Тема 17

Hygienic estimation of chemical factors of the production environment
The method of investigation of occupational diseases and poisonings.
Preliminary and periodic medical examinations as measures of their prevention.
Seminar.

Матеріал:

Occupational Hazards and Exposures:

Hundreds of millions of workers in both developed and developing countries are at risk from exposure to physical, chemical, biological, psychosocial or ergonomic hazards in the workplace. For many of these people there is often the risk of combined exposures to different occupational hazards.

- Approximately 30% of the workforce in developed and between 50 and 70% in developing countries may be exposed to heavy physical workloads or ergonomically poor working conditions, which can lead to injuries and musculoskeletal disorders. Those most affected include miners, farmers, lumberjacks, fishermen, and construction workers, warehouse workers and healthcare personnel.
- Physical hazards, which can adversely affect health, include noise, vibration, ionizing and non-ionizing radiation, heat and other unhealthy microclimatic conditions. Between 10 and 30% of the workforce in industrialized countries and up to 80% in developing and newly industrialized countries are exposed to a variety of these potential hazards.
- Exposure to hundreds of biological agents – viruses, bacteria, parasites, fungi and moulds – occurs in many occupational environments from agriculture to offices. The Hepatitis B and C viruses, HIV/AIDS infection and tuberculosis (particularly among healthcare workers), and chronic parasitic diseases (particularly among agricultural and forestry workers) are some of the most common occupational diseases resulting from such exposures.
- Thousands of toxic chemicals pose serious health threats potentially causing cancer, respiratory and skin diseases as well as adverse effects on reproductive function. Workers can be and often are exposed to hazardous chemical agents such as solvents, pesticides and metal dusts.
- Workers may also be exposed to various types of mineral and organic dusts. For example, silica, asbestos and coal dust cause irreversible lung diseases, including different types of pneumoconioses. Known since the time of Hippocrates, silicosis is still the most widespread occupational lung disease. Silicosis can predispose workers to tuberculosis and lung cancer;

it is progressive and incurable but preventable. Organic dusts can cause a number of respiratory conditions (such as byssinosis) and allergic reactions (such as asthma).

- The risk of cancer from workplace exposure is of particular concern. Around 350 chemical substances have been identified as occupational carcinogens. They include benzene, hexavalent chromium, nitrosamines, asbestos and aflatoxins. In addition, the risk of cancer also exists from exposure to physical hazards such as ultraviolet (UV) and ionizing radiations. The most common occupational cancers include lung, bladder, skin and bone cancer, leukaemia and sarcomas. In the European Union, approximately 16 million people are potentially exposed to hazards at work, including carcinogenic agents.
- Exposure to thousands of allergenic agents, including vegetable dusts, is a growing cause of work-related illness. A large number of allergens have been catalogued which can cause skin and respiratory diseases (e.g., asthma). The number of these disorders, registered in several industrialized countries, is increasing steadily.
- Social conditions at work, which raise serious concerns about stress, include inequality and unfairness in the workplace; management style based on the exclusion of workers from the decision-making process; lack of communication and poor organization of work; strained interpersonal relationships between managers and employees. Stress at work has been associated with elevated risks of cardiovascular diseases, particularly hypertension, and mental disorders.

In the least developed countries, occupational health problems are found essentially in agriculture and other types of primary production. Heavy physical work, often combined with heat stress, pesticide poisoning and organic dusts, is frequently aggravated by non-occupational factors such as chronic parasitic and infectious diseases. Poor hygiene and sanitation, nutritional problems, poverty and illiteracy heighten the risk of disease and/or occupational injury.

Practically in all spheres of labour activity the man has professional contact to that or other chemical substance. Industrial poisons, substances meeting during labour activity of the man as initial, intermediate, or the final products of synthesis, at infringement of the safety precautions regulations and hygiene of work can get in a workers organism in quantities dangerous to their health.

In modern conditions industrial poisons meet practically in all industries and agriculture. So at reception both processing of policondesated and polymeric plastic masses in air space of a working zone the containing initial monomeasures, catalytic additives, products incomplete polimerization and thermooxidative destruction, dust particle of powder polymers and ready products act with complex steam-gas and steam-aerosol complexes at their machining. The representatives of metals (wolfram, molibden, chromium, nickel, beryllium, lithium etc.) appear in metallurgy except for a long time well known oxides of carbon and sulfur as industrial harms. In collieries, mines, open

carriers, where the production of minerals by an explosive way in air will be carried out the oxides of nitrogen, carbon and high-dispersed aerosol are allocated. In a metalcutting industry the motor oils and antifrise liquids containing in the structure aggressive substances - naphten acid, alkalis etc are widely used. The significant quantity of industrial poisons is connected to technological process in a chemical industry (basic chemistry, coxochemical manufacture, manufacturing of dyes, synthetic polymers and plastic weights). In an agriculture in the large assortment and volumes are used pesticides and mineral fertilizers.

In study of influence of harmful chemical substances on worker organism with the purpose of contents safe and harmless working conditions on manufactures the section of hygiene of work named industrial toxicology is engaged.

Its basic sections - toxicometry and pathogenesis of intoxication. Toxicometric research precedes studies on pathogenesis of intoxication, with their help establish parameters of toxic ability and danger of substance, the clinic of a poisoning is described at unitary and repeated contact to the agent, the toxicodinamics (dynamics of infringements of separate functions of an organism is studied), the pathomorphology of a poisoning is described. Pathogenesis of intoxication - adjacent section of toxicology and pathological physiology studies toxicokinetics of poison (route of exposure, distribution, metabolism and deducing)), and also the conducting mechanisms of a toxic action are established: biochemical, biophysical, pathophysiological, imunological etc.

Industrial toxicology has as the goal to warn, to distinguish and to treat professional poisonings, to warn and to eliminate the remote consequences of harmful influence of the chemical agents on workers and their children and decides the following tasks:

1. Establishment of parameters of toxic ability and danger of new chemical substances
2. Development of the hygienic standards in view of complex and combined action industrial poisons
3. Study of ability of substances, used in manufacture, to cause change of reactivity of an organism and to cause the remote effects -cancerogenic, embriotoxic, teratogenic, mutagenic, atherogenic, premature aging etc.
4. Research toxicokinetics and toxicodinamics of an industrial poisons and development of ways of early diagnostics, pathogenetic therapy and preventive maintenance professional intoxications
5. Study of dependence of biological action industrial poisons from chemical structure and physical-chemical properties for development of express trains - methods of a toxicological estimation of new chemical substances both realization of search and synthesis of less toxic and dangerous chemical compounds.

As a whole, the briefly listed tasks can be reduced to three:

1) hygienic norm setting of the contents of harmful substances in objects of industrial environment

2) hygienic examination of toxic substances
3) hygienic standardization of raw material and products (N. Pravdin)

It is necessary to take into account, that the modern technological processes are frequently connected to risk complex (influence of one chemical substance at simultaneous receipt in an organism by various ways), combined (action of several chemical substances) and combining action (combination industrial harms with chemical and another (physical, biological) nature)

The modern classifications industrial poisons are based on allocation of separate classes of substances on their chemical structure, modular condition, degree of toxic ability and danger, character and mechanism of influence on an organism and other attributes.

By the chemical nature industrial poisons divide on inorganic, organic and elementary-organic.

To the basic groups inorganic industrial poisons concern: galogens, compounds of sulfur, nitrogen, phosphorus, arsenium, carbon, cianides metals etc. Poisons of an organic nature are carbohydrides of aliphatic and aromatic lines and their derivative, aliphatic spirits, simple and complex ethers, aldegides, ketones, heterocyclic compounds etc.

On a modular condition of substances in air environment all substances could be divided on gases (for example, chlorine), steams (concentrated alkalis and acids) and aerososl (with a firm or liquid phase).

By the route of exposure they distinguish inhalatoric, ingestive and percutanic poisons.

In the practical purposes it's used the division of industrial poisons on their application in various branches of a national economy: the industrial solvents, varnishes and paints, polymers and plastic weights, pesticides, mineral fertilizers etc.

On the mechanism of action industrial poisons for all flying industrial substances it's used dividing on 4 large groups (Henderson, Haggard):

1. Asphyctive substance:

Simple asphyctive (mechanism of action - replacement of oxygen from inhaled air): nitrogen, hydrogen, helium

Chemically active (cause hypoxic, hemic or tissual hypoxy): charcoal gas, hydrocianic acid

2. irritating substances: oxydes of sulfur, nitrogen, chlorine, hidrochlorine, hidrofluore, ammonia etc.
3. flying narcotic substances:

Not having expressed after-action (hypoxide of nitrogen, ethers, aliphatic carbohydrates

-toxic for parenchima (galogenic carbohidrides of an aliphatic line

-toxic for hemopoesis (aromatic carbohydrides)

-neurotoxic (alcohol, sulfurous compounds of carbohidrides of a greasy line)

-toxic for blood and cardiovascular system (aniline, nitrobenzyl)

4. Protoplazmatic poisons (inorganic and metalorganic substances): mercury, lead, phosphorus, arsenic acid etc.

Henderson, Haggard had divided all chemical substances till them toxicokinetics and toxicodinamics on reacting and not reacting. The toxic action of reacting substances can be caused as substance, and it metabolites (the toxic action at a poisoning with benzyl is connected also by its derivatives - phenol, pirokatechin and hydrochinon), in some cases the metabolites are more toxic than initial substance (lethal synthesis).

More modern classifications allocate such classes of chemical compounds on character of influence on a human organism: rendering general toxic, irritating, sensibilative, cancerogenic, mutagenic action influencing on reproductive function.

On localization of display of harmful action of chemical substances distinguish industrial poisons: local, resorbtive and mixed (local-resorbtive) action.

From positions of a hygienic science the classification by a degree of toxic ability and danger is especially important.

Toxic ability is a property of chemical compounds to cause harmful action. Toxic ability opposite is defined as size to absolute meaning of an average lethal doze or concentration:

$(\frac{1}{DL_{50}}; \frac{1}{CL_{50}})$.

By the level of toxic ability all chemical substances are divided on extremely toxic, very toxic, moderately toxic, low toxic; by the intensity of influence on an organism- on extremely dangerous, very dangerous, moderately dangerous, low dangerous). Accordingly to ГОСТ 12.1.007-76" ССБТ[1] “Harmful substances. Classification and the general requirements of safety " the classifications are based on such criteria as maximal admitted concentration (MAC), DL_{50} at introduction of substance in a stomach and drawing on a skin, CL_{50} for inhalatory receipt, factor of an opportunity of a inhalatory poisoning (FOIP), zone of sharp and chronic action:

Table 6.1 Classification of the chemical hazards

Parameter	norm on a class of danger			
	1	2	3	4
ПДК mg/m^3	< 0.1	0.1-1.0	1.1-10	> 10
DL_{50inh} mg/kg	< 15	15-150	151-5000	> 5000
DL_{50cut} mg/kg	< 100	100-500	501-50000	> 50000
CL50 mg/m^3	< 500	500-5000	5001-50000	> 50000
Zone of	< 6,0	6,1-18,0	18,1-54	> 54

[1] Special standards of ocuupational safety

acute action				
Zone of chronic action	> 10	10-5,0	4,9-2,5	< 2,5
FOIP	> 300	300-30	29-3	< 3

Basic toxicometric parameters are the parameters of potential danger - perspirative activity of compounds (or its derivative - FDIP and FDSIP (factor of danger (sudden) inhalatory poisoning), solubility in water and in fats, dispersity of an aerosole and parameters of real danger.

Toxic ability (value is back proportional to DL_{50} and CL_{50} and directly proportional to danger), absolute meanings of thresholds of harmful action (acute general toxic Lim_{ac}, chronic general toxic Lim_{ch}, specific Lim_{sp}) - back proportional dangers, and also derivative parameters (zone acute (Z_{ac}) and chronic general toxic (Z_{ch}) action, zone selective (specific) (Z_{sp}) action)

The routes of exposure of chemical substance are determined, first of all, by its modular condition. The inhalatory route of exposure is probable for gases, steams and aerosols. This route of exposure to industrial poisons in an organism is basic and most dangerous (the area of alveolar membranes exceeds 100 $м^2$). The speed of absorption of the agent in blood depends on its modular condition, solubility in water and bioenvironments, partial pressure in an alveolar air, level pulmonar ventilation, speed of blood stream in lungs, condition of tissues of lungs (presence of inflammatory processes, transsudates, exsudates), character of chemical interaction of the agent with biosubstrates of respiratory system.

The mechanism of absorption through a skin is combined. Direct transepidermic penetration through epidermis, hair folliculi and sebaceous glands, through ducti of sweat gland is probable. The sites of a skin on a medial surface of thighs and hands, in a inguinal area, skin of genitalia. Breast and the abdomen are most sensitive in this respect. The most dangerous for percutanic penetration are the substances which soluble both in water and in fats.

To industrial poisons capable to cause intoxication at contact to the unprotected skin and mucouses they distinguish aromatic amino- and nitrocompounds, phosphororganic insecticides, chlorined carbohydrides, metallorganic compounds. Electrolytes will not penetrate through a skin, they are lingered over, as a rule, in a horn or brilliant layer of epidermis. The exception is only for heavy metals (lead, tin, copper, arsenium, bismuth, mercury, antimony) and their salt, which are combining with greasy acids on a surface or inside a horn layer of epidermis and forming fat-soluble salts. Through a skin will penetrate not only liquid, but also flying gases and steams.

Resorbtion of toxic substances from the digestive channel in most cases has selective character, since its various departments have the special structure, chemical environment and enzyme system.

Some poisons (all fat-solvable substances, phenols, some salts (is especial cyanides)) are soaked up already in a cavity of a mouth. Thus them toxic ability grows, since they are not exposed to action of gastric juice and, missing portal circulation, so they are not neutralized in a liver. In a stomach all fat-solvable substances and not ionized molecules of organic compounds are absorbed by the simple diffusion. Through pores of a cellular membrane of gastric epithelium the penetration of substances is possible also by a filtration. Many toxic compounds are inactvated at contact to gastric juice: kurare, tetanotoxine, poisons of the snakes and insects. On the other hand, many poisons, including the compounds of lead, in gastric contents are dissolved better than in water, therefore they are absorbed better. Character and speed of adsorption are depend upon a degree of filling of a stomach, solubility of substance in gastric contents and it pH. The substances accepted on an empty stomach are most intensively soaked up.

The biggest part of the toxic agents is sabsorbed in the thin intestine.

Proteins of plasma especially albumines play the basic role in transportation of poisons by blood . The part of substances is transferred in erythrocytes by the formation of temporary compounds with hemoglobine.

The certain role in the pathogenesis of poisonings chemoreceptores of vessels of lesser (bulbar innervation) and greater (spinal innervation) circulation play.

The basic transformations of toxic substances are oxidation, restoration, hydrolysis, synthesis (formation of pair compounds) and conjugation. The biotransformation of poisons, as a rule, has their detoxication as results, with formation of low toxic polar water-solvable substances easily excreting with urine. The biotransformation can have a character of the lethal synthesis (it's very characteristic for phosphororganic and some chlorinorganic substances). The basic bodies participating in neutralization of the toxic agents, are a liver, the kidneys, lungs, walls of a stomach and intestine.

Industrial poisons and them methabolites in the kidneys, GIC and skin are allocated from the organism through lungs. Excretion of toxic substances can go simultaneously by several ways. Through lungs they are allocated flying nonelectrolytes. Through kidneys it's possible the allocation both electrolytes and nonelectrolytes (last one leaves by active renal transport). Through a digestive path are allocated poor-solvable and insoluble industrial poisons: with a saliva (lead and mercury), with gall etc. Through sebaceous glands they are allocated some fat-soluble industrial poisons, about then mercury, copper, oxydes of iron, hodrosulfur etc.

Some soluble in lypoides substances (benzyl, ethanol, chloroform) can be allocated by mammas with milk.

The selective action in relation to those or other bodies and systems is characteristic for many industrial poisons. On the other hand, depending on dozes industrial poisons are capable to cause all known pathologic processes: an inflammation, dystrophy, fever, allergy, remote results

(growth of malign and benign tumors, infringements of development of a fetus, infringement of the cell genome). The inflammatory reaction at action of the toxic agents can have expressed exsudative character (gases of asphyctic action - oxudes of nitrogen, ammonia, phosgen), alterative-inflammatory change are characteristic for high grade active chemical compoundss (phenol, naphtholes, calcium carbide, salts of chromium and nickel), a proliferation prevails at chronic influence of small concentration of substances with irritating and fibrogenic action (ammonia, chlorine, asbest). Dystrophic changes are accompanying an influence of any toxic substance, their localization (liver, kidney, myocardium, brain etc.) is determined by toxicodinamics and toxicokinetiks of substance. The fever of not infectious genesis frequently is connected with intoxications by compoundss of metals. So, the pathogenesis of a "foundry" fever is explained with protein denaturation and changing of antigenic properties of proteins under action of the oxidated forms of metals. An allergenic property derivative have aromatic, amines, nitric- and nitrose substances, arsenium, mercury, cobalt, nickel, chromium, platinum, beryllium, phormaldegide, turpentine, organic oxydes and hydrohydes, plenty of synthetic polymers and plastic. Allergenes with molecular weight less than 1000 Da are gaptenes, which are conjugated with proteins through NH_2-, SH- and -S-S- groups. To the remote consequences of the intoxications with the industrial poisons, it's having the long latent period, carry embriotoxic (teratogenic) action, mutagenic action, cancerogenic action.

The substances with cancerogenic action are classified by the International agency for research on cancer with allocation of three groups on a degree of their cancerogenity. The first group includes 23 substances (arsenium, asbest, chromium and their compounds, the soot, pitches, petroleum, benzyl, benzydine, 2-naphthalamine, 4-aminobiphenil, bis- (chlormethyl) ether, technical chlormethyl ether, vinilchloride, some medicinal means) and 7 industries (producation of oramine, rubbers, production and repair of footwear, furniture, isopropilic spirit (because of use of the concentrated acids), refined nickel), cancerogenic effect of which is most authentic

The second group represents substancies with potential danger for a man. There are 14 compounds with a high degree of cancerogenity (3,4-benzpiren, berillium, nickel and their compounds etc.) and 47 compounds with low cancerogenity (for example, compounds of cadmium).

The third group includes substances with low evidence of cancerogenity.

Besides industrial poisons can cause non-specific reactions: to reduce work capacity and resistance of an organism for various exo- and endogenic factors, to weak immunologic reactivity, to aggravate course of diseases, to promote occurrence the atherosclerosis, hypertonic disease, premature aging, infertility. Such action refers to paratoxic.

In some cases they observe the methatoxic action of a poison - the follow-up exacerbations after acute intoxication. (For example, occurrence of acute psychosis in many months later the acute poisoning with irritating gases).

The phenomena of methatoxic and paratoxic action for small dozes of the industrial poisons connect to phenomena of their material and functional cumulating.

Material cumulating consists in selective accumulation of the agent by biosubstrates (depot), functional - in summation and accumulation of functional changes (fermentative, reflectoric etc.)

Material cumulating is characteristic for poisonings with metals and their salts, cyanides, charcoal gas, functional - for a poisoning with clorined carbohydrides, benzyl, petrol, trinitrotololum and many other gases and pairs. Material cumulating can be combined with functional, but the conducting role in development of a chronic intoxication belongs for functional cumulating. (So, for example, carriage of some poisons (mercury, lead) can not be accompanied by clinical displays, and on the contrary, at many poisonings poisons and them metabolites in bioenvironments of an organism are not defined (flying narcotic compounds).

It's developing repeated action on an organism of chemical substances alongside with cumulating is the process of adaptation (adequate changes of the parties of an organism for the best adaptation). Thus the accustoming to toxic substance has three phases - phase of primary reactions, the phase of development of accustoming (in which number of the authors is allocated with the periods of pseudo-adaptation and indemnification of pathological process) and phase expressed intoxication.

The combined action of the industrial poisons can be realized as homogeneous joint (components work on the same system of receptors, at what the replacement of one component by another does not influence on toxity of a mix), independent joint (the components work on various physiological systems, at what the effect from influence can be caused by action only of one of the agents), synergic and antagonistic joint (toxity of a mix is defined by interaction of poisons and biosubstrate). For a quantitative estimation of the combined effect use concepts of additivity (summation) and its two gradation: antagonism (effect less additive) and synergism (effect more additive). Synergism is named also potentioning.

Summation is characteristic for the majority of combinations industrial poisons. Potentioning is often explained as blocking by one substance of biotransformation of another. So synergism of the effects of mixes various POS, is explained by an oppression of cholinesterase to one of the agents and thereof, braking of detoxication another.

The antagonistic effect takes place at interaction of components of a gas mix with formation less toxic compounds (sulforous anhydride and chlorine, ammonia and carbonic gas) or antagonistic action (competition for same receptors - for example, sympathomimetics and sympatholytics).

For a hygienic estimation of air environment under condition of additive action of industrial gases use the Averjanov's formula

$$\frac{C_1}{ПДК_1}+\frac{C_2}{ПДК_2}+\ldots+\frac{C_n}{ПДК_n}\le 1,$$

where C_1, C_2, C_n are the concentration of substances in air, and $ПДК_1$, $ПДК_2$, $ПДК_n$ are their maximal allowable concentration.

The combined influence of the toxic substances with the physical factors can be realized both as antagonism, and as synergism. So the noise (85-95 dBA) is acting a role of adaptogen to raise stability of an organism to influence of a line of the organic solvents (acetine etc). General low-frequency vibration and noise in a combination with separate toxic substances and complexes of toxic substances in quantities close to MAL and MAC are working by a type of synergism (it is explained by that the nose-vibrating complex, breaking hystohematic barriers and permeability of cellular and mitochondrial membranes, promotes penetration of the toxic agents into a cell, but also general vibration and noise reduce antitoxic and protein-synthetic function of a liver). The ionizing radiation strengthens an action of the chemical cancerogens; the ultra-violet irradiation in small dozes raises the resistance of an organism, and at an excessive irradiation strengthens an action of the industrial poisons.

Complex action of chemical substances is not only simultaneous exposure to the industrial poisons by several routes (organic solvents, salt of heavy metals simultaneously inhalated and penetrating through a skin), but also characteristic of situations, when the chemical substances act in the organism from various objects of environment. So, the compounds of polivinilchloride can act in an organism from air of a working zone, with drinking water and foodstuff, through clothes and footwear, from air of the occupied places. For industrial poisons, which except for inhalation have also a skin-resorbtive action establish alongside with MAC for air of a working zone also MAL of pollution of a skin. As the criterion of a hygienic estimation of an environment at the combined and complex influence of harmful substances is offered a parameter of a maximum safe load (MSL), i.e. the maximal intensity of action of all set of the factors of external environment which is not rendering of direct or indirect influence on a human organism and his posterity, not worsening of sanitary conditions of life.

Professional intoxication are divided on an acute and chronic. The acute poisonings arise owing to rather short-term (during one working change), but it is enough intensive (concentration exceeds MAC and hundred and thousand time) actions of the toxic agents. The reasons of acute professional intoxications can be emergencies, significant infringement of the technological rules (especially temperature mode), safety precautions regulations and industrial sanitary. In a line of cases the acute poisoning develops immediately (poisoning with petrol at clearing tanks), in other cases after the certain latent period.

Meet chronic professional intoxication much more often, which development is connected to cumulative action of the industrial poisons. The chronic professional poisonings grow out or action of small concentration of the poison at long expositions or as a result of several acute poisonings.

For prevention of professional poisonings the regulation and standardization of the industrial poisons will be carried out. The basic principles hygienic norm setting are the priniciple of stage norm setting and the principle of control on the established specifications, principle of thresholds and principle of the priority of the medical indications. The principle of threshold provides presence of a threshold of adverse influence of the chemical agent, the principle of the priority of the medical indications puts forward the requirements to an establishment of the hygienic specification not from reasons of technical practicability or economic issues, but under the medical-biological indications.

As the official hygienic specification for air of a working zone in Ukraine are accepted ПДК (MAC). The establishment MAC, as a rule is preceded by definition of ОБУВ (RSLA), which establish for 2 years. Then RSLA they replace on MAC or reconfirm with new term (if the substance is used is limited also complete toxicological experiment is not justified). RSLA are by the legal basis for realization of the current sanitary supervision on laboratory and semi-factory installations with quantity of workers, not exceeding 100 men. RSLA, as a rule, can not be used at designing multitonnage manufacture. As agreed with bodies госсаннадзора it is on occasion authorized to pawn in the design decisions only RSLA of chemical substances of the third and fourth classes of danger.

In process of accumulation new given about toxic ability with regulated harmful toxic substances of them MAC are reconsidered. So, MAC of benzyl has changed 4 times (from 200 mg/m^3 up to 100, 50, 20 and 5 mg/m^3), MAC of aniline - three times (from 10 mg/m^3 up to 5, 3 and 0,01 mg/m^3).

Hygienic norm setting of new chemical compounds is carried out in three stages. At a stage of laboratory synthesis, skilled and semi factory tests of new compounds with an establishment RSLA will be carried out the preliminary toxicological estimation. The design stage of multitonnage manufacture and wide introduction of substance in a national economy requires the complete toxicological estimation of MAC definition under the complete circuit of researches on laboratory animals. The correction MAC on the basis natural (clinical-statistical) researches is made during the first years of functioning of the enterprise and at studies on the late consequences of the exposure - and in later terms.

This principles of toxicological norm setting are used not only in Ukraine. In the USA five basic systems are used to describe safe workplace exposure limits for potentially hazardous environments. They are follows:

- Threshold Limit Value (TLV)
- Permissible Exposure Limits (PEL)

- Recommended Exposure Limits (REL)
- Immediately Dangerous to Life an Health (IDLH)
- Lethal Dose 50 (LD_{50})
- Lethal concentration 50 (LC_{50})

Hygienic norm setting has huge meaning for professional selection and dispensarization of workers on harmful chemical manufactures. The preliminary (primary) and repeated medical surveys will be carried out by the experts in necessary volume, with application of laboratory and instrumental methods of diagnostics, in view of a structure working. The person responsible for realization of medical survey as a rule is workshop ordinatore. In some cases the responsibility for realization of medical survey assign to the doctors of other specialities (for example, neurologist at survey of the workers having contact to compounds of mercury). The doctors conducting physical examination should be well prepared both in the field of a professional pathology, and on hygiene of work. For preparation of the doctors the managers by branches of occupational hygiene SES are answering. Before the beginning of survey the doctors get acquainted with manufacture, working conditions, professional harms.

The most effective way of preventive maintenance of professional poisonings is the replacement of the toxic agent by other compounds. Other change of the technological circuit consists in automation of the most dangerous sites of works. For decrease of pollution of objects of industrial environment the equipment should be germetized carefully. The sanitary - technical measures of preventive maintenance include the rational device of ventilation, with maintenance of workplaces by local air exhausted ventilation, with application of absorbers and other clearing structures.

The dangerous works are made with application of individual protective means. Last are subdivided into individual means of protection of bodies of breath, skin, organs of sight. The individual means of protection of bodies of breath subdivide on filtering and isolating. To filtering the gas masks and helmets ensuring purification of an inhaled air from harmful impurity, inhaled the air, of filters and sorbents it's concerning respiratores. Their use is not supposed, if at air there are unknown substances, at the high contents of harmful substances (more than 0,5 % on volume) and low contents of free oxygen (less than 18 %). In these cases use isolating IMPOB).

Filtering respiratores are subdivided into three groups: antidust (antiaerosole) - "Астра-2", "Кама-200", "At - 2к" and (patrone) "ШБ-1" a Petal " (filter-mask), antigase (РПГ-67) and universal (РУ-60Мб). Antiaerosole respiratores on a way of ventilation подмасочного of space are be without and with valves. On conditions of operation distinguish respiratory of expendable and reusable use. The wide circulation for protection of bodies of breath and eye was received by industrial filtering gas masks.

Isolating IMPOB -hose /supplied-air respirators/ (with submission of air from a clean zone) and the independent respiratory devices (with carried by a stock of oxygen or with regeneration of air) provide protection with isolation of bodies of breath of the man from an environment.

For protection of an eye at having poured of aggressive liquids the closed glasses with direct ventilation or tight glasses - canned food are recommended.

The means of protection of a skin include protective pastes, ointments and creams, and also special clothes and спецобувь. For protection against action of fat-soluble organic substances are used hydrophylic ointment and paste (on a basis of glycerin, gelatin etc.), for protection against water-soluble compounds - the hydrophobic ointment and paste (on a fatty basis).

The huge importance has a mode of work and rest.

The Ukrainian legislation provides especial care for the persons working with harmful substances restriction of a working day, increase of duration of annual holidays, establishment of the raised tariff rates, granting of pensions on favorable terms (decrease of pension age, reduction of the required experience). On some manufactures the women and teenagers are not supposed.

The medical-biological measures include also application of special diets of a medical-preventive meal and some other measures. The raised contents of protein in a diet promotes a reparation of the damaged structures and fermentative systems. With a meal of the workers enrich by vitamins (especially ascorbic acid and vitamins of group B), enter products containing calcium and iron, capable to incorporate to acid radicals and to participate deducing toxic aniones)). It's limiting quantity of fats, since the raised contents of fats in a diet promotes increase of mastering of fat-soluble compounds. The carbohydrate-riched diet promoting synthesis of glycogen and strengthens antitoxic function of a liver. The presence in a diet decorporators-demineralizators (pektines, lignine, cellulose) promotes deducing and reduces resorption of a toxic compounds. At work on manufacture of a phosphoric acid it is expedient to add in drinking water in small quantities sodium sulphate.

The complex realization of measures of administrative - organizational, technological, sanitary - technical and medical-biological character is a pledge of effective preventive maintenance of professional poisonings.

Chemical hazards. A number of professional poisonings is widely known. It is poisonings with salts of heavy metals (on an example of compounds of lead and mercury), methyl spirit, benzen, petrol, phosphorus, cadmium, compounds of fluorine, pesticides and with other toxic compounds.

Lead (Plumbum (Pb), nuclear weight - 207,19, density 11,34 г/см3) - silver-gray soft metal with temperature of melting 327,5^{o}C and temperature of boiling 1740^{o}C. In a nature there are five stabil isotopes of a lead -Pb^{208}, Pb^{207}, Pb^{206}, Pb^{204}, Pb^{202}. Inorganic compounds of lead are two-valentic, the element also forms four-valentic organic compounds (tetraethyllead, tetramethyllead).

Table 6.2 Major occupations and industries associated with lead overexposure

Battery manufacturing	Pigment manufacturing
Chemical industry	Pipe fitters
Construction workers	Plastics industry
Demolition workers	Pottery workers
Firing-range instructors	Printers
Foundry workers	Radiator repair
Gas-station attendants	Rubber industry
Gasoline additives production	Soldering of lead products
Jewelers	Solid waste production
Lead miners	Stained-glass makers
Lead smelters and refiners	Welders

The greatest quantity of a lead is spent in manufacture of electrical recharged batteries. The significant quantity of lead is used in a cable industry. The compounds of lead are used for manufacturing paints, in a porcelain-faience industry and in the production of crystal glass. The stability of lead oxides to corrosion has served as the reason of wide application of lead sheets in a building industry (roofing, hydro- and sound-proof material). Lead easily forms alloys, that allows to use it in manufacture of solder, cases of the stitches - in of bearings, font for polygraphic needs, folding pipes, screens for protection from ionizing radiation, for manufacturing an ammunition. The leaden soldering by a hydrogen flame is widely used. Tetraethyl- and tetramethyllead are used as antiknocking additive to petrol. Thus determined in industrial environment (in particular, in air of a working zone) the concentration are high enough:

At ceramic products -0,25 mg/m^3

-in manufacture of crystal -0,6 mg/m^3

-in manufacture of separate kinds of plastic -0,5 mg/m^3

Manufacture of batteries -1,0 mg/m^3

Air dispersion of lead-contained paints -3,0 mg/m^3

Manufacture of lead-contained paints -2,5 mg/m^3

Accordingly, risk of lead poisoning for various professional groups is not the same. By the WHO documents high risk of the intoxication is characteristic for such technological processes, as the melt primary and secondary lead, welding and is sharp of metal designs painted of lead-contained paints, welding of sheets with galvanic or zinc - siliconic leaden covering, disassembly of ships on breakage, leaden moulding, manufacture of accumulators (filling in of the leaden paste, assembly, welding of plates), manufacture of leaden dyes, colouring by dispersion, mixing manually of leaden stabilizers in manufacture of polivinichloride, mixing (manually) of the crystal glass-mass, clearing of surfaces from of lead-contained paints, burning of a lead in enamel shops

and repair of automobile radiators. The average degree of risk is characteristic for production of leaden ore, manufacture of cables, potentioning of a wire with cooling in lead, type matter (“garte”) and stereotyping in a composing room; low - for plumber's works, the assembly and repair of automobiles etc. Professional risk of loccurrence of a leaden poisoning are exposed for many occupations.

The basic way of receipt of a lead in an organism under production conditions is inhalatoric. The poison will penetrate in an organism as a steam, and also aerosols of condensation. The receipt of the lead through a skin (from the polluted overalls), and also peroral way of receipt (from the polluted hands, with the polluted food, water) is possible. At lead inhalation in concentration of the order 270-795 mg/m^3lead causes fatal poisonings, 9,9-11,4 mg/m^3- acute leaden posoning, 0,3-0,6 mg/m^3- display as the saturnism (chronic defeats of various bodies and systems).

In blood a lead circulates as lead phosphate and colloid lead. In bowls lead transformes in insoluble sulphate and in such kind is deduced from an organism. The part of lead is allocated through kidneys, sweat, salivatoria glands and mammas. The small quantity of lead is allocated in a gleam of a stomach . From an organism it is deduced not completely - collects in all tissues, but its basic part forms depot in bones as triphosphate. At condition accompanying with infringement of the acid-alcalic balance and infringements of an phosphoric-calcium exchange (overnutrition, starvation, food poisonings, infections, alcoholismus), insoluble lead triphosphate turns in soluble diphosphate. There is a mobilization of the toxic agent from depot, lead acts in blood, causing an aggravation chronic intoxication.

Lead and its compounds are strong protoplasmatic poisons, oppressing functional (amine, carboxyli, thyolic) group of proteins playing the important role in all biochemical processes. It results in changes in all bodies and systems an organism, first of all in central nervous and haemopoetic. In particular, lead breaks biosynthesis of hem, hemoglobine and breaks methabolism of iron in red blood cells.

The infringement of regeneratoric function of a red medulla is accompanied by occurrence of young degenerative forms -basophylic and vital-granular red blood cells (more than 500 and 80000 on 1 million of the normal red blood cells). The contents of the reticulocytes (up to 2-2,5 % is increased at norm 0,5-0,8 %). For the saturnism is characteristic a sideroachrestic anemia - reduction of the contents of red blood cells (up to 2,5-3 T/l) and hemoglobine (on 50 %) in blood at the normal or raised contents of iron in the serum (norm: 12,5-30,4 μmol/l). Are simultaneously observed aniso- and poikilocytosis; for leucogramm it is characteristic the high lymphocytosis and monocytosis.

The first symptoms of a CNS defeat are nonspecific, it can be conducted with astenovegetative syndrome. Further the organic defeats of peripheral and central nervous system develop, depending on character and localization of the centers of a defeat, the neurosaturnismus

can proceed as peripheral neuropatia (" a trailing hand", " of trailing stop "), encephalopolineuritis, encephalopatia.

Neurosaturnismus quite often accompanies with"leaden colic" -the spasm of a smooth musculature of the intestine, having with the central origin. Leaden colic is shown by a sharp pain in a stomach, nausea, constipation (some days), meteorism, increase of blood pressure, bradicardia can proceed.

At a defeat of digestive system develops a gastritis with infringements of secretoric function of a stomach, spastic colitis. On the gums occurs " leaden line " of dark blue or dark grey (chalk-aspide) colour. The occurrence of leaden line is connected with excretoric gingivites, characteristic for all intoxication by salts of heavy metals. The colouring mucous is caused by reaction free sulfuric hydrogen, present in an oral cavity, with kationes of lead, circulating in blood. Thus is formed insoluble lead sulphide, having dark tint. The toxic defeat of liver parenchyma is shown with hepatomegaly, morbidity, sometimes develops acute athrophy.

Tthe changes in the urine analysis (proteinuria, hypostenuria, microhematuria) are characteristic. The damage of kidneys has character of the chronic interstitial nephritis, in severe cases - malignant nephrosclerosis.

Characteristic symptom for saturnismus, known still antique authors, is "the leaden colour " - pale - grayish colour of the face skin. Its occurrence is connected with anemia and spasm of periphery vessels; the certain role has a photosensibilization action of porphirines - the products of incomplete synthesis and destruction of the hem -plays

The diagnostic importance has the raised contents of a lead in blood (more than 1,4 μmol/l) and in the urine (more than 0,05 mg/l), presence in the urine -of δ-aminolevulinic acid and coproporphirine.

The acute poisonings with a lead under production conditions meet seldom. To most often clinical syndromes of a chronic leaden poisoning concern anemic, gastrointestinal, hepatical, astenovegetative and astenoneurotic; can be polineuritic, seldom- encephalopatic, cardiovascular and renal syndromes.

They distinguish four stages of a chronic poisoning lead

1. Carriage of lead: " leaden line ", hyperplumburia
2. Light poisoning with lead: asteno-vegetative syndrome, reticulocytosis, basophilic granularity of read blood cells, porphirinuria
3. Poisoning lead of middle degree: syderoacherstic anemia (Hb no more than 5 mmol/l), leaden colic, toxic hepatitis, periphery polineuropatia
4. Heavy poisoning with lead: anemia (Hb less than 5 mmol/l), heavy leaden colic, encephalopatia.

Prevention of lead poisonings. Maximal single MAC of a lead in air of a working zone makes 0,01 mg/m^3, average-workdaily-0,005 mgr/m^3. The important meaning there is a replacement of a lead and its compounds by less toxic substances and materials (gart by a plastic font, leaden bleached - with titanic etc.); mechanization and automation of transportation, loading and unloading of loose materials; hermetic sealing of cabins of crane operators and operators of boards of management.

The installations for splitting, polishing and watering of materials containing lead, should be equipped with rational devices of local exhausted ventilation. Premises, where lead sucelt and spill, except for local ventilation are equipped also with central ventilation with 7-8 multiple of air exchanging. The internal lay-out of building designs of industrial premises should allow to carry out damp and vacuum cleaning. At the high contents of lead in air of a working zone the individual means of protection of breath are used.

The teenagers, and also pregnant women and feeding mothers are not supposed to work with lead and its compounds. Contra-indications to employment are the illnesses of blood, hypertonic disease, endarteriitis and other diseases in view of general contra-indications. The periodic medical surveys will carry out 1-2 times per one year by a brigade of the doctors - experts, such as the doctor - physician, neurologist, stomatologist and, under the indications, psychiatrist. Volume of laboratory researches necessarily includes the clinical analysis of blood, research of the urine on lead.

The important role in preventive maintenance of chronic poisonings with lead it is played an introduction in a diet pektine-containing products (vegetables, fruit candy, juices with pulp).

The concentration of lead in air of a working zone define by nephelometric method (by a degree of turbidity of a solution at the expense of formation of lead chromate (comparison with a standard scale). Sensitivity of a method - 0,006 мг/$м^3$. Exacter data receive at use atomic-adsorptive method, and also atomic-emission spectrometry, X-rays-fluorescent spectrometry, weights - spectrometry, straight line potentiometry, pulsing polarography and inversive voltampermetry.

Tetraethyllead *(TEL)* $(C_2H_5)_4Pb$ *(*$t_{boil}=200^oC$*) and tetramethyllead* $(CH_3)_4Pb$ *(*$t_{boil}=110^oC$*)* - colourless flying liquids used in quality antiknocking additives to fuel for engines of internal combustion. The solubility TEL in the organic solvents is rather high, the compound is easy sorbed by plaster, concrete and other porous materials. Ethylic (leaden) liquid contains up to 49 % TEL. Ethylic petrol used in a number of the countries in aircraft and a vehicle, contains on 1 l of petrol from 1,5 up to 6-8 ml of ethylic liquid (1,2-6,6 weight parts of TEL on 1000 weight parts of petrol). For the identification purposes an ethylic liquid paint in red colour, ethylic petrol - in pink.

At combustion TEL is decomposed with allocation of lead oxidating in air up to its oxide (PbO). With tetraethyllead and its mixes the workers can adjoin by its manufacture, the workers of mixing stations and other objects, on which the reception of en ethylic liquid and ethylic petrol is carried out. Besides the contact to these substances is possible at transportation and storage them in

warehouse premises, at service, test, operation and repair of engines of internal combustion working on leaden petrol, at service, test, operation and repair of engines of internal combustion working on ethylic petrol; at service station, auto garages etc.

Under production conditions TEL can act in an organism through respiratory ways, and also be soaked up through the intact skin.

TEL renders toxic influence by a complete molecule. It will penetrate through a hemato-encephalic barrier, easily cooperates with lipoide components of the neurons, than is explained it huge neurotoxic action. Circulating in an organism TEL works on chemoreceptors of the vessels. The part of TEL is split and is deduced from an organism with the urine and feces, the part cumulates in parenchimatous bodies and in a head brain (ability to material cumulation of TEL is less expressed than at inorganic compounds of lead) .A great importance in patogenesis has functional cumulation.

Tetraethyl-lead - a strong poison. At an acute poisoning within several hours (day) the latent period (period of imaginary well-being) is observed. Its duration is defined by a doze of the agent and reactivity of an organisma. In adverse cases probably lightning progressing of process resulting in death. In an initial stage of an acute poisoning there is an acute headache without the certain localization, metal taste in a mouth, general weakness. Quite often patient is in euphoria or is in depression. One of early symptoms are dessomnia - faltering superficial sleaping with dreadful dreams; parestesia ("sensation of a hair on tongue"). It's characteristic hypotermia in a combination with hypotonia and bradicardia, is possible hypersalination. Accrues neurologic symptomatic: thremor, nistagm, atactic gait, swinging in Romberg's pose, infringement of speech as easy disartria, adiadochokinesia, dysmetria. Signs accrues, is realized mental disorder. In a culmination stage of the acute poisoning is observed toxic delirium, hypertermiz, sometimes convulsive syndrome and meningeal phenomena. At the persons who have transferred TEL psychosis, is long the residual phenomena as cerebrastenic phenomena, intellectual degradation, rack focal symtomatic is kept.

Chronic intoxication with TEL frequently has oligosymptomatic character. In its current it is possible to allocate an initial stage, in which prevail asteno-vegetative and asteno-neurotic syndromes. In a stage of subindemnification the occurrence organic simptomatic is possible: parestesias, cerebellar (ataxia, dysartria, nystagm, intention tremor, dysmetria etc.) and extrapyramidal (muscular dystonia, hypomimia, bradikinesia) symptoms. The displays of encephalopatia accrue. In a stage of the decompensation there are aggravations of current of disease, arise psychotic conditions. The displays of toxic hepatitisa, periphery oedemas, myocardiodystrophia, moderately expressed changes in blood (basophility of RBC, reticulocytosis, leucopenia) can be observed. Porphirinuria it is marked seldom. Plumburia is insignificant - from 0,02 up to 0,2 mg/l.

Measures of preventive maintenance of poisonings with tetraethyl lead and its mixes:

Now in the majority of the advanced countries use of ethylic petrol is legislatively forbidden. The replacement of ethylic petrol by other kinds of fuel (high-octane petrols) will allow to remove TEL from the technological circuits. It is the best way of preventive maintenance.

Maximal single MAC for TEL - 0,005 мг/м^3.

To work with TEL for the teenagers, pregnant and feeding, person the patients by organic diseases CNS, epilepsia, mental diseases, endocrinic diseases, diseases of a liver, labirintitis, chronic otites, arterial hypotonia, hypertonic disease and other diseases are not supposed. The persons working with TEL and its mixes are exposed to regular medical surveys. At contact with pure tetraethyl- or tetramethyl lead physical examinations will be carried out monthly; the medical surveys of the persons working with ethylic petrol (of the airmechanics, , workers of mixing stations etc.) will be carried out) of time per one half-year. In survey participate physician and neurologist.

Obligatory measures are the safety precautions and personal hygiene. Washing hands and washing of overalls in ethylic petrol, blowing of hoses by a mouth are forbidden. After work emplyee should tale a shower. Food should be enriched by protein, fiber and vitamins.

Mercury *(Hydrargirum (Hg),* nuclear weight, t_{melt} =-38,8oC; t_{boil} =-357,25oC) - silver-white liquid metal. Mercury and its compounds are applied in instrument making, electrical engineer, the receptions of fungicides, caustic soda are used for extraction of metals from ores as amalgams, for needs of a pharmaceutical industry, by manufacture of explosive mercury. The compounds of mercury are widely used

Steams of mercury will penetrate in an organism basically through bodies of breath (already at 0_oC mercury evaporates). Salt of mercury can penetrate through skin also. Ingestion of metal mercury is not dangerous and has no risk for health.

The mercury circulates in an organism as its albuminate, enters into reaction with thyolic proteins, causing disturbations af the metabolism change functional conditions of bodies and systems. It's possible material cumulation of the agent in parenchimatous bodies. The mercury is strong protoplasmatic poison. The acute and chronic poisonings with mercury are possible. The acute poisonings arise at failures, at cleaning of the boiler and furnaces at mercury factories. The displays of the toxic hepatitis, ulcerous stomatitis, phenomenon of an hemorrhagic colitis and acute renal insufficiency are typical.

Chronic intoxication (micromercurialism) arise at working in conditions of long contact with mercury. There are characteristic asteno-vegetative and asteno-neurotic syndromes, tremor of the extremities, excretoric stomatitis with occurrence characteristic grey line on the gums. The part of the patients has original disorder of mental functions known, as mercury erethism. For it is characteristic the shyness, emotional lability, unadequacy and instability of affect. In complicate cases the picture of mercury encephalopaty develops, rather seldom meet mercury polineurities.

Prevention of mercury poisonings: MAC of the steams of metal mercury in air of a working zone are 0,01 mg/m^3, and average-workdaily MAC - 0,005 mg/m^3. MAC for sulema production 0,2 mg/m.

The best prevention of mercury poisoning is a replacement of mercury by not toxic or less harmful substances. If it is impossible we use other methods. All works with mercury should be carried out in the specially equipped separate premise. The walls and ceilings in a premise should be covered with special mercury-un penetrative paints.

The definition of mercury steam will be carried out by colorimetric methos on pink colouring on a background of a white suspension copper iodide. Sensitivity of a method 0,01 mg/m^3. For selection of tests two consistently connected Poleghaev's devices, containing on 2 ml of a absorptive solution can be used. Exacter data receive at use atomic-adsorptive method, and also atomic-emission spectrometry, X-rays-fluorescent spectrometry, weights - spectrometry, straight line potentiometry, pulsing polarography and inversive voltampermetry.

Benzene (C_6H_6, molecular weight 78,12 Da; density - 0,879 g/cm^3; t_{boil}=80,5^oC, t_{melt}=5,5^oC; elasticity of the steams at 20^oC -9,97 kPa; a parameter of refraction -1,5) colourless liquid with a characteristic smell. It mixes up in all parities with the not polymeric solvents (turpentine, ethers, carbohydrogenes), dissolves fats, rubber, synthetic pitches. The technical grades of benzene contain significant quantities of impurity others aromatic carbohydrogenes.

Benzene use for organic synthesis (reception phenol, stirol, cyclohexane, caprolactam, artificial protein, artificial rubber, plastic weights, detergents and medicins), at work with laser installations, for extracting of protein, degreasing of bones and fat-containing substancies. Benzene is allocated in air of a working zone at the enterprises petroleum and chemical industry as an intermediate product. Benzene is a component of crude petroleum

In conditions of manufacture the poisoning with benzene is observed owing to inhalation of its evapour. Probably also route of benzene exposure through a skin. Benzene sorption from air in the lungs makes 40-65 %. Benzene is convertible contacts to proteins of blood, is exposed to intensive biotransformation by oxidation (are formed phenol, hydrochinon, pirocatechin, oxihydrichinon and muconic acid), conjugation (phenylmercapturic acid). Phenol and poliphenols communicate and are deduced from an organism by the chamois and glucoronic acids. The part of the poison is deduced through lungs.

Benzene - politropic poison, causing an acute and chronic poisoning. At an acute poisoning (the concentration in some g/$м^3$) benzene works as a narcotic. In modern conditions the acute poisonings with benzene arise only in exvisiting cases (emergencies etc.). The chronic poisoning with benzene (concentration about several tens and hundreds mg on cubic meter) proceeds with a prevailing defeat of system of hemopoesis and nervous system. Hematological changes have hypoplastic character. The quantity of cellular elements of the peripheral circulating pool and

truncal cells of red medulla decreases. The pathognomic attribute for chronic intoxication with benzene is neutropenia with decrease of activity of cytochromoxydase, alkaline phosphatase and increase of activity sour phoshatase in neutrophilic granulocites. The clinic signs of hemorrhagic syndrome is determined by a level of trombocytopenia. Bleedings can be marked at the normal contents blood plateelets too, that is connected to infringements them adhesive and agregation activity and defects of formation of a blood clot). Anemic syndrome differs by bent to be progressed. The cases of occurrence of hemoglobinoses at working with benzene are described. Are characteristic enough for the persons who have transferred benzene poisoning, dysproteinemia. The level of general protein of the blood serum is increased, changes albuminic/globulinic an index, the contents of β- and γ-globulines is increased.

The chronic poisoning with benzene has results in infringement of function cardiovascular system: to increase of minute volume of blood, decrease of peripheral resistance of vessels and blood pressure. The locomotoric apparatus is damaged also. On rentgenograms it's the centers of osteoporosis, little focuses of osteosclerosis, destructurization of cortical substance of long tubular bones are defined.

Main gasrointestinal syndromes are the changes of secretoric function of a stomach, hypoaciditas, decrease of activity of pancreatic enzymes, signs of malabsorbtion.

On a background of depression of immunity and infringements of barrier functions of tissues of an organism rather the various infections quite often getting general character.

In experiment on laboratory animals is proved mutagenic and cancerogenic activity of benzene (group 1 of IARC), the opportunity sensibilizative, irritating action of the poison and its influence on reproduction function was shown.

Prevention of benzene poisonings: The preventive maintenance is carried out by introduction of multiplane improving measures. By the ГОСТ 12.1.005-88 it is established that an average work-daily MAC of benzene in air of a working zone is 1,5 mg/m^3, maximal single MAC (5 mg/m^3), MAL of pollution of hands skin is 0,05 mg/cm^2. Using of benzene, as solvent for clearing details, washing of hands is forbidden.

The replacement of benzene by less toxic compounds is provided. At use benzene in technological process, installations and units of the equipment are being hermetized. So, important meaning has a maximal hermetic sealing of the process equipment and transport communications, , observance of a mode of operation of locking fixture. The workplaces are equipped with rational ventilation.

To work with benzene they do not suppose the teenagers, pregnant and feeding. The periodic medical surveys will carry out annually. The persons with attributes of the poisoning should be order on other works, untied with benzene. With the preventive purpose at the enterprises with high risk of intoxication apply diets of a treatment-preventive meal (enrichment of a diet by

products containing a plenty sulfurcontaining aminoacids - cheese, curd), in the preventive purposes apply the large dozes a of an ascorbic acid (150 mg/day).

Methyl spirit (methanol, CH_3COOH, 32,04 Da, t_{boil}=64,7°C) - colourless liquid. It turns out by dry destillation of a wood or by synthesis. Is applied as the solvent of fats, oils, rubber; enters into structure of the solvents, polyrounds. Is used in a chemical industry, as raw material for synthesis; can enter into structure of antifreeze.

Toxity of methyl spirit is connected with action of an integral molecule of methanol, and also in compound with formation of formaldegide and formic acid at its biotransformation. Intoxication with methanol is accompanied by infringements of perfusion of brain tissue, as a consequence of influence on suprasegmentar structure of vegetative nervous system and, simultaneously, degeneration of ganglonar elements. In particular, the neurotoxic action is shown as toxic retrobulbar neuritis of an optic nerve, in heavy cases is possible the atrophy of n. opticus. Some methyl spirit at poisonings collects in a spinicerebral liquid, and also in aquose liquid moisture and corpus vitreua of an eye apple.

Under production conditions opportunity the acute and chronic intoxications owing to inspiration steam or absorption of methyl spirit through a skin is rather limited. The risk of a poisoning is great at cleaning closed tanks. The poisonings with methyl spirit basically are observed in ingestion (instead of ethyl spirit).

The acute poisoning with methanol in mild cases is shown temporary cerebral disorders. Some days after the ingestion are observed general cerebral symptoms, focal symptomatics, disappearing after.

At seroious poisonings the clinical symptoms are the vision disorders. It can be combined with cerebral signs. Vision disorder appear not at once, sometimes in 2-3 days of apparent well-being. In the beginning patients complain for a net and fog before eyes. In some hours (sometimes in 1-2 days) begins acutely to be reduced an acuteness of sight down to complete loss of sight. In a number of cases the blindness comes suddenly.

In severe cases the cerebral phenomena prevalent, which can result in development of a comatous condition and lethal exit.

The chronic poisonings of pairs of methyl spirit develop gradually, are expressed in an irritation of mucous environments, general weakness, headaches, noise in a head, tremor, the dispeptic phenomena

Prevention of methyl spirit poisoning: Maximal single limiting - admitted concentration (MAC) of methyl spirit in air of a working zone makes 50 mg/m^3. For prevention of an opportunity of the use of methyl alcohol inside, the observance of a strict mode of its expenditure and storages, transportation, and also realization of the appropriate sanitary - educational work among the persons working in conditions of contact to it(him) is necessary.

Petrol (gasoline) - mix of methan, naphten, aromatic and unsaturated carbohydrogenes - transparent, colourless or yellow, flying, inflammable liquid with a characteristic smell.

Gasolines are applied basically as fuel to engines of internal combustion, and also as the solvent and thinner in rubber and paint industry, for extraction of vegetable oils from seeds , fat from bones etc.

Steams of petrol act in an organism and are deduced through lungs. They have percutaneous and peroral route of exposure.

The sharp poisonings can take place at cleaning tanks, tanks, at clearing bulk-oil courts, transfusion of petrol in small premises, pneumatic colouring, at failures oligoextractive and other equipment. The clinic of the acute intoxication depends on concentration inhaled steams of petrol. At concentration 5000-10000 mg/m^3 in some minutes occur a headache, cough, lacrimation, hyperemia of the person. In concentration 15-20000 mg/m^3 the loss of consciousness is possible, and the very high concentration (35-40 g/m^3 and more) are fatal.

The ingestion is observed at aspiration of petrol through a hose by a mouth. Painful cough up to nausea at once begins. At hit of petrol in a stomach the clinic of gastroenteritis prevails, at the aspiration - toxic pneumonia.

The chronic poisoning with petrol result as asteno-vegetative and asteno-neurotic syndromes, disorders of digestion. At the high contents aromatic carbohydrogenes the changes of the hemogram are possible. At regular contact of a skin of hands to petrol the development of sharp and chronic skin diseases (drematites, exema etc.) is possible

Prevention of gasoline poisoning:

MAC for cracking-petrols 100 mg/m^3, for the petrol - solvent - 300 mg/m^3.

At danger of an acute poisoning it is necessary to use hose gas masks, overalls. On workplaces with the high contents steams of petrol in air it is forbidden to work in the single. To protection of a skin of hands apply pastes such as " of biological gloves ", other protective ointments, greasing of a skin by greasy creams and ointments after work. It is categorically forbidden aspiration of petrol by a mouth.

Pesticides (substances for pest control) is an extensive group of compounds intended for struggle with the wreckers of an agriculture, number of synantropic organism and for regulation of growth of plants.

Depending on purpose distinguish:

- Acaricides- preparations for struggle with ticks
- Algicides for destruction of seaweed and other water vegetation
- Antiseptics are the preparations for desinfection of needs (mainly for processing surfaces)
- Arboricides- for destruction undesirable wood and bush of vegetation
- Aphicides - preparations for struggle with aphid

- Bactericides- preparations for struggle with patogenic bacteria in external environment (in various objects)
- Herbicides- for struggle with weed plants
- Zoocides (rodenticides, raticides) for struggle with rodents
- Insectcides are the compounds for struggle with harmful insects
- Limacides (molluscocides) for struggle with molluscs
- Nematocides - for struggle with round vermes
- Fungicides for struggle with fungi
- Retardants preparations which are slowing down development of plants
- Defoliants - preparations causing falling of leaves
- Deflorants preparations for removal of superfluous flowers
- Desicants are the preparations for desiction of plants
- Repellents - means which are frightening off insects
- Attracants are the substances for attraction of insects
- Sexual sterilizators (infertilizators) of insects - preparations for sterilization of insects
- Antifidings (antifidants) - means which are frightening off insects from food

The most spread agents are herbicides, insecticides, fungicides, and also regulators of growth of plants. On character of action it can be herbicides of continuous and selective action, on features of application - contact, system and working on root system of plants or on sprouting sedds. In turn it can be contact , intestinal, system insecticides or fumigants. Last will penetrate in an organism of an insect through bodies of breath. Fungicides are usually divided on fungicides for seeds and for of plants, which in turn subdivide into preparations of preventive and treatment action.

The hygienic classifications of pesticides are based on allocation of various groups them on their toxity: high toxic (DL_{50} up to 50 mg/kg, high toxic - DL_{50} more than 1 g/kg), on a degree of skin resorbtion (is acute, middle- and lightexpressed); on a degree of evaporation, on a degree of cumulation (superhigh factor of cumulation less than 1, expressed - 1-3, moderate -3-5, weak - more than 5) and on stability (very proof - time of decomposition 1-2 years, proof -6-12 months., moderately proof -1-6 months and unstabil - to 1 month).

1. On toxity at introduction in a stomach (up to LD_{50} mg/kg):
    1. Strong poisonous substances — up to 50
    2. High toxic — 50 — 200
    3. Middle toxic — 200 — 1000
    4. Low toxic — more than 4000

II. On skin-resorbed toxity (up to LD_{50})

1. Sharply expressed — it is less. 300 (skin-oral factor is less 1)
2. Expressed • — 300 — 1000 (skin-oral factor)

3. Poorly expressed — more than 1000 (skin-oral factor is more 3)

** Skin-oral factor — the ratio of the size of average mortal doze established at drawing of substance on a skin, to a average mortal doze it at introduction in a stomach*

III. On a degree of evaporation:

1. Very dangerous substance is equal toxity
2. Dangerous — sating
3. low dangerous — sating actions

IV. On cumulation

1. Supercumulation— coefficient of cumulation is less 1
2. Expressed — it's 1 — 3
3. Moderate — 3 — 5
4. low expressed — more than 5

V. On cancerogenic ability:

1. the obvious cancerogenes — cause separate cases of a crawfish in the people; strong cancerogenes in experiences on animals
2. cancerogenes — cancerogenity is proved in experiences on animals, but is not proved in public
3. low cancerogenic — light canceronity in experiences on animals
3. Suspicious on canceronity

VI. On mutagenity:

1. Supermutagenes — cause 100 % and more of mutation in plants and .animals (for 100 % is accepted 100 mutation on 100 chromosomas)
2. Strong mutagens — 5 — 100 % of mutagenity
3.Middle mutagens ~ 2 — 5 %
4.Light mutagenes -1-2%
5. Very light mutagens -0.5-1.0%

VII. On teratogenity:

1. The obvious teratogens
2. Suspicios on teratogenity

VIII. On embriotoxity:

1. selective embriotoxic
2. moderate embriotoxity

IX. On allergenic pecualirities:

1. strong allergens
2. light allergens

Pesticides are used not only in an agriculture and industry (for prevention of damage and destruction of not metal materials (wooden cross ties etc.) harmful an organism). In system of public health services a lot of pesticides is used for struggle with malaria mosquitoes (insecticides, in particular DDT), for struggle with synantropic organisms (insecticides (ce-ce fly), rodenticides).

By the chemical nature all pesticides are divided on carbohydrogenes, galogenic compounds of aliphatic, alicyclic and aromatic carbohydrogenes, nitrose compounds, amines and salt of quadritic ammonia alcales, spirits, phenols, simple ethers, aldegides, ketones, chinons; aliphatic, alicyclic and aromatic carbonic acids, ariloxyacrilcarbonic acid and their derivative, derivative of coal acids derivative of carbamate, thyo- and dithyocarbamate acids derivative of carbamide and thyocarbamide; thyols, sulphides and sulfons, thyocianates and isothyocianates; derivative by the chamois and sulfuric acid, sulfonic acid and their derivative, derivative of hidrasine and nitrocompounds, organic compounds of mercury, tin, silicon, lead. germanium, organic compounds of phosphorus, compounds of arsenic, antimony, bismuth, iron, borum, heterocyclic compounds. In separated classes it's allocated inorganic pesticides (sulfur and its compounds, compound of copper, galogenes, inorganic phosphorus and others (barium carbonate and barium chloride, tallium sulphate, boric acid, preparations nickel and cobalt etc.) and pesticides, received by biotechnology (antibiotics).

The forms of application pesticides are diverse are powders (dusts), granulated and microcapsuled preparations, water solutions and solutions in the organic solvents moistened powders, concentrates emulsion, the aerosols impregnated pesticides of a polymeric tape etc. Pesticides can be used is isolated or as mixed preparations, as dusting, spraying, fumigation etc. Probably manual (with planger type knapsack sprayerhand spray, spray gun, soil injector, fly swat etc), , pendulum spreyers, machine (with the help special tractor-mounted sprayer, with the help of aircraft) dispersion of dusts and liquid pesticides. In a number of cases the poisoned baits are used, the container for a storage of products etc. is processed

The organic compounds of mercury (diethylmercury, ethylmercury (preparations the granozan, mercuran and mercurhexan), ethylmercurphosphate (cerezan-M) etc.) are compounds with high toxity. The cases of mass poisonings with a grain, dressed with mercury-contained fungicides (1971-1972 ., Iraq - about 6500 diseases and 459 fatal cases), the pollution of objects of external environment can be accompanied by cases of illness Minamata (poisoning with cumulated in biological objects, in particular in a fish, organic compounds of mercury). The symptoms of intoxication is occured usually in 3-5 months after beginning of work with preparations of mercury, the basic clinical displays remind clinic of a poisoning with inorganic mercury. As the organic compounds of mercury will penetrate through a hematoencephalic barrier encephalopathy and dementic changes develop at earlier stages of disease.

MAC for mercury-contained pesticides is 0,005 мг/м3.

Phosphororganic compounds (POC) are the most widespread class of insecticides. Alongside with it, some compounds are highly effective as the acaricides, herbicides, nematocides. Now only in an agriculture it is used more than 250 POC, including thyophos, carbophos, mercaptophos, UC-8305 etc. To major advantages of POC is concerned:

1) High activity
2) Wide range persistence of compounds
3) Low cumulation and rather small chronic toxity
4) Fast decomposition in ground and other objects of external environment
5) Small charge of a preparation and speed of action
6) Systemic action.

The demerite of these compounds is high acute toxity for mammalia and man.

The basic route of exposure for POC in an organism is inhalation, but it is possible also percutaneous route

Patogenesis of the intoxication with POC is connected from them anticholinesterase activity. Continuous stimulation of M- and H-choline receptors of nervous and myonevral synapses results in realization of bronchospastic, dyspeptic, ophtalmic, psychotic and convulsive components of clinic of an acute poisoning. In clinic of a chronic poisoning the displays of asteno-vegetative and asteno-nevrotic syndromes prevail. It's possible also microfocal symptomatics.

MAC for chlorophos is 0,5 mg/m^3.

Chlororganic compounds are protoplasmatic poisons. The biotransformation of some COC is accompanied with lethal synthesis. The majority COC differ by the expressed cumulative properties. One of the most typical variants of action is hepatotoxic effect. In compound with high stability in external environment so the application of a number of chlororganic pesticides is limited.

Prevention of pesticides poisoning:

It's forbidden the work with pesticides for the teenagers, pregnant, feeding, person in a condition of alcoholic intoxication, person, with deviations in a condition of health. The storage and preparation of poisons is carried out in the specially allocated places and with use of the appropriate marks; the persons working with pesticides should pass instructing in the safety precautions and to be supplied overalls (combinezone, boots, gloves, gas mask or respirator. The periodic medical examinations of the workers will regularly be carried out(not less often 1 time per 6 months); all workers are provided with a treatment-preventive meal (diet enriched by protein and vitamins), vitamin preparations.

The application pesticides is carried out according to the technological requirements to given agriculture, advantage have the preparations with low stability in external environment,

minimally toxic for poikilotermic organisms and man at high activity. More preferable in comparison with ground is the air way of application of pesticides.

By manufacture of pesticides and their packing it is widely used the automation, remote control of technological units and operations. The industrial premises is equiped with balanced ventilation, both general and local. In corridors of management moves only plenty air, exhaustion is organized from reagent and dosage cabins. Took air and waste water is being detoxicated by burning in fire torch or filtration through sorbents (with their subsequent burning). Degazation of the polluted overalls and equipment is made under the authorized instructions with application of oxidizers and superficial - active compounds.