infrasound is divided into:

- constant, the sound pressure level of which is on the "Linear" scale on the "slow" characteristic changes by no more than 10 dB per 1 min. observation;
- non-constant, the sound pressure level of which is on the scale "Linear" on the "slow" characteristic changes by more than 10 dB in 1 min. observation.

Normalized infrasound parameters. For constant infrasound - sound pressure levels in octave frequency bands with geometric mean frequencies of 2; 4; 8; 16 Hz in decibels. For unstable infrasound - the total equivalent sound pressure level on the "Linear" sound level meter scale in dB. For an approximate assessment of permanent infrasound, sound pressure levels are compared on the "Linear" and "A" scale of the sound level meter.

According to ДСН 3.3.6.037-99 “Санітарні норми виробничого шуму, ультразвуку та інфразвуку”. Permissible sound pressure levels in octave frequency bands with geometric mean frequencies of 2, 4, 8, 16 Hz are equal to 105 dB, the permissible total sound pressure level is 110 dBlin.

NASA established criteria for noise exposure applicable to space craft and space stations. The infrasonic, long-term annoyance noise exposure requirements stated that the infrasound sound pressure level in natural and induced environments SHALL be less than 120 dB in the frequency range 1 to 16 Hz for 24-hour exposure. WHO and U.S. EPA did not give any guidance for an upper limit to infrasound exposure. The "therapeutic" infrasound devices would be subject to regulation by FDA (Federal Food Drug and Cosmetic) act as products meeting the definition of electronic product radiation. According to Section 532 of the Act "the term 'electronic product radiation' means any sonic, infrasonic, or ultrasonic wave, which is emitted from an electronic product as the result of the operation of an electronic circuit in such product".

Health effects. Infrasound leads to changes in nervous, cardiovascular, respiratory, endocrine and other systems of an organism. Weakness, fast fatigue irritability, working capacity decrease, vestibular infringements, visual acuity and hearing decrease, headache and dizziness, nausea, shakes and shivering, aches during swallowing, mouth dryness, numbness of palate and facial skin, nervous and psychic disorders (fear, anxiety, cenesthopathy) are characterizes.

It was shown a low-frequency noise of ~7 Hz occurring in several office rooms produced symptoms in individuals typical of sick building syndrome, demonstrating that the low-frequency component of ventilation noise can be amplified in tightly sealed rooms. It was proposed that repeated or long-term exposure could be "triggering an allergic-type response." Another study of 1063 residents in multifamily buildings in Sofia, Bulgaria, experiencing noise level above 60 dBA and infrasound levels from 55 to 78 dB found a statistically significantly increased percentage of persons with psychosomatic complaints (e.g., weakness and fatigue) and sleep disturbance (e.g., restlessness during sleep) versus those exposed to lower level of noise and infrasound. Researchers of the University Hospital of Mainz, Germany have shown the exposure to high levels of infrasound (more than 100 dB) interferes with cardiac muscle contractile ability, as early as one hour after exposure. There are numerous additional studies which support this health effect.

Vibration is the mechanical oscillations of an object about equilibrium point. The study of health effects of vibration requires measures of the overall "pressure waves" that are generated by vibrating equipment.

Vibration enters the body from the organ in contact with vibrating equipment. When a worker operates hand-held equipment such as a chain saw or jackhammer, vibration affects hands and arms. Such an exposure is called ***hand-arm vibration exposure*.** When a worker sits or stands on a vibrating floor or seat, the vibration exposure affects almost the entire body and is called ***whole-body vibration exposure.***

There are general, local and combined vibrations. Basis of vibrating illness is made nervously-trophic and hemodynamic infringements.

The most serious disorder, known as Raynaud's syndrome or vibration white finger (VWF), can result from the extensive exposure of vibratory hand tools, especially in cold weather. The condition is seen most frequently among workers who handle chain saws, grinders, pneumatic drills, hammers, and chisels. Forestry workers in cold climates are particularly at risk. Initial signs of VWF are tingling and numbness of the fingers, followed by intermittent blanching; redness and pain occur in the recovery stage (Fig. 5). In a minority of cases the tissues, bones, and joints affected by the vibration may develop abnormalities; even gangrene may develop. VWF can be prevented by using properly designed tools, avoiding prolonged use of vibrating tools, and keeping the hands warm in cold weather.

Whole-body vibration is experienced in surface and air transport, with motion sickness its most familiar effect. Whole-body vibration can cause fatigue, insomnia, stomach problems, headache and "shakiness" shortly after or during exposure. After daily exposure over a number of years, whole-body vibration can affect the entire body and result in a number of health disorders. Sea, air or land vehicles cause motion sickness when the vibration exposure occurs in the 0.1 to 0.6 Hz frequency range. Studies of bus and truck drivers found that occupational exposure to whole- body vibration could have contributed to a number of circulatory, bowel, respiratory, muscular and back disorders. The combined effects of body posture, postural fatigue, dietary habits and whole-body vibration are the possible causes for these disorders. Studies show that whole-body vibration can increase heart rate, oxygen uptake and respiratory rate, and can produce changes in blood and urine. East European researchers have noted that exposure to whole-body vibration can produce an overall ill feeling which they call ***"vibration sickness".***

Figure 5. Death finger in vibration sickness

Recommendations for the prevention of the negative effects of vibration:

- use of sound ergonomic equipment that reduces vibration transference to the hands;
- use of vibration absorbing gloves or pads. Gel padding is better than foam padding for protecting against vibration;
- hold equipment loosely;

- work in short durations with frequent breaks;
- take at least one 10-minute break every hour;
- keep hands warm to keep blood flowing;
- avoid smoking or other drugs or substances that inhibit a blood flow;
- maintain a Healthy Body You need to stay healthy and fit; maintain a healthy weight; strong bodies are more resilient against the stressors that cause vibration white finger;
- maintain good cardiovascular health; good blood flow to the hands is crucial.

Microclimate – a climate of limited territory or space, differing from environment. It divided on ***comfortable***, causing good heat sensation, an optimum functional status of central nervous system and high working capacity and ***uncomfortable*** – heating and cooling.

Microclimate of industrial premises is defined by combination of temperature, humidity and motility of air, and temperatures of environment surfaces.

Effects of heating microclimate:

- skin temperature raises;
- water-salt exchange is broken;
- there is organism dehydration;
- loss of mineral salts and water-soluble vitamins;
- activity of cardiovascular, respiratory and other systems.

Cooling microclimate can cause hypothermia promoting augmentation of catarrhal diseases, vasomotor spasms, freezing injuries. Exposure to heating or cooling microclimate harmful actions of chemical, physical and biological factors of environment strengthen.

In cold and transitive season temperature in manufacturing rooms is recommended 20-25°C, during warm time – to 21-28°C.

Relative humidity should be 15-75 %, speed of air movement 0.01-0.2 m/s.

Optimum microclimatic conditions provide general and local sensation of thermal comfort at minimum strain of thermoregulation mechanisms; do not cause deflections in health level.

High atmospheric pressure is marked at work in mines, caissons, performance of diving works.

In the conditions of raised pressure following symptoms are observed:

- pains in ears;
- dizziness;
- frequency of breath and pulse decrease;
- can lead to infringement of coordination of movements, excitation, memory easing, hallucinations, consciousness loss.

Decompression sickness (caisson disease) can result from fast decompression. Under increased atmospheric pressure (such as that experienced by deep- sea divers or tunnel workers), fat-soluble nitrogen gas dissolves in the body fluids and tissues. During decompression the gas comes out of solution and, if decompression is rapid, forms bubbles in the tissues. These bubbles cause pains in the limbs (known as the bends), breathlessness, angina, headache, dizziness, collapse, coma, and in some cases death. Emergency treatment of decompression sickness consists of rapid recompression in a compression chamber with gradual subsequent decompression. The condition can be prevented by allowing sufficient decompression time for the excess nitrogen gas to be expelled naturally.

Prevention of caisson illnesses consists in protection by time – standardization of stay duration in conditions of the raised pressure. At first signs of disease the man is located in a special box (recompression chamber) in which raise pressure up to primary level. Approximately through 30 min – 1 hour the painful phenomena disappear, then slowly and little by little pressure is reduced. In caissons there should be a temperature of air in limits 17-22^0 C. Divers should pass medical survey, and then during a week - the medical control. The diver has telecommunication with service of ground for informs the coordinates about health state.

Influence on person of ***lowered atmospheric pressure*** (at planes, at works, in mountains) leads to occurrence of *hypobaropathy* (high-altitude illness). The gases in solution in the body tissues under normal atmospheric pressure form bubbles when pressure rapidly decreases, as when aviators in unpressurized aircraft ascend to high altitudes too quickly. *Hypobaropathy* is characterized by:

- headaches;
- infringement of coordination of movements;
- muscular weakness;
- sight and hearing frustration;
- depression;
- deterioration of attention and drowsiness.

There can come coma and death from paralysis of respiratory center. Prevention of high-altitude illness consists in training in pressures chamber, high-altitude flights, mountain ascensions, application of oxygen devices and in maintenance with special clothes. In modern conditions use isolating, compensative survival suits. In survival suits pressure in under closing space is automatically supported. Cabins of flying devices are pressurized, in them the temperature, humidity, pressure of air and maintenance O2 is automatically supported also.

Ionizing radiation damages or destroys body tissues by breaking down the molecules in the tissues into positively or negatively charged particles called ions. Radiation that is capable of causing ionization may be electromagnetic (X rays and gamma rays) or particulate (radiation of electrons, protons, neutrons, alpha particles, and other subatomic particles) and has many uses in industry, medicine, and scientific research.

Ionizing radiation injury is in general dose-dependent. Whole-body exposure to doses in excess of 1,000 rads results in acute radiation syndrome and is usually fatal. Doses in excess of 3,000 rads produce cerebral edema (brain swelling) within a matter of minutes, and death within days. Lesser doses cause acute gastrointestinal symptoms, such as severe vomiting and diarrhea, followed by a week or so of apparent well-being before the development of the third toxic phase, which is characterized by fever, further gastrointestinal symptoms, ulceration of the mouth and throat, hemorrhages, and hair loss. There is an immediate drop in the white-cell elements of the blood, affecting the lymphocytes first and then the granulocytes and platelets, with a slower decline in the red cells. If death does not occur, these symptoms may last for many months before slow recovery begins.

Nonionizing forms of radiation include electromagnetic radiation in the radio frequency, infrared, visible light, and ultraviolet ranges. Exposure to radiation in the radio frequency range occurs in the telecommunications industry and in the use of microwaves. Microwaves produce localized heating of tissues that may be intense and dangerous. Various other disorders, mainly of a subjective nature, such as functional frustration of nervous and cardiovascular systems, have been reported in workers exposed to this frequency range.

Infrared radiation can be felt as heat and is commonly used in industry in drying or baking processes. Prolonged exposure to the radiation can result in severe damage to the skin and especially to the lens of the eye, where cataracts may be produced.

Working under poor *lighting conditions* can adversely affect worker efficiency and well-being and may even cause temporary physical disorders, such as headache or dizziness. Proper lighting should provide adequate, uniform illumination and appropriate contrast and color, without any flickering or glare.

Exposure to *ultraviolet* (UV) radiation from the Sun or such industrial operations as welding or glassblowing causes erythema of the skin (a condition familiarly known as sunburn), dermatitis, puffiness, itch and skin cancer.

High intensity of UV radiation is hazardous to the eyes, and exposure can cause welder's flash (photokeratitis or arc eye) and may lead to cataracts, pterygium, and pinguecula formation. Inflammation of the conjunctiva and cornea in welders can cause photo-ophthalmia. Pigmentation offers natural protection against sunburn, and clothing and glass can also be used as effective shields against ultraviolet radiation.

Sometime influence of industrial ultraviolet radiation may cause headaches, hyperthermia, nervous excitation, local or systemic immunosuppression.

Lasers emit intense infrared waves and can causes rupture of tissues and change of their properties, functional frustration of central nervous, cardiovascular and endocrine systems, changes of peripheral blood, cataract, blindness.

Hygienic requirements to computers

Computers are sources of weak x-ray, ultra-violet, infra-red, microwave radiation, is low- and ultralow-frequency electromagnetic field, electrostatic field, and air ionization.

Health Effects of computers:

- decrease in working capacity of eyes;

- development of asthenopia;
- headache;
- eye reddening;
- lacrimation;
- photophobia;
- hands' tendinitis;
- traumatic epicondylitis;
- diseases of CNS, CVS, TRT, GIT.

Preventions of harmful influence of computer:

- duration of continuous work should not exceed 25 minutes;
- each 10 minutes need to be taken away on 5-10 seconds about a sight aside from the screen;
- performance of relaxation exercises for eyes, muscles of neck, shoulders and palms;
- image on display screen should be accurate, contrast, not have reflexions from surrounding subjects;
- sizes of furniture should correspond to height of workers;
- placing of computers should exclude cross irradiation of workers (Fig. 6).

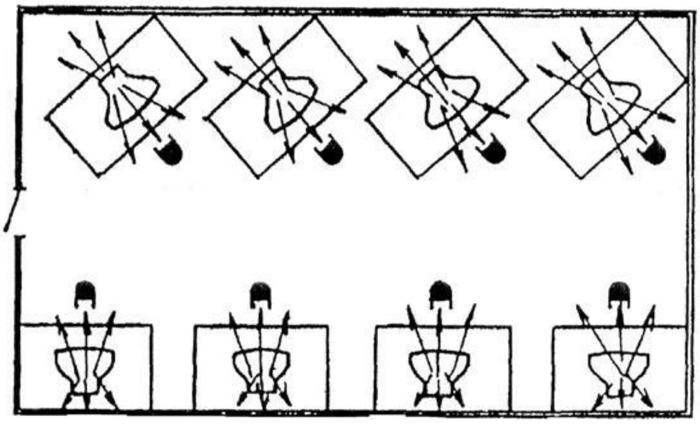

Figure 6. Recommended placement of computers in the classroom

Duration working time with the computer:

- for students of 1st year – 1 hour;
- for other students of older years – 2 hours with break 15-20 minutes;
- for operators of computers – 6 hours with break 20 minutes through everyone 2 hours;
- for teachers – 4 hours with break 15-20 minutes through everyone 2 hours.

Professional diseases caused by exposure of psychophysiological features of labour process

The special place in a number of harmful industrial factors is taken by psychophysiological features of labour process. The labour process is connected with physical (static and dynamic) and psychological overloads (intellectual overloading, sensory overloading, monotony of work, emotional overloads) (table 4).

Heaviness of the labour – is characteristic of labour process reflecting primary loading on locomotion and functional systems (cardio-vascular, respiratory, metabolic, secretory) of an organism, providing its activity. Heaviness of the labour is the characteristic of energy loss in work process.

Table 4 - Criteria of work classification by level of heaviness and intensity

Criteria	Categories of the work			
	Light, low intensive (I)	Middle, low intensive (II)	Hard, Intensive (III)	Very hard, very intensive (IV)
Physical work				
Dynamic loading				
Power of the work with general loading	<20 W	<45W	<90W	>90W
Regional loading (shoulder girdle)	<10W	<22W	<45W	>45W
Local loading (hands and forearms)	<2W	<4.5W	<9W	>9W
Maximal weight	<5 kg	6-15 kg	16-40 kg	>40 kg
Walking:				
By the horizontal	<15 steps/min	<30 steps/min	<40 steps/min	>40 steps/min
By the stairs	<5 steps/min	<15 steps/min	<30 steps/min	>30 steps/min
Inclinations of the trunk >30°	<0.5 /min	<1.0/min	<2.0/min	>2.0/min
Static load				
-holding by a hand	<18000 kg/s	<43200 kg/s	<97200 kg/s	>97200 kg/s
-holding by hands	<43200 kg/s	<97200 kg/s	<208400 kg/s	>208800 kg/s
-holding with participation of trunk and legs muscles	<61200 kg/s	<129600 kg/s	<266400 kg/s	>266400 kg/s
Compelled pose	free pose	10-25% of work time	<50% of work time	>50% of work time
Mental loading				
Intensity of the attention				
Number of the supervision objects	<5	<10	<25	>25
Duration of the supervision	<25% of work time	<50% of work time	<75% of work time	>75% of work time

Density of the signals	<15/hours	<35/hours	<60/hours	>60/hours
Emotional load	No	work by strict time-list	high responsibility	personnel risk, responsibility for safety of others
Time of work	Morning 7-8 hr	Afternoon 7-8 hr	In the night	Irregular with night work
Intensity of visual work:				
Category of the visual work	Unexact	Low- and middle exact,	high exact	very high exact
Volume of the operative memory	-	<2 elements	<5 elements	>5 elements
Intellectual load	No	Exact (according by instruction)	Exact (by algorithm)	Evristic activity
Monotony:				
-quantity elements of operation	>10	6-10	3-5	1-2
-number of repeating per hour	<40	<90	<180	>180
-time of the passive observation	80% of the work time	90% of the work time	95% of the work time	98% of the work time

It is characterized by the following parameters:

- physical dynamic loading;
- weight of lifted and moved cargo;
- quantity of stereotypic working-class movements;
- working pose;
- moving to space;
- static loading.

Static work is process of reduction of muscles necessary for keeping body or its parts in space.

Dynamic work is a process of reduction of muscles resulting to moving a cargo, and also body of the man or its parts in space. The dynamic work is subdivided on general, regional and local. General muscular dynamic work is carried out more than two thirds of weight skeletal muscles including legs and trunk.

Regional muscular work is made mainly with shoulder girdle or pelvic girdle (from one up to two thirds of weight of skeletal muscles). Local muscular work is made with participation less than one third of skeletal muscles.

Stress of separate organs and systems of organism at work is marked in cases of finding of workers in the compelled, inconvenient pose. The work connected with expressed stress of locomotion, can lead to deformation of joints, chronic arthritis, myositis, neuritis, easing of muscular strength, decrease of muscles tone and touch frustration.

Compelled pose at work standing usually leads to development of platypodia, varicose expansion of veins.

As a result of long work sitting scoliosis, lordosis or kyphosis of backbone, hemorrhoids, colitis and chronic constipation in some cases develops.

Muscle cramps often afflict workers engaged in heavy manual labour as well as typists, pianists, and others who frequently use rapid, repetitive movements of the hand or forearm. Tenosynovitis, a condition in which the sheath enclosing a tendon to the wrist or to one of the fingers becomes inflamed, causing pain and temporary disability, can also result from prolonged repetitive movement. When the movement involves the rotation of the forearm, the extensor tendon attached to the point of the elbow becomes inflamed, a condition commonly known as tennis elbow.

Also, exposure to characteristics of heaviness of labour can cause the following diseases:

- deformation of pelvis bones with infringement of bodies position;
- infringement of menstrual cycle of women;
- vegetative-sensory polyneuropathy of hands;
- compressive neuropathy of peripheral nerves of a hand;
- backbone osteochondrosis;
- neurosis;
- professional myofibroses of muscles;
- diseases of aroundjoint tissue (tendinites, tenosynovites, periartrosis, deforming osteoarthrosis).

Intensity of the labour – characteristic of work process reflecting loading mainly of central nervous system, sense organs, emotional sphere of workers. Intensity of the labour can be characterized by the following parameters:

- intellectual load;
- sensor load;
- emotional load;
- monotony;
- work regimen.

Intellectual work is submitted as trades concerning sphere of material manufacture (the designers, engineers, engineering, dispatchers, operators etc.), and outside (doctors, teacher, writers, actors, artists etc.). The intellectual work is characterized, as a rule, by necessity of processing of large volume of the diverse information with mobilization of memory, attention, frequency of stressful situations. At the same time muscular efforts are insignificant, the daily allowance energy loss makes 10 – 11.7 MJ (2000 - 2400 kcal per day).

Occupational diseases caused by exposure of characteristics of intensity of work:

- overstrain of vocal apparatus (chronic laryngitis and tracheitis, small knots of singers, phonasthenia - infringement of rhythm of phonatory band vibration);
- sight overstrain (sight infringement to the end of working day, asthenopia, accommodation spasm, myopia);
- syndrome of chronic weariness;
- syndrome of emotional stress.

Psychological distress is often expressed in affective (depressive) symptoms, psychophysical or psychosomatic symptoms (e.g., headaches, stomachaches, etc.), and anxiety symptoms. The relation of adverse working conditions to psychological distress is thus an important avenue of research.

Members of three occupational groups, lawyers, secretaries, and special education teachers (but not other types of teachers), showed elevated rates of major depression, adjusting for social demographic factors.

Prevention of professional diseases caused by exposure of irrational weight of work is included:

- mechanization of manual operations;
- restriction of admissible weight at lifting and carrying over of
- weights;
- improvement of tools;
- rational regimen of work;
- correct arrangement of workplace;
- carrying out of industrial gymnastics;
- organization of preliminary and periodic medical inspections.

Professional poisonings caused by exposure of chemical production factors

Industrial poison – chemical substance arriving from objects of industrial environment which can causes poisonings or alteration of state of health, found out by modern methods both in course of work with it, and in the remote terms of a life of present and subsequent generations.

Harmful influence of industrial poisons on a person is studied by ***industrial toxicology*****.** Industrial poisons by origin classified by organic and inorganic, by properties – by hydrophile and hydrophobic nonelectrolyte and electrolytes, by aggregate state – firm aerosols, liquid aerosols and gases, by solubility – on soluble in air, water, oil and other liquids, by stability – on unstable and stable.

Industrial poisons by character of action on a human body are subdivided: toxic, irritating, sensitizing, cancerogenic, mutagen; by way of penetration to organism: inhalation, percutaneous, oral.

Toxicity – measure of poison compatibility with life.

Toxicity of industrial poisons depends from:

- chemical structure and physical properties.
- concentration and durations of action of harmful chemical substance.

Factors influence to toxicity of industrial poisons:

- features of worker's organism;
- individual sensitivity;
- health level;
- physiological condition;
- gender and age;
- adverse working conditions.

Hazard – possibility of poisoning occurrence in manufacture. Classification of harmful substances by hazard (table 5):

- extremely dangerous (1 class);
- highly dangerous (2 class);
- moderately dangerous (3 class);
- little dangerous (4 class).

Table 5 - Classification of harmful substances

Indicator	Classes			
	1	2	3	4
Maximum permissible concentration in air of working zone, mg/m^3	<0.1	0.1-1	1.1-10	>10
Average lethal dose at introduction via the stomach, mg/kg	<15	15-150	151-5000	>5000
Average lethal dose at introduction via the skin, mg/kg	<100	100-500	501-2500	>2500
Average lethal concentration, mg/m^3	<500	500-5000	5001-50000	>50000
Zone of acute action	<6	6-18	18.1-54	>54
Zone of chronic action	>10	10-5	4.9-2.5	<2.5

Toxicometry – set of researches methods for quantitative estimation of toxicity and danger of poisons**.**

A time of exposure (**dose**) to a chemical or toxic substance, will cause an effect (***response***) on the exposed organism. If the amount or intensity of the **dose** increases, there will be a proportional increase in the ***response*****.**

Dose – the amount of a substance administered (or absorbed), usually expressed in milligrams of substance per kilogram of the exposed organism (mg/kg). Response – the effect(s) of a substance; may be positive or negative (Fig.7). Possible response levels:

- no response: at low dosage levels there may be no response at all;
- threshold dose: the lowest level of dosage at which a response is manifested;
- above threshold dose: response can be positive up to a point and then could become toxic to the organism.

Different people or organisms will exhibit a variety of responses.

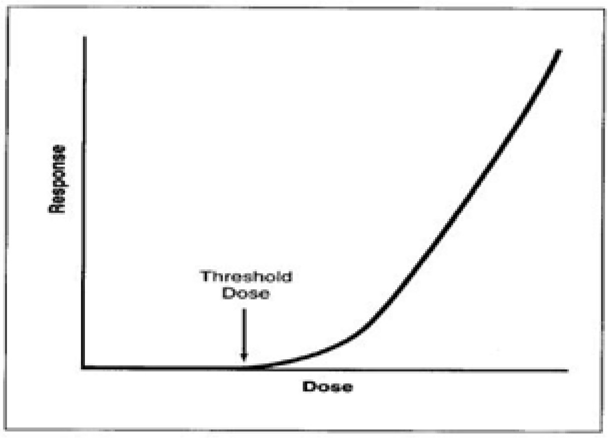

Figure 7. Dose – Response Curve

Routes of exposure of toxins**:** inhalation, ingestion, absorption through the skin. Less common routes are injection and absorption through eyes and ear canals (Fig.8).

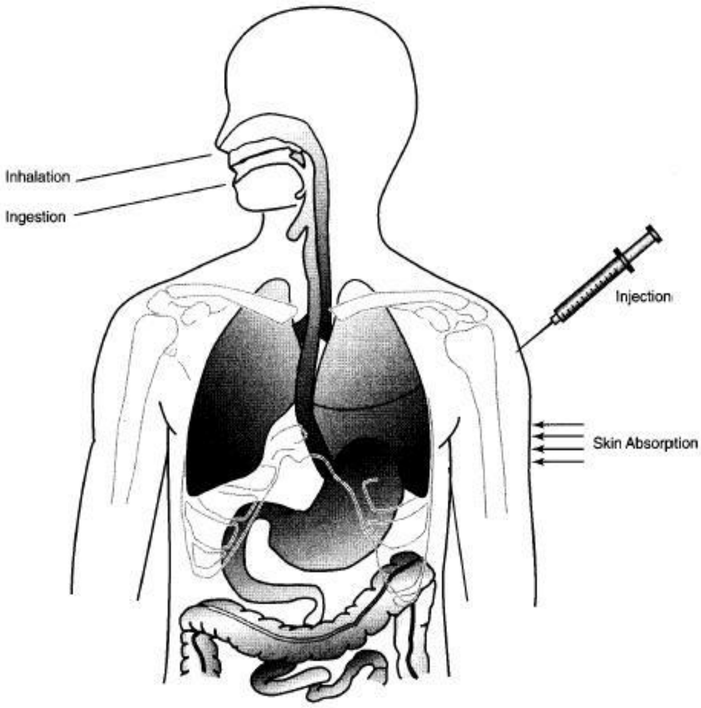

Figure 8. Routes of exposure to toxins

Inhalation – is the most common route of entry into body, therefore our area of highest concern. Lungs are designed for efficient gas exchange between the air and bloodstream, therefore great potential for toxins to enter bloodstream.

Skin absorption (2nd most important route) - materials can be absorbed into blood stream just below the skin surface or toxins can be stored in fat deposits. Obviously, workers can easily expose their hands into solvents, oils, chemicals, etc., plus these materials can be sprayed or rubbed on other parts of the body. Many chemicals are either soluble in water or in oil (fat, lipid). The skin easily absorbs lipid-soluble materials, water-soluble materials are not easily absorbed.

Ingestion (3rd most important route) is not usually intentional. The digestive tract is moist and designed for efficient absorption. Surface area of intestines is greatly increased by small projections (villi). Thin surfaces, highly vascularized. Materials easily transferred to bloodstream.

Distribution of toxins – once toxins are in the body, there are several mechanisms of movement and action. Arrived in organism industrial poisons intensively collect in bodies and tissue having good blood supply. After inhalation toxics may enter bloodstream, irritate or scar lung tissues directly. After skin absorption toxics may enter bloodstream, irritate, corrode or burn skin directly. The exit of poisons in a bloodstream occurs at diseases, nervous stress, cooling, overheating, alcohol reception.

Once absorbed into the body, toxins can move to other tissues and organs through various ways:

1. Filtration – toxins move through membrane pores.
2. Diffusion – movement from higher concentration to lower concentration.
3. Active transport – movement across a membrane otherwise impermeable by a transport mechanism; chemical reaction or carrier molecule, requires energy.
4. Phagocytosis – toxins "eat" or engulf other cells or by use of white blood cells.

In the human organism, industrial poisons interact with structural components, chemical substances of cells, and intertissue liquid and are exposed to metabolism.

Poisons metabolism in an organism occurs by means of oxidation-restoration reactions microsomal enzymes, reactions of hydrolysis, dehydroxyalkylation, dehalogenation and other transformations. As result of metabolism in an organism less poisonous substances are formed. The basic body destroying harmful chemical substances is the liver.

Excretion of toxic substances from an organism occurs through lungs, intestines, kidneys, integuments and glands.

Industrial poisons courses local and general **effect**s in a human body. Local effect – pathological effect develops before poison absorption in blood, is characterized by the damage of tissues contact to poison, evident by skin inflammations, and burns.

General (resorptive) effect – pathological effect develops in result of poison absorption in blood, affection of internal bodies is characterized.

Effects of poisons in the human body:

- toxic;
- psychotic;
- suffocating;
- lacrimatory;
- irritating;
- gonadotoxic;
- embryotoxic;
- teratogenic;

- cancerogenic;
- mutagenic.

Professional poisonings (intoxications) – poisoning arising due to exposure of industrial poisons:

1. Acute poisoning arisen after unitary influence on worker large quantities of industrial poison (short time / high concentration).
2. Subacute poisoning arises at receipt in an organism of the big doses of poison, but develops more slowly and characterized by a long current.
3. Chronic poisoning developing after constant exposure of industrial poison throughout long time in small concentration (long-term, low concentration).

Symptoms can vary from mild to moderate and severe. Mild poisoning symptoms usually resolve quickly, are localized (i.e., affect one area of the body), and do not require medical treatment.

Mild symptoms of poisoning may include the following:

- behavior changes (e.g., restlessness, crankiness);
- diarrhea;
- dizziness;
- drowsiness;
- fatigue;
- headache;
- loss of appetite;
- minor skin or eye irritation;
- nausea or upset stomach;
- passing cough (cough that comes and goes);
- soreness or stiffness in the joints;
- thirst.

Moderate symptoms of poisoning may be prolonged (i.e., long lasting) and systemic (i.e., affect more than one organ, organ system, or part of the body) and often require treatment. Moderate poisoning symptoms, which usually are not life threatening or permanent, may include the following:

- blurred vision;
- confusion and disorientation;
- difficulty breathing;
- drooling;
- excessive tearing;
- fever;
- low blood pressure (hypotension);
- loss of muscle control and muscle twitching;
- paleness (pallor) or flushed or yellowish skin;
- persistent cough;
- rapid heart rate;
- seizures;
- severe diarrhea;

- severe nausea;
- stomach cramps;
- sweating;
- thirst;
- Trembling;
- Weakness.

Severe poisoning symptoms are life threatening and can result in permanent brain damage, disability, or death. Major symptoms of poisoning include the following:

- Cardiopulmonary arrest;
- Convulsions;
- Disseminated intravascular coagulation (condition that causes uncontrolled bleeding or blood clothing);
- Esophageal stricture (narrowing of the organ that carries food from the mouth to the stomach);
- Fever;
- Inability to breath;
- Increased respiration (rapid breathing);
- Loss of consciousness;
- Muscle twitching;
- Rapid heart rate with low blood pressure;
- Respiratory heart rate with low blood pressure;
- Respiratory distress that requires intubation;
- Seizures that do not respond to treatment (called status epilepticus);
- Thirst.

Symptoms characterizes for professional poisonings:

- irritation of mucous membranes of eyes, top respiratory ways and lungs (conjunctivitis, pharyngitis, laryngitis, tracheitis, bronchitis, pneumonia, edema of lungs);
- irritation of skin (dryness of a skin, raised sweating, dermatitis, cracks of nails, burns);
- defeats of central and peripheral nervous system (asthenovegetative syndrome, phenomena of general narcotic character, headaches, dizziness, visual acuity decrease, polyneuritis);
- liver defeats (cholestasis, hepatomegaly, liver dystrophy).
- cardiovascular frustration (decrease of blood pressure and pulse rate);
- gastroenteric frustration (pains in a stomach, nausea, vomiting, diarrhea, colitis);
- defeats of urinary systems (nephropathy);
- infringement of processes of hemopoiesis (leukocytosis, lymphopenia, eosinopenia, leukoses, anemias, infringement of coagulability of blood).

Characteristic of main occupation poisons

Organic solvents – methyl, ethyl spirits, some ethers, some ketones, benzine, benzol, etc. General health hazards associated with solvent exposure include toxicity to the nervous system, reproductive damage, liver and kidney damage, respiratory impairment, cancer, and dermatitis.

Symptoms of acute poisoning by organic solvents:

- easy intoxication;
- excitement;
- infringement of movements coordination;
- drowsiness;
- depression with headaches;
- nausea;
- spasms.

Many solvents can lead to a sudden loss of consciousness if inhaled in large amounts. Solvents like diethyl ether and chloroform have been used in medicine as anesthetics, sedatives, and hypnotics for a long time. Ethanol (grain alcohol) is a widely used and abused psychoactive drug. Diethyl ether, chloroform, and many other solvents (e.g., from gasoline or glues) often with harmful long term health effects like neurotoxicity or cancer. Methanol can cause permanent blindness and death.

It is important to note that ethanol has a synergistic effect when taken in combination with many solvents. For instance, a combination of toluene/benzene and ethanol causes greater nausea/vomiting than either substance alone.

Some solvents including chloroform and benzene (an ingredient of gasoline) are carcinogenic. Many others can damage internal organs like the liver, the kidneys, or the brain.

Chronic exposure to organic solvents in the work environment can produce a range of adverse neuropsychiatric effects, asthenovegetative syndrome with gradual organic changes in cerebral cortex and other organs.

Processes of neutralization of organic solvents are carried out in liver, gastrointestinal tract and in other organs.

Sulfuric, nitric, hydrochloric and other mineral acids exposure to skin cause chemical burns. Water solutions of acids lead to dryness, hyperkeratosis of palms, dermatitis.

Caustics (strong acids and alkalis), when ingested, burn upper GI tract tissues, sometimes resulting in esophageal or gastric perforation. Initial symptoms include drooling and dysphagia. In severe cases, pain and sometimes bleeding develop immediately in the mouth, throat, chest, or abdomen. Airway burns may cause coughing, tachypnea, or stridor.

Swollen, erythematous tissue may be visible intraorally; however, caustic liquids may produce no intraoral burns despite serious injury farther down the GI tract. Esophageal perforation may result in mediastinitis, with severe chest pain, tachycardia, fever, tachypnea, and shock. Gastric perforation may result in peritonitis. Esophageal or gastric perforation may occur within hours, after weeks, or anytime in between.

Chlorine gas is a pulmonary irritant with intermediate water solubility that causes acute damage in the upper and lower respiratory tract. Occupational exposures constitute the highest risk for serious toxicity from high-concentration chlorine. Exposure to low concentrations of chlorine for prolonged periods may have destructive effects, as might very short-term exposure to high concentrations. Chlorine aspiration at easy acute toxic poisonings causes irritation and cauterization of mucous membranes of respiratory tracts and lungs with development of bronchitis, bronchial pneumonias, pulmonary edema. Patients have severe resting dyspnea during the second hour, diffuse crackles/rhonchi on auscultation, and a partial pressure of oxygen of 32 mm Hg breathing room air. The radiograph shows diffuse pulmonary edema without significant cardiomegaly (Fig. 9).

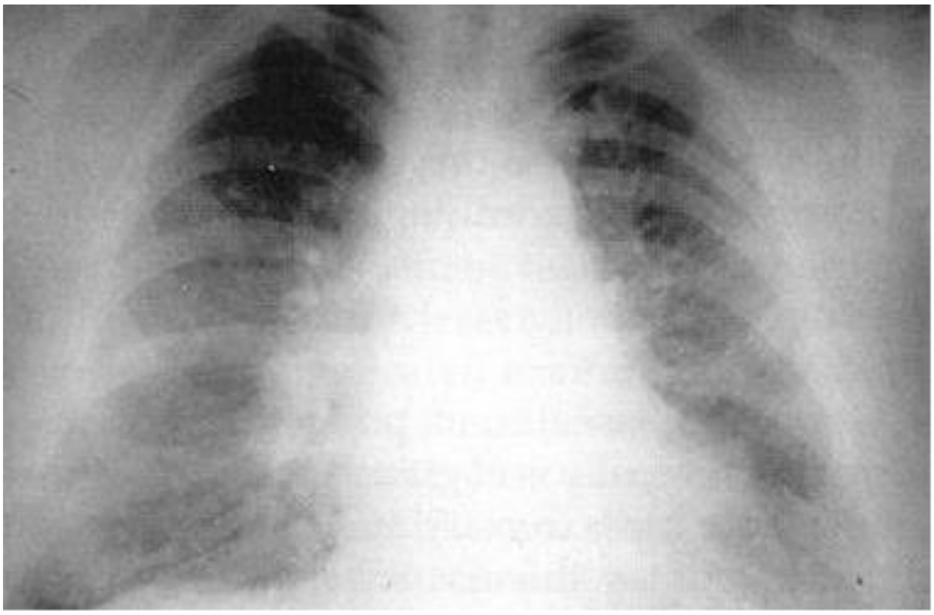

Figure 9. Chest radiograph of a 36-year-old chemical worker 2 hours postexposure to chlorine inhalant

Symptoms may vary depending on the degree of exposure. Exposure possibilities include acute low levels, acute high levels, and chronic low levels.

Low-level (3-5%, 1-15 ppm) acute exposure. Manifestations are as follows:

- eye tearing, nose and throat irritation;
- sneezing;
- excess salivation;

general excitement or restlessness

High-level (20%, >30 ppm) acute exposure. In addition to the symptoms seen with low-level exposure, high-level exposure may result in the following:

- dyspnea: upper airway swelling and obstruction may occur.
- violent cough;
- nausea and vomiting (with the smell of chlorine in emesis);

- lightheadedness;
- headache;
- chest pain or retrosternal burning;
- muscle weakness;
- abdominal discomfort;
- dermatitis (with liquid exposure);
- corneal burns and ulcerations may occur from splash exposure to high-concentration chlorine products;
- esophageal perforation.

Manifestations of *chronic exposure* include the following:

- acne (chloracne);
- chest pain;
- cough;
- sore throat;
- hemoptysis;

Findings on physical examination may include the following:

- tachypnea;
- cyanosis (most prevalent during exertion);
- tachycardia;
- wheezing;
- intercostal retractions;
- decreased breath sounds;
- rales (pulmonary edema);
- nasal flaring;
- aphonia, stridor, or laryngeal edema;
- ulceration or hemorrhage of the respiratory tract;
- rhinorrhea;
- lacrimation, salivation, and blepharospasm;
- chloracne or tooth enamel corrosion (with chronic exposure);
- redness, erythema, and chemical burns to the skin from dose dependent exposure to liquid.

Iodine makes irritating and cauterizing action on a skin and mucous, harmful influence on nervous system and blood.

Easy acute poisoning by ***nitrogen oxides*** causes irritation of respiratory system, cough, general weakness. Diseases of respiratory system, infringement of functions of nervous and blood systems are observed in chronic intoxications.

Hydrogen sulphone has irritating effect on mucous membranes of eyes and respiratory tract, causes infringement of heart activity.

Ammonia causes irritation of mucous membranes of upper airways and eyes.

Mercury arrives in an organism through lungs, gastrointestinal tract and skin. The inhalation of mercury vapour can produce harmful effects on the nervous, digestive and immune systems, lungs and kidneys, and may be fatal.

The inorganic salts of mercury are corrosive to the skin, eyes and gastrointestinal tract, and may induce kidney toxicity if ingested.

Neurological and behavioral disorders may be observed after inhalation, ingestion or dermal exposure of different mercury compounds. Symptoms include tremors, insomnia, memory loss, neuromuscular effects, headaches and cognitive and motor dysfunction. Mild, subclinical signs of central nervous system toxicity can be seen in workers exposed to an elemental mercury level in the air of 20 $\mu g/m^3$ or more for several years. Kidney effects have been reported, ranging from increased protein in the urine to kidney failure.

High exposures to *inorganic mercury* may result in damage to the gastrointestinal tract, the nervous system, and the kidneys. Both inorganic and organic mercury compounds are absorbed through the gastrointestinal tract and affect other systems via this route. However, organic mercury compounds are more readily absorbed via ingestion than inorganic mercury compounds.

Symptoms of high exposures to inorganic mercury include: skin rashes and dermatitis; mood swings; memory loss; mental disturbances; and muscle weakness.

Acute inhalation mercury poisonings are characterized by presence of stomatitis, diarrhea, pains in a stomach, general weakness, defeat of gastrointestinal tract and kidneys.

Chronic poisoning by mercury compounds, or mercurialism, is characterizes by headaches, dizziness, fast fatigue, emotional instability, depressive reactions, tremor of hands, changes of blood, liver, kidneys, metal smack in mouth, gingivitis, fearfulness, shyness, lack of self-confidence (mercury erethism).

Sulfurs oxides are possessing irritating action on mucous membranes and lungs.

Lead and lead compounds play a significant role in modern industry, with lead being the most widely used nonferrous metal. A wide variety of industrial populations is at risk of occupational exposure to lead (battery manufacturing, chemical industry, construction workers, demolition workers, firing-range instructors, foundry workers, gas-station attendants, gasoline additives production, lead miners, etc.).

Lead is absorbed primarily through the respiratory and gastrointestinal systems, with the former being the more important route of entry in occupational exposures. Cutaneous absorption of inorganic lead is negligible. However, organic lead compounds, because of their lipid solubility, are readily absorbed through intact skin. After lead is absorbed into the bloodstream, through either ingestion or inhalation, most of it is carried, bound, to erythrocytes. The freely diffusible plasma fraction is distributed extensively throughout tissues, reaching highest concentrations in bone, teeth, liver, lungs, kidneys, brain and spleen. Lead in blood has an estimated half-life of 35 days, in soft tissue 40 days and in bone 20 to 30 years. Inorganic lead does not undergo any metabolic transformation or digestion in the intestines, or detoxification in the liver.

With chronic exposure over a long period of time, most absorbed lead ends up in bone. Lead, it appears, is substituted for calcium in the bone matrix. Although lead is excreted by several routes (including sweat and nails), only the renal and gastrointestinal pathways are of practical importance. In general, lead is excreted quite slowly from the body (with the biologic half-life estimated at 10 years).

Excessive occupational exposure to lead over a brief period of time can cause a syndrome of *acute lead poisoning*. Classic clinical findings in this syndrome include abdominal colic, constipation, fatigue and central nervous system dysfunction. With even greater doses, acute encephalopathy with coma and convulsions may occur. In milder exposures, headaches and personality changes may be the only signs of neurologic toxicity.

Symptoms of chronic toxicity may include arthralgias, headache, weakness, depression, loss of libido, impotence and vague gastrointestinal difficulties, hepatic syndrome. Late effects may include chronic renal failure, hypertension, gout and chronic encephalopathy. Lead border on edge of gums, increase in blood reticulocytes and basophilic-granular erythrocytes are observed for chronic intoxication of lead, or saturnism (Fig.10).

Manganese has influences to metabolism, oppresses activity of cholinesterase, affect nervous system. Manganese exposure may cause manganoconiosis.

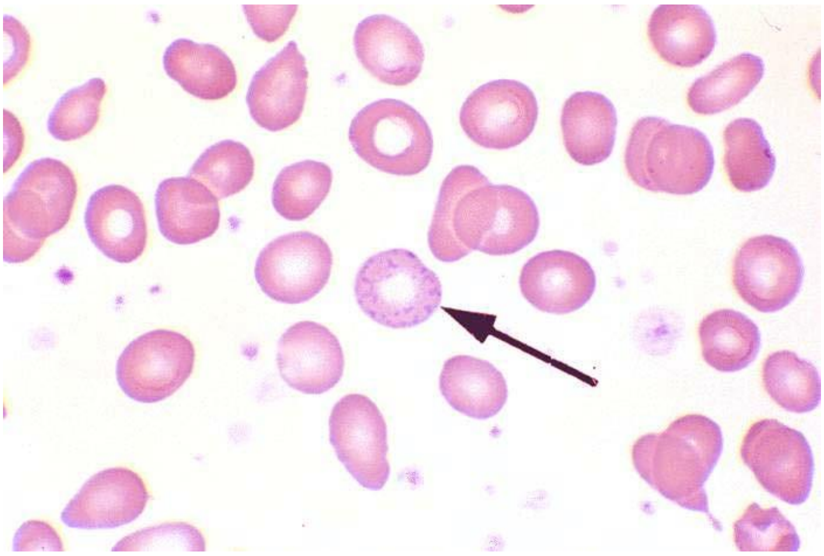

Figure 10. Blood picture in lead anaemia (basophilic stippling of erythrocytes)

Carbon monoxide poisoning causes acute symptoms such as headache, nausea, weakness, angina, dyspnea, loss of consciousness, and coma. Neuropsychiatric symptoms may develop weeks later.

Symptoms tend to correlate well with the patient's peak blood carboxyhemoglobin levels. Many symptoms are nonspecific. Headache and nausea can begin when levels are 10 to 20%. Levels > 20% commonly cause vague dizziness, generalized weakness, difficulty concentrating, and impaired judgment. Levels > 30% commonly cause dyspnea during exertion, chest pain (in patients with coronary artery disease), and confusion. Higher levels can cause syncope, seizures, and obtundation. Hypotension, coma, respiratory failure, and death may occur, usually when levels are 60%.

Professional diseases caused by exposure of biological production factors

To group of harmful production factors of a biological nature belong pathogenic microorganisms (bacteria, viruses, rickettsia, spirochetes, fungi, protozoa) and products of their ability to live (having, as a rule, high sensibilization property), antibiotics, protein-vitamin drugs, enzymes and also number of organic substances of natural and semisynthetic origin.

Bacteria, viruses, fungi, and other living organisms can cause acute and chronic infections by entering the body either directly or through breaks in the skin. Occupations that deal with plants or animals or their products or with food and food processing may expose workers to biological hazards. Laboratory and medical personnel also can be exposed to biological hazards. Any occupations that result in contact with bodily fluids pose a risk to workers from biological hazards.

Pathogenic microorganisms can cause allergic diseases, candidiasis, chronic bronchitis, bronchial asthma, etc.

Can be infectious diseases:

- bacterial nature (tuberculosis, brucellosis);
- virus nature (ornithosis, rabies);
- fungicide nature (actinomycosis);
- protozoa nature (toxoplasmosis);
- helminthiasis nature (trichinosis).

Professional infections can arise at short or even unitary contact.

Occupational diseases caused by exposure of antibiotics, protein-vitamin drugs, enzymes:

- allergic diseases of breath organs in form of rhinitis, rhinopharyngitis, bronchial asthma, asthmatic bronchitis;
- allergic conjunctivitis;
- functional defeats of cardiovascular system;
- changes of central and peripheral nervous system, focal defeats of a brain, vegetative-vascular dystonia;
- changes of immunologic reactance of an organism;
- dysbacteriosis – more often a candidiasis.

In occupations where animals are involved, biological hazards are dealt with by preventing and controlling diseases in the animal population as well as proper care and handling of infected animals. Also, effective personal hygiene, particularly proper attention to minor cuts and scratches, especially those on the hands and forearms, helps keep worker risks to a minimum.

In occupations where there is potential exposure to biological hazards, workers should practice proper personal hygiene, particularly hand washing. Hospitals should provide proper ventilation, proper personal protective equipment such as gloves and respirators, adequate infectious waste disposal systems, and appropriate controls including isolation in instances of particularly contagious diseases such as tuberculosis.

Prevention of professional diseases and poisonings

Prevention of professional intoxications and diseases includes realization of some legislative, technological, sanitary-technical, planning, organizational and treatment-prophylactic actions, use of personal protective equipment.

Legislation and control: working out of hygienic norms for harmful materials (table 6, 7, 8), labour legislation.

Table 6 - Maximum permissible concentrations of harmful substances in air of working area.

Substance	MPC, mg/m^3	Substance	MPC, mg/m^3
Ammonia	20	Manganese	0.1
Hydrogen sulfide	10	Benzene	15
Nitrogen dioxide (IV)	2	Mercury	0.01
Chlorine	1	Lead	0.05
Sulfuric acid	1	Beryllium	0.003
Hydrogen chloride	5	Formaldehyde	0.5
Acrid alkali	0.5	Methanol	5
Dichloroethane	10	Ethanol	1000
Aniline	0.1	Acetone	200
Methyl acetate	100		

Table 7 — Maximum-permissible concentration of dust in air of working zone

Substance	MPC, mg/m3
Dust of vegetative and animal origin:	
with impurity 2-10 % silicon dioxide	4
bast, cotton, linen, woolen, down, etc. (with impurity silicon dioxide more than 10 %)	2
Grain	4
wood, etc. (with impurity silicon dioxide less than 2 %)	6
cotton flour	0.5

Table 8 — Admissible microclimatic conditions at performance of easy work

Period of year	Parameters of microclimate			
	Air temperature,°C	Surfaces temperature,°C	Relative humidity, %	Velocity of air movement, м/сек
Cold and Transitive	20-25	19-26	15-75	0.01
Warm	21-28	20-29	15-75	0.1-0.2

Thermal irradiation of workers should be no more than 35 Vt/m^2 at irradiation 50 % and more a body surface, 70 Vt/m^2 - at an irradiation of 25-50 %, 100 Vt/m^2 - at an irradiation no more than 25 % of a body surface.

Technological measures - regulation of content in raw materials of toxic substances, replacement at manufacture toxic substance by less toxic, for example, use of benzine instead of benzol. Full removal of harmful substance from a work cycle practice.

Organizational measures - restriction of time of worker's stay in dangerous zone, in equipment and capacities with toxic substances, work and rest rationalization correct organization of workplace.

Sanitary-technical measures – rational system of a forced-air and exhaust ventilation, strict constant control over content of extremely dangerous substances in air of a working zone, rational illumination and optimum microclimate on workplaces.

Planning – equipment of sanitary-household premises (shower, wardrobe, laundries for washing of overalls, etc.).

Treatment-preventive measures – preliminary and periodic medical inspections, preventive nutrition, sanatorium treatment.

A written sanitation program shall be available which will include instructions on the sanitary and hygiene.

Cleaning requirements are applicable to all production areas of the plant, especially manufacturing areas that require special attention. They are also applicable to processing equipment. Disposal procedures for waste materials and debris should be recorded and maintained.

In a case when it is not possible to decrease concentration of harmful substances in a working zone to safe level, workers should use **personal protective equipment** (PPE) (ointments, mittens, gloves, oversleeves, goggles, masks, helmets, ear plugs, muffs, safety glasses, respirators, gas masks, overall, aprons, trousers, boots, hard-hats special linen and clothes from the rubber and other materials steady against toxic substances) (Fig. 11). Training on PPE should be done.

When the worker suffers from a work accident or is proved to have an occupational disease, the employer must send him to the nearest hospital immediately. If the employer is not in the place of work when the worker has an accident, the worker or a family member should inform the employer or his representative within 24 hours orally or in writing. After the employer has been informed, s/he should report to the insurance company all the details about the accident and provide all evidence at the same time. The insurance company then analyses the information and ascertains whether it is a real accident; when it is confirmed, the insurance company pays the victim compensation according to the terms of the policy.

Figure 11. Personal protective equipment.

Investigation of occupation disease and poisoning

The scheme of the statement of investigation of occupational disease (poisoning):

- account group in the state register.
- a place of drawing up of the statement.
- the enterprise's name, shop, sector.
- investigation date, the commission members (Chief Inspector of labour safety, sectorial doctor, doctor-hygienist, safety engineer, a person of trade union): first name, middle initial, last name, a post, a work place;
- the date and hour of an incident;
- the notice has arrived to the hygiene and epidemiology center (the date, an hour);
- the establishment which has diagnosed the case;
- the disease was revealed during routine physical examination/during visit to a doctor;
- the victim (first name, middle initial, last name), age, sex, trade (post).
- the work experience in the given trade, in the given shop;
- the experience of work in the conditions of the harmful production factors influence which have caused the disease;
- the diagnosis (preliminary, definitive, basic);
- the victim's state of health at the moment of investigation (work capacity in the trade, is on out-patient treatment, is hospitalized, the sick-list, number of days, is registered as a disabled person, has died);
- occupational disease has arisen under the following circumstances and working conditions (the detailed description of concrete factors is given);

- the immediate cause of the occupational disease is: the raised dust content of the working zone air (concentration of dust average, maximum); gassed air of the working zone (concentration of substances average, maximum); noise level (parameters in dB and the frequency characteristic); level of the general and local vibration (the frequency characteristic); other harmful production factors.

On the basis of the investigation results it was established by the commission that the present case of occupational disease has resulted from (concrete circumstances and conditions are specified), the immediate cause of the disease (poisoning) was (the concrete harmful production factor).

First name, middle initial, last name, a post of the persons responsible for the sanitary-and-hygienic norms performance and rules of labour safety.

In order to eliminate and to prevent occupational diseases it is offered (concrete organizational, technical, sanitary and hygienic actions, the official and term of its performance).

The date. Signatures of commission members.

Hygiene of work in different industries

Occupational exposure to active pharmaceutical ingredients can cause unintended health effects in workers handling these substances. Chemical compounds that are routinely handled in the pharmaceutical industry are unique from other chemicals in that these compounds are designed to have an effect on the human body. Feature of a ***modern pharmaceutical industry*** is wide application of technologies of biological and chemical synthesis of medical products, and also chemical and physical ways of processing of raw materials, intermediate and end-products.

Qualitative laboratory researches assume all-round studying of a new medical product in experiment, qualitative clinical researches include studying of influence of a new medical product on the person, qualitative manufacture is directed on release of an effective medical product.

High chemical cleanliness of production, full sterility of preparations for hypodermic, intramuscular and intravenous injections, small volume of manufacturing of many medicinal forms, the big expense of medicinal raw materials and auxiliary materials, fast expansion of assortment of medicines, creation of combined technological processes of reception of several preparations within a year are characterized for pharmaceutical industry.

In pharmaceutical industry there are following factories: manufacture of synthetic medicines, antibiotics, tablets, dragee, plasters and other medicinal forms. For the reception of medical products, the various synthetic and natural raw materials of a vegetative, mineral and animal origin are used.

Professional harm of a pharmaceutical industry:

- harmful chemical substances;
- dust;
- adverse microclimate;
- noise;

- vibration;
- compelled position of body;
- stress of separate organs.

The radio-electronic industry includes microelectronics, manufacture of microprocessor devices, electrical engineer, exact instrument making, television manufacture, etc. General prominent feature of work in the named branches is absence of heavy physical activities, strictly fixed workplace and compelled working position. Here there is a set of accurate manual operations which performance requires long concentration of attention. Thus, low light exposure, small contrast of object of distinction with a background, presence of direct and reflected brightness, frequent light readaptation of eyes can cause strain and overstrain of the visual analyzer, and the conveyor organization of work leads to monotony.

Dust-lack air environment in a combination with constant temperature-humidified regimen negatively influences to functional condition of workers organism and leads to decrease of immunological reactance.

Various radio engineering devices can be sources of electromagnetic fields of radio-frequency ranges and static electricity. Soldering processes there is a pollution of the air environment by aerosols of solders.

Workers contacting to lead-bearing and other solders, neurotic and asthenic syndromes, increase of erythrocytes, reticulocytes, change of function of gastrointestinal tract are observed.

Mining of coal, metal ores and other minerals is undertaken extensively around the world. Historically mine workers have suffered higher incidences of ill health than workers in other heavy industry sectors. Coal mining has long been associated with the dust induced lung disease 'Pneumoconiosis' and other illnesses such as work related 'Emphysema'. Mining activities can present particular hazards to health from various substances.

These may be from the mineral being extracted or may be present as undesirable by products / contaminants.

The main health hazard is exposure to dust in various forms. *Asbestos* is mined in a number of countries around the world, it is also found in trace quantities in deposits of other minerals such as talc.

The hazards of asbestos are presented in a separate section of this manual.

Arsenic is present in metal deposits such as tin and copper. It may be encountered as an undesirable component during mining and processing but is also produced commercially as a by- product of the refining. Arsenic is toxic and can kill if large doses are either consumed or inhaled.

Silica is present in many minerals and particularly in stone extraction.

Mining can also present a range of physical hazards such as noise, vibration, radiation, heat stress, damp/humidity and changes in atmospheric pressure. Absence of daylight in underground conditions keeps danger of traumatism.

Mechanical engineering – a complex of industries making the tools of work for a national economy. It includes machine-tool constructing, instrument-making, automobile, tractor, agricultural and other kinds of the industry.

Technological processes in machine engineering industry are diverse: receptions of preparations and their preprocessing in casting, forging and thermal shops, machining, welding, colouring, assemblage. There are sites with technology of chemical, electrotechnical and other industries. Professional harm in machine construction:

- heating up microclimate;
- intensive noise;
- general and local vibration;
- ultrasound;
- currents of high frequency;
- harmful chemical substances;
- raised danger of an industrial traumatism.

Petroleum - refining industry includes the enterprises for oil refining and manufacture of mineral oil (gasoline, black oil, diesel fuel, etc.). Petrochemical industry is directed on manufacture of synthetic materials and products on the basis of oil refining (synthetic rubber, rubber, plastic, varnishes, paints, etc.). Professional harm in oil-processing industry:

- air pollution of working zones by limiting, nonlimiting and aromatic hydrocarbons, hydrogen sulphide, oxides of sulfurs, ammonia, phenol, acetone;
- intensive industrial noise;
- nervous-emotional stress.

Professional harm in manufacture of polymers:

- harmful chemical substances;
- adverse microclimate;
- noise.

The industry of building materials unites enterprises for extraction of natural materials, manufacture of ceramic, farforo-faience, glass, thermal-insulation, polymeric, wood and metal materials and products. Professional harm in industry of building materials:

- dust;
- heating up microclimate;
- air gassed condition;
- noise;
- vibration;
- physical and psychological overloads.

Professional harm in building:

- meteorological conditions;
- physical overloads;
- dust;
- gases;
- steams of chemical substances;
- noise;
- vibration;
- psychological overloads.

From natural and chemical fibers yarn and various fabrics in **the textile enterprises** are received. Natural fibers can be vegetative (cotton, flax, jute), animal (wool, natural silk) and mineral origin (asbestos). Capron, lavsan concern to chemical fibers. The basic stages of technological process are the primary processing of fibers, spinning, weaving and furnish.

Negative working conditions are defined by influence of dust, noise, microclimatic conditions and multiple service of devices. For multiple service of devices stress of visual and acoustical analyzers, high functioning capacity of industrial operations, absence of constant workplace is characteristic. Work in the majority of trades is carried out in a standing position with moving, inclinations.

Professional harm of clothing enterprises:

- dust of a vegetative or animal origin on workplaces;
- considerable pressure of sight;
- professional harm at footwear manufacturing;
- chemical factor;
- noise;
- vibration;
- heating up microclimate.

Hygiene of work in agriculture

Typically, some pulmonary diseases are caused by frequent contact with moldy firewood, grain or feed, which release harmful viruses and arouse allergic effects. Other pulmonary diseases are caused by humid and static air breathed by workers cultivating mushrooms in basements.

Green house disease is also induced by bad air circulation. Fanners who grow vegetables and strawberries in plastic covered houses suffer from high temperatures, high humidity but less fresh air all year round, and they are likely to get sick.

Poisoning is common among farmers who usually spray liquid pesticides. After several days of spraying, pesticides containing poisonous elements will not only kill pests, but harm humans too.

Pesticides are also blamed for leukemia. About 50 percent of leukemia in patients in rural areas is directly caused by frequent contact with pesticides and herbicides, which destroy their blood system and finally developed into leukemia.

Farmers who walk barefoot in water contaminated by fertilizers may become anemic due to hookworm or parasitic worms living in water that penetrate people's skin.

Breeding livestock like pigs or cattle can make farmers susceptible to viruses carried by animals.

Professional harmful factors:

- original microclimatic conditions;
- air pollution of a working zone by dust, exhaust gases, microorganisms;

- noise and vibration presence;
- contact to combustive materials;
- heating microclimate;
- air pollution of working zone by dust and exhaust gases, pesticides, mineral fertilizers, etc.;
- noise and vibration presence;
- contact with fuels and lubricants oils;
- intense working pose.
- compelled working pose;
- pollution of air environment;
- special microclimate of working premises;
- physical and nervously-emotional stress in an operating time;
- contact with toxic irritating substances;
- infringement of regimen of day.
- organophosphate;
- organochlorine;
- organo-mercuric compound;
- derivatives of urea and phenol;
- preparations of sulphur, arsenic and copper, etc.

A crop-duster spraying pesticide on a field. A **pesticide** is a substance or mixture of substances used to kill a pest. A pesticide is any substance or mixture of substance intended for: - preventing, destroying, repelling or mitigating any pest. A pesticide may be a chemical substance, biological agent (such as a virus or bacteria), antimicrobial, disinfectant or device used against any pest. Pests include insects, plant pathogens, weeds, mollusks, birds, mammals, fish, nematodes (roundworms), microbes and people that destroy property, spread or are a vector for disease or cause a nuisance. Although there are benefits to the use of pesticides, there are also drawbacks, such as potential toxicity to humans and other animals.

Pesticides can be classified by target organism, chemical structure, and physical state. Pesticides can also be classed as inorganic, synthetic, or biologicals (biopesticides), although the distinction can sometimes blur. Biopesticides include microbial pesticides and biochemical pesticides. Plant-derived pesticides, or "botanicals", have been developing quickly. These include the pyrethroids, rotenoids, nicotinoids, and a fourth group which includes strychnine and scilliroside.

Many pesticides can be grouped into chemical families. Prominent insecticide families include organochlorines, organophosphates, and carbamates. ***Organochlorine*** hydrocarbons could be separated into dichlorodiphenylethanes, cyclodiene compounds, and other related compounds. They operate by disrupting the sodium/potassium balance of the never fiber, forcing the nerve to transmit continuously. Their toxicities vary greatly, but they have been phased out because of their persistence and potential to bioaccumulate. ***Organophosphate*** and carbamates largely replaced organochlorines. Both operate through inhibiting the enzyme acetylcholinesterase, allowing acetylcholine to transfer nerve impulses indefinitely and causing a variety of symptoms such as weakness or paralysis. Organophosphates are quite toxic to vertebrates, and have in some cases been replaced by less toxic carbamates. ***Thiocarbamate and dithiocarbonates*** are subclasses of carbamates. Prominent families of herbicides include phenoxy and benzoic acid herbicides, triazines, ureas, and chloroacetanilides. Phenoxy compounds tend to selectively kill broadleaved weeds rather than grasses. The phenoxy and benzoic acid herbicides function similar to plant growth hormones, and grow cells without normal cell division, crushing the plants nutrient transport system. Triazines interfere with photosynthesis.

Many commonly used pesticides are not included in these families, including

- glyphosate;
- algicides or algaecides for the control of algae;
- avicides for the control of birds.
- bactericides for the control of bacteria.
- fungicides for the control of fungi and oomycetes.
- herbicides (e.g., glyphosate) for the control of weeds.
- insecticides (e.g. organochlorines, organophosphates, carbamates, and pyrethroids) for the control of insects - these can be ovicides (substances that kill eggs), larvicides (substances that kill larvae) or adulticides (substances that kill adults).
- miticides or acaricides for the control of mites.
- molluscicides for the control of slugs and snails.
- nematicides for the control of nematodes.
- rodenticides for the control of rodents.
- virucides for the control of viruses.

Fungicides are chemical compounds or biological organisms used to kill or inhibit fungi or fungal spores. Fungi can cause serious damage in agriculture, resulting in critical losses of yield, quality and profit. Fungicides are used both in agriculture and to fight fungal infections in animals. Chemicals used to control oomycetes, which are not fungi, are also referred to as fungicides as oomycetes use the same mechanisms as fungi to infect plants.

Fungicides can either be contact or systemic. A contact fungicide kills fungi by direct contact; a systemic fungicide has to be absorbed by the affected organism.

Most fungicides that can be bought retail are sold in a liquid form. The most common active ingredient is sulfur, present at 0.08% in weaker concentrates, and as high as 0.5% for more potent fungicides. Fungicides in powdered form are usually around 90% sulfur and are very toxic. Other active ingredients in fungicides include neem oil, rosemary oil, jojoba oil, and the bacterium *Bacillus subtilis*.

Fungicide residues have been found on food for human consumption, mostly from post-harvest treatments. Some fungicides are dangerous to human health, such as vinclozolin, which has now been removed from use.

Environmental effects of pesticides

Pesticide use raises a number of environmental concerns. Over 98% of sprayed insecticides and 95% of herbicides reach a destination other than their target species, including non-target species, air, water and soil. Pesticide drift occurs when pesticides suspended in the air as particles are carried by wind to other areas, potentially contaminating them. Pesticides are one of the causes of water pollution, and some pesticides are persistent organic pollutants and contribute to soil contamination.

In addition, pesticide use also reduces biodiversity and results in lower soil quality, reduced nitrogen fixation, contribute to pollinator decline, can reduce habitat, especially for birds, and can threaten endangered species.

Health effects of pesticides

Pesticides can be dangerous to consumers, workers and close bystanders during manufacture, transport, or during and after use.

The American Medical Association recommends limiting exposure to pesticides and using safer alternatives. Particular uncertainty exists regarding the long-term effects of low-dose pesticide exposures. Current surveillance systems are inadequate to characterize potential exposure problems related either to pesticide usage or pesticide-related illnesses. Considering these data gaps, it is prudent to limit pesticide exposures and to use the least toxic chemical pesticide or non-chemical alternative.

Anyone who has grown a garden, maintained a lawn, or kept house plants knows that it is necessary to apply a fertilizer to the soil to keep cultivated plants healthy.

As they grow, plants extract nutrients they need from the soil. Unless these nutrients are replenished, plants will eventually cease to grow. In nature, nutrients are returned to the soil when plants die and decay. However, this does not occur with cultivated plants.

Humans cultivate plants mainly for food, either for themselves or for livestock. When cultivated plants are harvested, the nutrients that the plants extracted from the soil are taken away. To keep the soil productive, it is necessary to replace these nutrients artificially. The kinds and amounts of nutrients that plants need have been determined and can be supplied by applying to the soil substances that contain these nutrients.

Pesticides may cause acute and delayed health effects in workers who are exposed to it. Pesticide exposure can cause a variety of adverse health effects, ranging from simple irritation of the skin and eyes to more severe effects such as affecting the nervous system, mimicking hormones causing reproductive problems, and also causing cancer. Lymphoma and leukemia showed positive associations with pesticide exposure. Strong evidence also exists for other negative outcomes from pesticide exposure including neurological, birth defects, fetal death, and neurodevelopmental disorder.

Fertilizers – are materials, either natural or manufactured, containing nutrients essential for the normal growth and development of plants. There are:

- organic fertilizers.
- inorganic fertilizers (composed of synthetic chemicals and/or minerals).

Fertilizers typically provide, in varying proportions:

- six macronutrients: nitrogen (N), phosphorus (P), potassium (K), calcium (Ca), magnesium (Mg), and sulfur (S);
- six micronutrients: boron (B), chlorine (Cl), copper (Cu), iron (Fe), manganese (Mn), molybdenum (Mo), and zinc (Zn).

Effects of fertilizers. Nitrate levels above 10 mg/L (10 ppm) in groundwater can cause «blue baby syndrome» (acquired methemoglobinemia), leading to hypoxia (which can lead to coma and death if not treated). Nitrite may react with compounds in the stomach to produce N-nitroso-compounds, particularly nitrosamines, which have carcinogenicity.

Mercury, lead, cadmium and uranium are some of the toxic heavy metals that have been found in fertilizers and can cause disturbances of the kidneys, lungs and liver and cause cancer.

Usage of fertilizers can cause dermatitis, rhinitis, conjunctivitis, resorptive action leading to dystrophic changes of a liver, kidneys, a spleen and heart.

Prevention of professional pathology for agricultural workers is spent by the same principles, as in industries and includes legislative, technological, sanitary-technical, planning, organizational and treatment-prophylactic actions, and also use of individual protective equipment. Special attention is given to ***prevention of poisonings by pesticides*****:**

- pesticides should be stored in warehouses specially intended for it;
- all toxic chemicals should be packed into container with accurate marks;
- in an operating time in warehouse, it is forbidden to accept food, to drink water and to smoke;
- to work it is necessary in overalls, respirators or gas masks and other individual protective equipment;
- for transportation of toxic chemicals and mineral fertilizers use special cars, barges, automobile and cartage.

Hygiene of work of medical officers. Working conditions of doctors must be **optimum**. Working conditions – is set of production factors influencing health and working capacity of person in the course of work. There are several parameters of doctors' working conditions:

- chemical, physical, biological and psychophysiological factors of industrial environment;
- character and work organization;
- planning and sanitary-technical accomplishment of premises;
- household maintenance of workers;
- psychological climate in collective, etc.

Optimum working conditions creates when workers' health remains and preconditions for maintenance of high level of working capacity.

Features of doctor's work:

- presence of diurnal and night watches;
- absence of fixed lunch break;

- big congestion of working day;
- infringement of work, rest and food regimen.

Doctors had harmful factors: big nervously-emotional stress, ionizing, laser and ultra-violet radiances, ultrasonic sound and fields of superhigh frequency, raised and depressed atmospheric pressure, influence of aerosols of antibiotics, anaesthetics and other medicine.

Hazards in the work of doctors:

Physical nature: ionizing, laser and ultraviolet radiation, ultrasound, ultra-high- frequency fields, high and low atmospheric pressure, noise and vibration.

Chemical nature: highly active chemotherapy drugs, antiseptics, anesthetics, medical gases, medical aerosols.

Biological nature: bacteria, allergens, protein-vitamin and immunological products, certain antibiotics.

Psychophysiological nature: increased psycho-emotional stress and muscle tension, stress of visual and auditory analyzers.

Adverse professional factors of therapists**:**

- unfavorable environmental factors;
- work disturbance;
- possibility of infestation by infectious diseases from contact to patient.

General pediatricians care for the health of infants, children, teenagers, and young adults. They specialize in the diagnosis and treatment of a variety of ailments specific to young people and track patients' growth to adulthood. Most of the work of pediatricians involves treating day-to-day illnesses-minor injuries, infectious diseases, and immunizations-that are common to children, much as a general practitioner treats adults. Some pediatricians specialize in pediatric surgery or serious medical conditions, such as autoimmune disorders or serious chronic ailments.

Anesthesiologists focus on the care of surgical patients and pain relief. Like other physicians, they evaluate and treat patients and direct the efforts of their staffs. Through continual monitoring and assessment, these critical care specialists are responsible for maintenance of the patient's vital life functions-heart rate, body temperature, blood pressure, breathing-during surgery. They also work outside of the operating room, providing pain relief in the intensive care unit, during labor and delivery, and for those who suffer from chronic pain. Anesthesiologists confer with other physicians and surgeons about appropriate treatments and procedures before, during, and after operations.

Adverse professional factors of doctors-anesthesiologists:

- high nervously-emotional stress;
- influence of narcotic materials;
- irrational regimen of work;
- heating microclimate;
- x-ray irradiating.

Obstetricians and gynecologists (OB/GYNs) specialize in women's health. They are responsible for women's general medical care, and they also provide care related to pregnancy and the reproductive system. Like general practitioners, OB/GYNs attempt to prevent, diagnose, and treat general health problems, but they focus on ailments specific to the female

anatomy, such as cancers of the breast or cervix, urinary tract and pelvic disorders, and hormonal disorders. OB/GYNs also specialize in childbirth, which includes treating and counseling women throughout their pregnancy, from giving prenatal diagnoses to assisting with delivery and providing postpartum care.

An obstetrician is a doctor who specializes in caring for pregnancies, as well as labor and the postpartum period. Many obstetricians have also received training in gynecology, which deals with the health of the female reproductive system. Those doctors who are trained in both fields are referred to as obstetrician/gynecologists or OB/GYN.

Professional work of obstetricians-gynecologists is similar to activity of surgeons. Specificity of their job consists in constant readiness for arising difficult situations demanding strain of attention, exact coordination of touch sensitive and motor functions.

Psychiatrists are the primary mental health caregivers. They assess and treat mental illnesses through a combination of psychotherapy, psychoanalysis, hospitalization, and medication.

Psychotherapy involves regular discussions with patients about their problems; the psychiatrist helps them find solutions through changes in their behavioral patterns, the exploration of their past experiences, or group and family therapy sessions. *Psychoanalysis* involves long-term psychotherapy and counseling for patients. In many cases, medications are administered to correct chemical imbalances that cause emotional problems.

Adverse professional factors of physiatrists:

- influence of ultrasonic sound;
- influence of infrasound;
- influence of fields of superhigh frequencies and magnetic field;
- influence of ozone;
- influence of electric current.

Surgeons specialize in the treatment of injury, disease, and deformity through operations. Using a variety of instruments, and with patients under anesthesia, a surgeon corrects physical deformities, repairs bone and tissue after injuries, or performs preventive surgeries on patients with debilitating diseases or disorders. Although a large number perform general surgery, many surgeons choose to specialize in a specific area. One of the most prevalent specialties is orthopedic surgery: the treatment of the musculoskeletal system. Others include neurological surgery (treatment of the brain and nervous system), cardiovascular surgery, otolaryngology (treatment of the ear, nose, and throat), and plastic or reconstructive surgery. Like other physicians, surgeons also examine patients, perform and interpret diagnostic tests, and counsel patients on preventive healthcare.

At a hospital, modern surgery is often done in an operating theater using surgical instruments, an operating table for the patient, and other equipment. The environment and procedures used in surgery are governed by the principles of aseptic technique: the strict separation of "sterile" (free of microorganisms) things from "unsterile" or "contaminated" things. All surgical instruments must be sterilized, and an instrument must be replaced or re-sterilized if it becomes contaminated (i.e., handled in an unsterile manner, or allowed to touch an unsterile surface). Operating room staff must wear sterile attire (scrubs, a scrub cap, a sterile surgical gown, sterile latex or non-latex polymer glove and a surgical mask), and they must scrub hands and arms with an approved disinfectant agent before each procedure.

Adverse professional factors of doctors-surgeons:

- big nervously-emotional stress;
- forced posture;
- heating microclimate;
- sharp oscillation of light exposure;
- high operational load;
- night watches;
- narcotic and toxicants;
- anesthetics;
- X-rays, laser radiation;
- microbial factor;
- hazard of infestation AIDS, syphilis, virus hepatitis.

As result of surgeons' professional work hypertonia, hypotension, phlebeurysm of inferior extremities, platypodia, stenocardia, ischemic heart disease, and other illnesses can educe.

Other physicians and surgeons work in a number of other medical and surgical specialists, including allergists, cardiologists, dermatologists, emergency physicians, gastroenterologists, ophthalmologists, pathologists, and radiologists.

Adverse professional factors of ***roentgenologists*** *and* ***radiologists*****:**

- insufficient light exposure;
- unfavorable microclimate;
- raised radioactivity;
- ozone and nitrogen oxide;
- external and internal irradiation.

For ***prevention of professional pathology*** and creation of favorable working conditions standard parameters of microclimate, air environment and air exchange should be provided. In procedural, inhalation, dressing-room and sterilizing premises fuming board with wash sink and drainage in water drain should be provided.

For medical personnel necessary composition of sanitary-household premises is provided:

- wardrobe;
- cases for storage house and working clothes;
- footwear and headdresses;
- shower;
- toilets;

- rooms of personal hygiene.

Providing of workers with hot food in hospitals is carried out in dining rooms or buffets. There should be rooms for personnel with area not less than 12 m^2, equipped with refrigerators, electrowater-heating devices and washstands. Medical personnel working in harmful working conditions, should pass preliminary and periodic medical inspections.

Improvement of surgeons' working conditions

- conditioners and special boards operational for the visual control of a patient's state and equipment;
- maintenance by centralized supply of oxygen, anesthetic gases and vacuum to each operational table;
- carrying of orthopedic footwear;
- work and rest rationalization;
- rationing of planned operational loading no more than 10 hours per week and 2 duty days per month.

Improvement of anesthesiologist's work

- air conditioning;
- centralized supply of oxygen, anesthetic gases and vacuum;
- local exhaust ventilation;
- presence of armchair rotating and easily changing height in the workplace;
- rational mode of work and rest.

Prevention of a professional pathology of radiologists and roentgenologist:

- placing in separate buildings;
- presence of a separate input for reception and removal of radioactive substances and specially equipped premises for carrying out of radiological researches;
- placing no more than 2 beds in ward;
- organization of special system of a waterpipe and faecal-economic water drain with treatment facilities.

Protection principles of personnel working with occluded sources**:**

- by the quantity - reduction of source's radiation capacity;
- by the time - reduction of operating time with source;
- by the distance - increase of distance from source to working person;
- by the shields - application of materials absorbing an ionizing radiation.

The average annual effective dose for personnel directly working with ionizing radiation sources, should not exceed 20 mSv.

Гігієна праці

Курс лекцій
для студентів Медичного інституту

Відповідальний за випуск В. А. Сміянов

Редактор Н. А. Галушко

Комп’ютерне верстання Н. А. Галушко

Формат 60×84/8. Ум. друк. арк 10,81. Обл.-вид. арк. 5,16.

Видавець і виготовлювач
Сумський державний університет,
вул. Римського-Корсакова, 2, м. Суми, 40007
Свідоцтво суб’єкта видавничої справи ДК № 3062 від 17.12.2007