МИНИСТЕРСТВО ЗДРАВООХРАНЕНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ

УЧРЕЖДЕНИЕ ОБРАЗОВАНИЯ
«ГОМЕЛЬСКИЙ ГОСУДАРСТВЕННЫЙ МЕДИЦИНСКИЙ УНИВЕРСИТЕТ»

Department of the General Hygiene, Ecology and Radiation Medicine

HYGIENE OF THE ENVIRONMENT

Учебно-методическое пособие
для студентов 2 курса
факультета по подготовке специалистов
для зарубежных стран

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Настоящее учебно-методическое пособие предназначено для студентов медицинских вузов, обучающихся на английском языке. Учебное пособие состоит из трех взаимосвязанных разделов и посвящено изучению гигиены окружающей среды, рассчитано на 12 часов практических занятий. Первый раздел называется «Гигиеническая оценка влияния микроклиматических условий и комплексного влияния метеорологических факторов на здоровье человека», второй — «Гигиеническая оценка влияния условий размещения на здоровье населения», третий — «Гигиеническая оценка качества питьевой воды. Методы улучшения качества питьевой воды».

Учебно-методическое пособие соответствует требованиям высшей школы.

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TOPIC 1: HYGIENIC ESTIMATION OF INFLUENCE OF MICROCLIMATIC CONDITIONS AND COMPLEX INFLUENCE OF METEOROLOGICAL FACTORS ON HUMAN HEALTH

Total time: 4 hours

URGENCY

The thermal acceptability of the enclosed space in hospital chambers, educational classes, sanatoria, auditoriums, industrial shops, living rooms is defined and estimated both by subjective sensations, and objective parameters.

Hygienic standardization of microclimatic parameters of the enclosed spaces scientifically is proved: by age features of heat regulation processes; a kind of activity; time and a season of year; temporary or round-the-clock stay in a premise; production; a health state and a premise destination; technological process. If technological process is accompanied by superfluous heat release the thermal comfort is achieved by architectural features, ventilation system, a drinking regimen, work and rest, clothes. If technological process needs of low temperatures, there is a protection by time, clothes. In other premises the thermal comfort is provided with the heating, natural and a combined extract and input ventilation with mechanical prompting, air-conditioning.

Microclimatic conditions it's temperature, air mobility and humidity; radiant heat. Various combinations of these components define: processes of heat regulation an organism of the healthy, weakened or sick man; its subjective susceptibility to thermal comfort or discomfort; capacity for work; efficiency of improvement, treatment, training. The microclimatic parameters of the enclosed space are regulated, social standards are entered on them. Barometric pressure also essential influence on health, comfort, workability, but it entirely depends on external meteorological factors. Meteorological components of open spaces are formed by the atmospheric phenomena and not regulated. The protection can be realized by clothes, a drinking regimen, by nutrition, length of stay.

In the practical work the doctor should take into account and use microclimatic and meteorological factors in estimation of health, treatment, improvement, rehabilitations, diagnostic.

Requirements to initial level of knowledge

It is necessary to repeat from:

— ***Normal physiology:*** functional systems of an organism; processes heat regulation; a metabolism and energy; thermal balance, a homeostasis; adaptation to temperature parameters; hardening; a health state.

— ***Pathological physiology:*** typical infringements of a metabolism; action of environment factors on an organism; aetiology; pathogenesis.

— ***Biophysics:*** heat and mass exchange; physical properties of the air environment.

— ***A lecture course:*** hygiene as a science about health; principles of hygienic standartization.

The purpose of class:

— To study microclimatic conditions of enclosed space and fully to estimate influence of meteorological factors on human health.

— To give the conclusion and recommendations.

Solvable tasks:

— To study the equipment for measurement of meteorological factors.

— To fill the table.

THE PROTOCOL OF RESEARCHES

(Date)

1. Research of a microclimate was carried out in a class room № _____, the area _____, quantity of the persons _____.

2. For research the following devices were used: psychrometer, anemometer, barometer.

3. A temperature condition (table 1):

a) A temperature condition on various levels:

The table 1 — The basic temperature parameters

Distance from a floor, m	Measuring points of temperature			Fluctuation in temperature on horizontal, degrees
	From external wall, 0,2 m	In the center of a premise	From internal wall, 0,2 m	
0,1				
1				
1,5				
Fluctuation in temperature on verticals, degrees				

b) average temperature air: in sum tº: 9.

c) A temperature condition of room:

The minimal temperature of air _____.

The maximal temperature of air _____.

Fluctuation in air temperature _____.

4. Air humidity (on psychrometer):

Indication of the dry thermometer _____.

Indication of the damp thermometer _____.

Relative air humidity (tabulated point)_____ %

5. Mobility of air, m/s.

6. Effective temperature (ET) (determine with the nomogram) _____.

7. Barometric pressure _____ mm of mercury.

8. Subjective estimation of thermal comfort on heat sensation: comfort, cool, warm, cold, hot.

9. Complaints: the weakness, slackness, apathy, drowsiness, chilliness, headache, there is no desire to work, etc.

10. Recommendations.

Teaching-material maintenance

— Psychrometer.
— Anemometer.
— Barometer.
— Nomogram for humidity and effective temperatures.
— Test questions.
— Situational tasks.

Educational questions

— The air environment and its hygienic value as man's habitat.
— Physical properties of atmosphere, meteorological factors and their influence on human health.
— The barometric pressure, permissible daily fluctuations.
— A thermal condition of the air environment.
— Principles of hygienic standardization of enclosed space microclimate.
— Air temperature, a temperature regimen, heat exchange.
— Air mobility, influence on thermal sensation.
— Absolute, maximal, relative air humidity, influence on heat regulation.
— Loading of environment, TLE.
— Thermal balance.
— Effective temperature.

Teaching material to a theme

The air environment (an atmosphere) — a gas blanket of the Earth essentially influences on energy and hydrological processes, quantity and quality of solar radiation. The meteorological and microclimatic components of the air environment consist of temperature, air humidity and mobility, non-ionizing sun irradiation, barometric pressure. Physical factors as components of an environment and the enclosed space provide vital functions and human health. They are not uniform, unstable, connected with global and local processes, self-purification, geographical position. Belarus is in middle latitudes and longitude, above sea level, on the average 200 meters, in favorable climatic conditions. The solar radiation and air temperature determine a thermal condition of the man, his vital functions: growth, development, resistence, exchange processes, health.

The sources of formation of air humidity are open reservoirs. Absolute air humidity is moisture content, concentration water vapour in air. The maximal humidity is full air saturation by water vapours. Relative humidity is the percentage of absolute

humidity to the maximal humidity. The air temperature at which humidity is maximal and water vapor condensation comes is refered to as a dew-point temperature.

Hygienic value of air mobility is defined by effect of heat emission. Barometric pressure for Belarus is defined in 740–760mm mercury (1 mm mercury is equal 1,33 Hectopascal). Daily fluctuations of atmospheric pressure in 3–5 mm mercury do not render essential influence on an organism of the healthy person. At decrease of organism functionalities the sensitivity to barometric pressure difference raises.

The thermal comfort of the enclosed space is provided with a hygienic regulation and social standards of microclimate. The basic physiological mechanism of thermal comfort is processes of heat regulation and heat exchange with the environment. The ratio of losses and heat reception by convection, radiation, conduction and evaporation define thermal loading of environment **(TLE)**. This parameter are used for a hygienic estimation of complex action of physical, meteorological and microclimatic factors on a thermal condition of organism, for develop measures of protection by clothes — **CLO.**

The thermal condition of an organism (thermal balance) depends on age, a sex, moving activity, kind and working conditions, training, a health state. Microclimatic parameters are regulated by destination premises and a season.

For complex estimation of microclimatic and meteorological factors influence is used a parameter — effective temperature **(ET)**. Effective temperature is the relative parameter which base on comparison heat sensation of people at the data meteorological conditions with their heat sensation in conditions of motionless, air completely sated with water vapour at certain temperature (table 3).

For usually dressed people which are taking place in rest or carrying out easy work, «the comfort zone» in which 50% of people will be comfortable heat sensation, is in limits ET between 17,2º and 21,7º, and «comfort line» is a part of scale ET in which 100% of people feel themself comfortably, in limits ET from 18,1º till 18,9º.

For average work the zone of comfort on scale ET is reduced approximately on 1^0, and for heavy ones — on 2,5º ET. ET can be defined with the help of tables and nomograms. ET is determined by nomogram, connected by a straight line of the indications of the dry and damp thermometer of psycometer. Find a point of crossing of this line with a curve corresponding to speed of air movement, and on vertical shaped define ET (figure 1).

In modern hygienic classification the microclimate of premises is subdivided into kinds:

— The heating microclimate — is marked infringement of heat exchange of the man with an environment (with accumulation of heat in an organism above optimal size > 0,87 Kj (kilojoule)/kg, or increase in a share of loss of heat, sweat evaporation > 30%, discomfortable heat sansation is slightly warm, warmly, hot.

— A cooling microclimate is deficiency of heat in organism > 0,87 Kj /kg.

— A monotonous microclimate is microclimate without significant temperature differences, no more than 2,5 degrees (table 2).

— The dynamic microclimate is outside monotonous aside heating and cooling ones, its injurious effect on an organism is most expressed.

The table 2 — Hygienic specifications depending on premises destination

Sort of premises	Optimal parameters						
	Temperature, Cº		Differences, tº			Relative Humidity, %	Air rate of movement, m/sec
	Max. permissible	Average optimal	Daily	On horizon	On vertical		
Living and educational	25	18–20	2–3	Up to 2	Up to 2,5	30–60	0,1–0,2
Medical: chambers for adults		20–22	2	Up to 2	Up to 2	30–60	0,2–0,2
Chambers for children		22–24	2	Up to 2	Up to 2	30–60	0,1–0,2
Chambers for prematurely born children		25	2	Up to 2	Up to 2	30–60	0,1–0,2
Operational and dressing		21–22	2	Up to 2	Up to 2	30–60	0,15–0,2
Chambers for patients with hypothyrosis		24	2	Up to 2	Up to 2	30–60	0,15–0,2
Chambers for patients with thyrotoxicosis		15	3	Up to 2	2,5	40–60	0,2–0,4
Boxes, demiboxes, chambers, isolation ward		22	2	Up to 2	2	30–60	0,15–0,2

The table 3 — Various combinations of temperature, humidity and the air mobility corresponding to effective temperature, equal 18, 8ºC

ET	Temperature of air, ºC	Relative humidity, %	Mobility of air, m/s
18,8º	18,8	100	0
	22,3	50	0,5
	27,0	20	3,5

Thermal loading of environment (TLE) is an empirical, integrated parameter in degrees, reflects a combination effect of air temperature, its humidity and mobility, the thermal radiation (infra-red) on heat exchange of man with environment. Protection by clothes, a unit of measurements of thermal resistance of clothes - CLO. One unit CLO of resistance is equal to 0,155 degrees Celsius, m^2 /Wt. Thermal organism stability is given only after carrying out of medical researches, definition of physiological criteria of a thermal condition of organism using the formula:

Q = 4 • pulse – 255,

where Q — the general energy expense, Wt/m^2; ***pulse*** — mean-shift pulse.

Energy expenses at physical work can be expressed in terms of work or capacity by means of ratio:

1 kcal *corresponds* 4187 joule
1 Jl *corresponds* 0,102 кgм
1 кgм *corresponds* 9,81 joule
1 Wt *corresponds* 1 joule *or* 0,102 кgм/s
1 кgm/s *corresponds* 9,81 Wt
1 Wt *corresponds* 0,86 kcal/hour
1 kcal/h *corresponds* 1,16 Wt

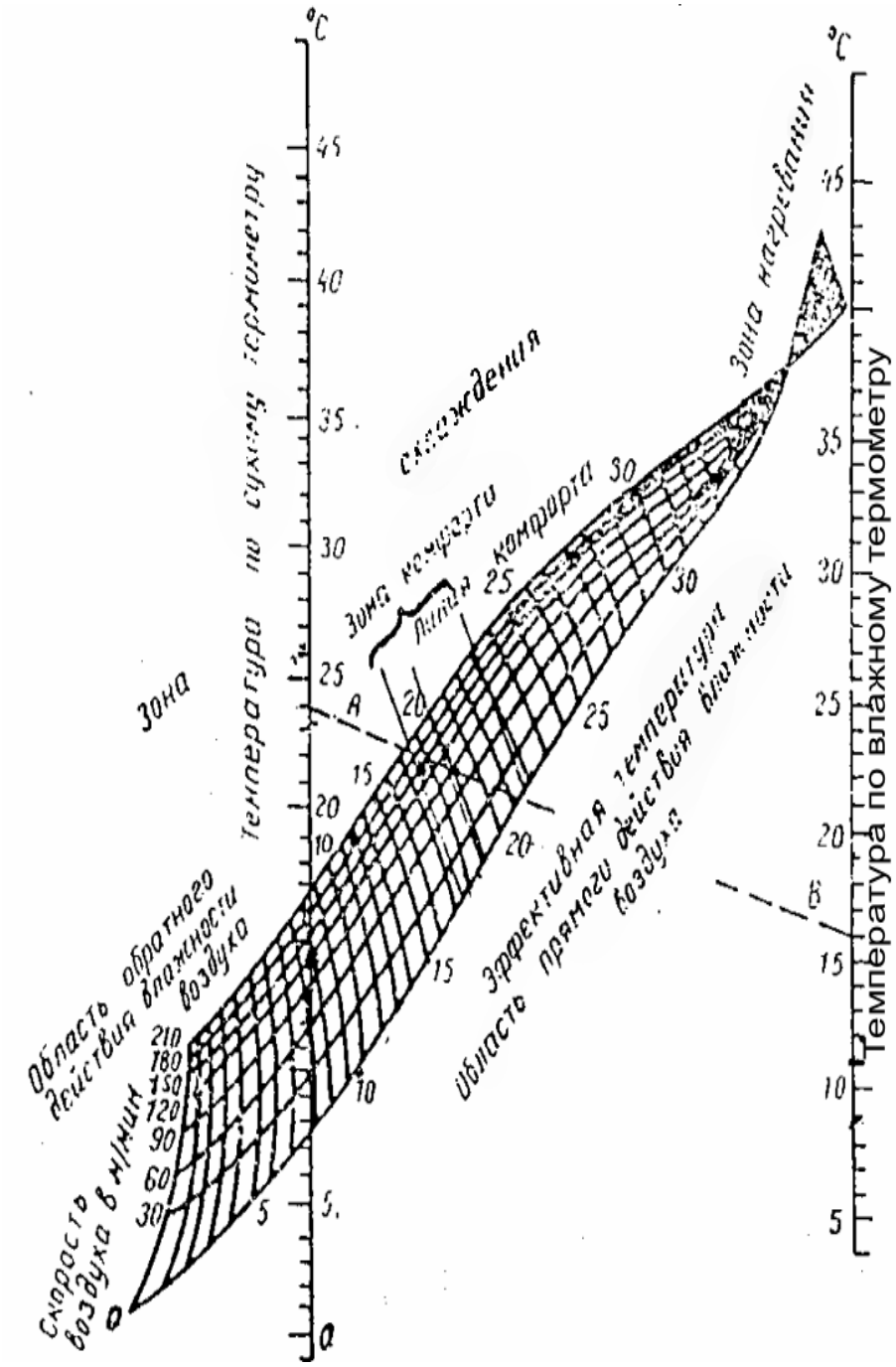


Figure 1

The table 4 — The basic signs of an organism overheating

Degree of overheating	Subjective and objective parameters
Weak	Complaints to weariness and impossibility of performance of work; a body temperature +38,5 … +39,5ºC, (behind a cheek); a pulse rate of 180–190 beats/minutes
Average	Complaints to deterioration of health state, a body temperature +39,5 … +40ºC, (behind a cheek); pulse rate — 190–200 beats/minutes
Strong	Complaints to sharp deterioration of health state (dizziness, sharp general weakness); the termination (discontinuance) of hidrosis and pallor of skin, a body temperature +40,5ºC and higher, (behind a cheek); a pulse rate — 200 and more b/min

Thermal adaptation of the man is physiological process which is characterized by good health state, workability. Thermal adaptation is accompanied by specific and nonspecific reactions. They underlie of the organism hardening.

Practical skills

— To measure air temperature at different levels across both verticals on the dry and damp thermometer by Assman's aspiration psychrometer. Data is necessary to enter in the table.

— Using tables and nomogramms to determine relative air humidity. Data is necessary to enter in the table.

— To define air mobility. Air mobility is defined by anemometer.

— To find effective temperature with the help of nomogram (ET), to enter in the report.

— To determine atmospheric pressure by a barometer.

— In the report to enter data of subjective thermal sensations.

— In the report to enter complaints (if it present).

— To give complex hygienic estimation of microclimate, to estimate a health state.

Technique of carrying out of measurements

In living and public premises the air temperature is measured at height of 1,5 m from a floor in the middle of room. For definition of a temperature mode in premises make measurements not less than in 6 points (3 across and 3 on a vertical). The difference of temperatures defines from an external wall to internal or from the heat emitter. Thermometers establish at distance of 0,2 m from an external wall (or the heating device), in the middle of a premise and 0,2 m from an opposite wall. Temperature drop in living room across should not exceed 2–2,5ºC.

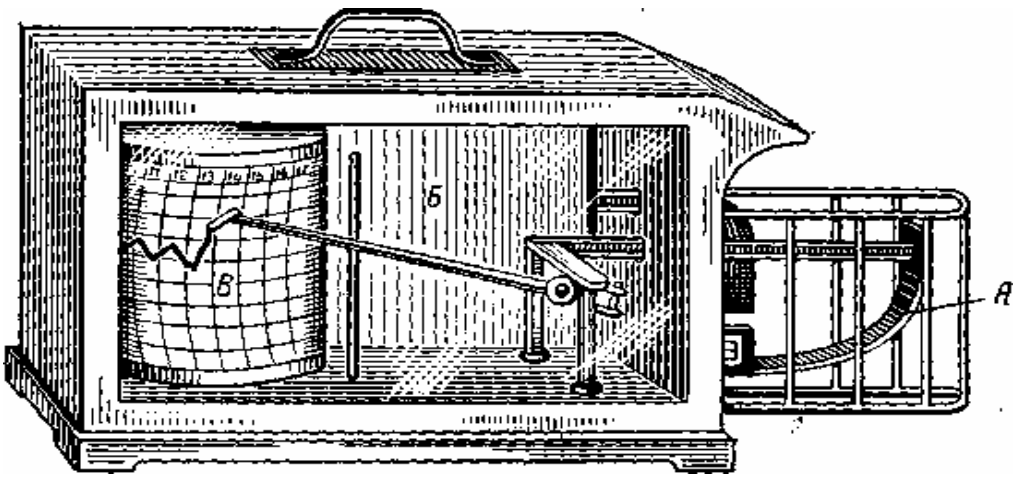
For definition of temperature distribution on a vertical thermometers establish at height 0,1 — 1–1,5m from a floor if necessary in 0,2 m from a ceiling. In living room the difference of temperatures near the floor and at height of a head should not exceed 2,5ºC.

To receive average temperature of air in room, measurements make in various places (about windows, doors, at a floor, etc.). Then indications of thermometers summarize and divide into quantity of measurements.

Daily average of air temperature receives from the separate measurements executed on morning, in the afternoon, in the evening and at night. In industrial premises technological process can influence on air temperature, therefore at uniform technological process of measurement make in the beginning, in the middle and at the end of change. If manufacture has periodic character to take temperature it is necessary in addition during the certain moments.

Definition of temperature and humidity of air by Assman's aspiration psychrometer

The given device includes dry and damp thermometers. Mercury tanks of thermometers are made in the metal sleeves protecting them from influence of thermal radiation. Protective sleeves pass in a protective tube at the end of which it is placed aspiration fan. The fan provides constant speed of air movement at mercury tanks (2 m/s). For wetting by distillation water of the damp thermometer are given a special pipette. In process of humidifying psychmeter is hold vertically: it prevents hit of water in the fan. For definition of humidity psychmeter is suspended in a researched point (figure 3, table 4). For long-term follow-up of temperature changes are used thermograph (figure 2).



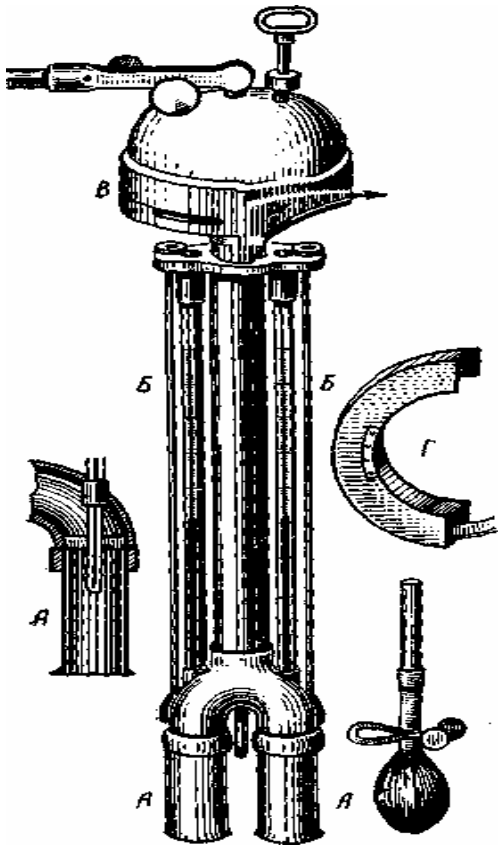
А — a plate filled with toluol; ***Б*** — an arrow with a stylus; ***В*** — a rotating drum

Figure 2 — Thermograph

Definition of speed of air movement

Definition of speed of air movement exceeding 1 m/s is made with the help anemometer. Little speeds of movement of air (less than 1 m/s) is defined with the help electrical anemometer.

In production area speed of air movement 0,5–1 m/s, in living — 0,1–0,3 m/s is allowable.



А — metal tubes in which tanks of thermometers are placed;
Б — thermometers; ***В*** — aspirator; ***Г*** — safety lock from wind;
Д — a pipette for wetting the damp thermometer

Figure 3 — Aspiration psychrometer

Revolving-cup analyzer is used for meteorological supervision in a free atmosphere for definition of speed air movement from 1 up to 50 m/s (figure 4). In the top part of it is present four hollow the hemispheres, fixed on crosspiece which with the help of an axis contacts by means of a tooth gearing to a tachometer. Under influence of pressure on hemispheres of moving air the axis starts to rotate. Each revolution is transferred to cogwheels which axes are supplied with pointers and are deduced on a surface of a box. The big pointer goes on a dial which is divided into 100 parts. Each small pointer moves on a dial divided into 10 parts and shows numbers in 10 times more then previous. Each dial division of the first small pointer corresponds to 100, the second — 1000, the third — 10000, etc. For turning on or turning off of tachometer there is sideways a dial a small loop — rod.

Manual revolving-vane analyzer. The device is more sensitive and is suitable for definition of speed air movement within the limits of 0,3 up to 5 m/s. In it instead of hemispheres there are the easy aluminium wings concluded into a metal ring (figure 5). Before definition of speed of air movement the initial indications of the counter are wrote down, anemometer is placed in air stream.

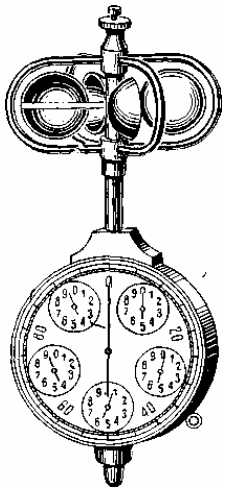


Figure 4 — Revolving-cup analyzer

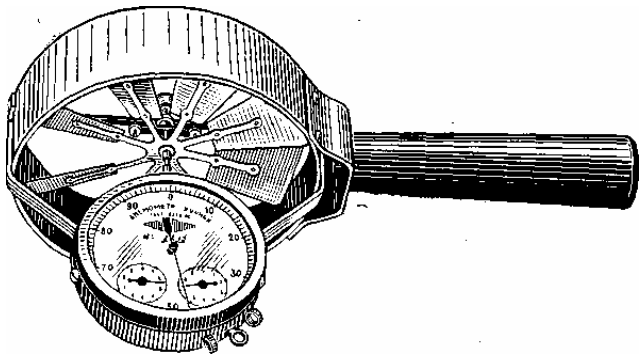
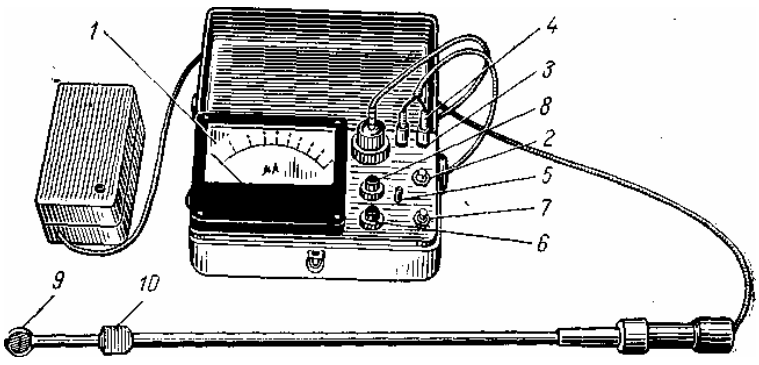


Figure 5 — Manual revolving-vane analyzer

Heat-loss anemometer ЭА-2М. With the help of this device it is possible to determine speed of air movement in limits from 0,03 up to 5 m/s and its temperature in limits from 10 till 60ºС. The principle of work of the device is based on cooling of semi-conductor microthermistor by moving air (figure 6).



1 — a galvanometer; ***2*** — the switch of power supply;
3 — plugs for turning on the device in power circuit;
4 — a plug of the gauge; ***5*** — the switch for measurement of temperature of air speed;
6 — the switch «measurement-control»; ***7*** — the handle of voltage adjustment;
8 — the handle of heating adjustment; ***9*** — the sensor (microther-mistor);
10 — protective sensor holder

Figure 6 — Heat-loss anemometer ЭА-2М

Barometer-aneroid (figure 7). Barometric pressure is measured in millimeters of a mercury column and in millibar. For normal atmospheric pressure is accepted atmosphere capable at temperature 0º on sea level and breadth 45º to counterbalance column of mercury in height of 760 mm. Millibar (it is equal 0,7501mm mercury) is the pressure which renders a body weight 1g on 1 sm^2.

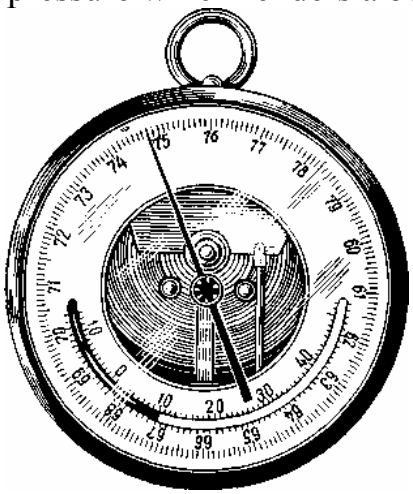


Figure 7 — The Barometer-aneroid

After practical work for development of practical skills to solve situational tasks.

Situational tasks

1. The average air temperature in the flat is equal 20º, relative air humidity is 65%, mobility of air is 0,1 m/s. *Estimate a microclimate in flat and its influence on human health. To define ET.*

2. Air temperature of on the dry thermometer of psychrometer in sleeping room is equal +20º, and on the damp thermometer +12º. *Define relative humidity of air and estimate its influence on heat exchange.*

3. During winter time in living room the average air temperature is equaled 18º, the vertical gradient of temperature changes within the limits of 2–3º, the difference of temperature near internal and external walls is 4º. *Estimate temperature conditions in the room and possible complaints on state of health.*

4. In a sleeping room the daily average temperature is 20º. At night and morning hours falls up to 14º, and in the afternoon rises up to 24º. *Estimate temperature conditions and possible consequences of it action on health.*

5. The air temperature in room is equal 22º, relative humidity is 85%, mobility of air 0,1 m/s. *What are there thermoregulation processes in this conditions? To define ET.*

6. The air temperature in room on the dry thermometer of psychrometer is equal 20º, on damp +12º, speed of air movement — 0,05 km/s. *Give a complex estimation of all named microclimate elements on workers, dressed in daily clothes and carrying out easy work. To define ET.*

7. With approach of cold period at rooms of hostel began to appear diseases (neuromyositis, radiculitises, neuritis, rhinitises, etc.). At inspection of this hos-

tel it is established, that the temperature of air keeps within the limits of 18º, relative humidity is 70%, speed of air movement — 0,2–0,25 km/s. *Estimate conditions of accommodation of rooms and connection with the mentioned above diseases. What measures of prophylaxis need. To define ET.*

8. It was established, that the air temperature in room reaches 32ºC, humidity is 75%, speed of air movement 0,3 km/s. *Estimate a microclimate and its action on human organism. Define ET.*

9. Working conditions of loaders of the refrigerator occupied with stacking of products in refrigerating chambers were studied. Work of loaders is mechanized. Air temperature in refrigerating chambers is from –18 up to –20ºC. Temperature of floor and walls is from +2 up to +5ºC. Relative humidity is 80%, speed of air movement of 0,15–0,2 km/s. *To define ET. By what ways it is carried out heat irradiation in these conditions? Estimate microclimatic conditions in which loaders work. Name the actions necessary for the prevention of organism overcooling.*

10. In living room the average air temperature is equal 25ºC, relative humidity is 75%, mobility of air is 0,1 km/s. *By what ways it is carried out heat irradiation in these conditions? Estimate a microclimate in room and ET. Offer preventive actions.*

11. In the summer the group of students came to field on the open machine. Air temperature of on the dry thermometer of Assman's psychrometer is 28ºC, on damp — 12ºC, wind counter 3 km/s. *Give complex estimation of influence of all named microclimate elements, ET.*

12. In room 11 operators work. By the end of the working day the most part from them complains of significant exhaustion, a body temperature +38ºC, a pulse rate of 180 bits/minutes. The air temperature in a room keeps within the limits of 25–27ºC, humidity — 80–85%, speed of air movement near 0,1 km/s. *Estimate a microclimate, ET, your offers for its improvement.*

THE LITERATURE

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4. Lecture material.

TOPIC 2: THE HYGIENIC ESTIMATION OF INFLUENCE OF ACCOMMODATION CONDITIONS ON HUMAN HEALTH

Total time: 4 hours.

URGENCY

Accommodation conditions of people in settlements — is the most important hygienic factor. City planning are carried out at a stage of precautionary sanitary inspection from a choice of a platform or a place for construction, zoning of territory and the continuous sanitary inspection in process of building use. For creation of thermal, light and air comfort inside inhabited and public buildings, in educational audiences, in chambers, medical-improving halls, industrial premises it is necessary to use maximum effectively natural forces and factors of the nature. Radiant heat, the infra-red and ultra-violet radiation, visible light, a direction of air streams can provide light and air comfort, sufficient isolation and natural illumination, purity of the air in premises if to observe of hygienic norms and rules.

First of all, it: orientation of buildings to the parties of horizon; a prevailing direction of a wind in a year cycle (wind rose); presence of sanitary-protective zones; observance of hygienic specifications on distance between buildings; hygienic characteristics of building materials; an internal planning of premises depending on their aim.

For balance of autopurification processes and pollution of air, reduction noise effect it is necessary to observe normative percent of planting of greenery in territory.

The greatest hygienic value has isolation — the illumination by solar beams. Isolation renders improving influence on an organism, bactericidal action on air microflora. The visible spectrum of sunlight is important for physiological processes. As a result of insufficient light exposure there is a phenomenon «children of a vault (underground)», a condition named «winter depression», «emotional seasonal disease». Thus resistency of an organism, efficiency in work is reduced, there is no feeling of vivacity at awakening, activity of contact is reduced.

In addition to light comfort the air comfort which is regulated by an air cube and norms of air exchange is necessary. The principle of loss of uptake is put in a basis of a regulation in air of products of live ability of the man, a degree of bacterial pollution. Long, independent influence of an original combination of meteorological factors with the increased physical and chemical loadings is changed with conditions of accommodation and a status of health.

The practical doctor is obliged to know and understand importance of observance of hygienic norms and rules on conditions of accommodation of people in primary prophylaxis of infringements of a status of health. To use a technique of definition and an estimation of risk factors in diagnostics of pre-nozological conditions –is the secondary prophylaxis.

Requirements to an initial level of knowledge

For independent preparation of the student for lesson it is necessary to repeat from course:

— ***Human physiology:*** the basic functions of the visual analyzer; light and thermal adaptation; light sensation; lung volume; functions of respiratory system; influence of solar radiation factors on the central and peripheral nervous system, health, capacity for work.

— ***Pathophysiology:*** pathogenic and damaging action of solar radiation, anthropogenous bacterial and chemical air pollution of the closed premises.

— ***Biophysics:*** electromagnetic radiations of a different spectrum; character of their physical and biochemical influences; vizial light, ultra-violet and infra-red radiation, non-ionizing and ionizing radiations.

— ***lecture course:*** principles of hygienic standardization.

The purpose of lesson

— To give a hygienic estimation to conditions of people accommodation in settlements, in different to destination on light and air, chemical and bacterial components of environment.

— To formulate recommendations of conditions improvement of people accommodation.

Tasks for achievement of the lesson purpose

— To study the equipment for definition of natural and artificial illumination, isolation of premises.

— To study the equipment for definition of anthropogenous chemical and bacterial pollution of the air environment.

— To master methods of definition of light and air comfort in workers, medical premises.

— To perform independent work, to formalize the report of researches (table 1).

THE REPORT OF RESEARCHES

_____

Date, time

1. Definition of natural and artificial light exposure, chemical and bacterial pollution of the air environment was carried out in an educational audience (chamber) № _____ the area of a room _____, quantity of windows _____, the area of the glazed surface _____,

(height of a window, width of a window)

Color of a room _____,

(walls, ceiling, floor, tables, the equipment)

the orientation of window apertures _____

Height of a room _____, volume of a room _____ (m^3), presence of ventilating apertures _____, their area _____, mobility of air _____, quantity of the persons in a room _____.

2. For research the following devices were used: luxmeter, actinometer, electrical aspirator, Petri's cup, Krotov's device, tape-line.

3. A light and air regimen, isolation.

The table 1 — The illumination and ventilation parameters

Parameters	Actual	Normative	Estimation
Light coefficient, LC; Educational rooms Chambers Apartment		 1/4–1/5 1/4–1/5 1/6–1/8	
Light angle		Not less than 27º	
Apertures angle		Not less than 5º	
Ratio of height and depth of a room		1:2	
Factor of natural illumination, FNI, % Educational rooms, Chambers		 1,5 0,5	
Natural light exposure / artificial light exposure, lx Educational studies Chambers, apartment		 200–250/150–300 80–100	
Artificial light exposure, Wt/m^2 Incandescent lamp / luminescent (daylight lamp) Over the slate Educational premises / working surfaces Chambers, inhabited rooms		 32/80 24/48 8/20	
Air cube, m^3 per one adult		25	
Ventilation rate per hour		Not less than 1,5–2 times	
Orientation of chambers, class rooms		South-east, south-west,	
Isolation regimen		Max: 5–6 hour	
Maintenance CO_2 in air		Maximal concentration limit 0,1% or 1,0‰	
The microorganisms content, quantity of colonies in 1 m^3, chambers, audiences, clean air		Summer <3500 winter <5000	
Volume of ventilation for one adult, m^3 per hour		Not less than 37,7	

4. Subjective estimation of light comfort: comfortably, dimly, darkly, brightly.

5. Subjective estimation of air comfort: comfortably, it is fresh, unpleasantly.

6. Complaints: it is poorly visible — eyes hurt, it is tired; too brightly — blinds eyes, it is tired; I hardly distinguish the text; sharp pain in eyes; the head hurts; to pant, etc. (your complaints).

7. The conclusion. The complex hygienic estimation of air is light regimen of a room. Action on health. The estimation of building accommodation, it isolation.

8. Recommendations for air improvement — thermal regimen in a premise, conditions of people accommodation.

Training - material maintenance

— The Teaching-methodical school-book.
— Luxmeter.
— Electrical aspirator.
— Petri's cup.
— Indicator tubes.
— Tape-line, rulers.
— Actinometer.
— Krotov's device.
— Reference source.
— Test questions.
— Situational tasks.

Educational questions

— A visible spectrum of sunlight, value for health, vision, ability for work.
— Infra-red radiation, value of premises isolation, air comfort.
— Ultra-violet radiation, value for health, cleanliness of the air environment.
— Precautionary sanitary inspection of settlements accommodation, planning.
— The sanitary inspection of permanent residence people in premises, isolation, aeration.
— A role of a wind direction and «wind rose» in setting out of settlements, orientation of window apertures.
— Gas structure of air and pollution by anthropotoxins, action on an organism.
— Air cube, volume of ventilation, value for health, ability for work.
— Bacterial pollution of the air environment, prophylaxis of respiratory infection.
— Ventilation rate, value for air comfort.
— Local and general ventilation, concentration of CO_2 as a parameter of air pollution.
— Local and general artificial illumination, value for vision, ability for work.
— Natural illumination and a ratio of parameters of premise height and depth; the areas of a premise and glazing.

Teaching material

Accommodation of settlements in cities and a countryside is the important hygienic factor. The accomplishment and a sanitary condition of the occupied places influence directly on health of the population, therefore the choice of a place for construction is very important. Questions of a planning, zoning of territory, types and density of building, gardening are connected to hygiene of the air environment. For cleanliness of the air environment in inhabited quarters and premises of any purpose, maintenance sufficient isolation and natural illumination it is necessary to take into account orientation of buildings on the sides of horizon, a wind rose, to arrange sanitary breaks and to observe hygienic specifications of the distance between buildings.

It is important to know a prevailing wind in the given region. At a lay-out of cities and accommodation in their territory of schools, hospitals, sports constructions and residential buildings it is necessary to have them windward (sides) in relation to the industrial enterprises, able to pollute air by a smoke and gases.

On fig. 1 the graphic representation of frequency (repeatability) of winds on the points, being characteristic for the given region in the course of year is resulted. This name of scheme ***is a wind rose.*** This one is showed on civil-engineering designs of new settlements and separate constructions, for example stadiums, schools, hospitals. It construction is made in the following way: from the center by points the pieces corresponding to number of days with identical directions of a wind are postponed; the ends of pieces join direct lines. The calm is displayed by a circle in the center of a wind rose; the radius of a circle should correspond to number of calms.

In figure 1 as shown, that in the given direction south-east winds dominate.

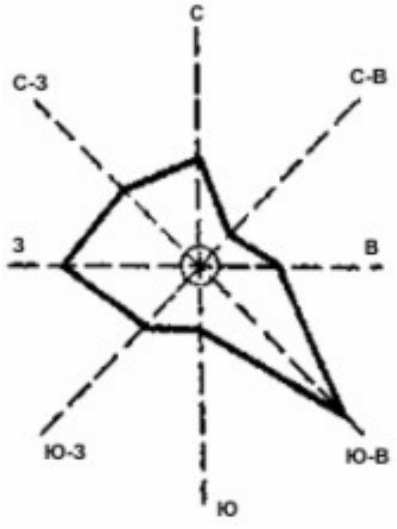


Figure 1 — Points for a designation of a wind direction and a wind rose

For efficiency of autopurification processes of air, noise reduction, inside settlement it is necessary to observe density of gardening, not less than 50% from all territory of area.

Urbanization it is rationally, it allows to develop most effectively the industry, to use personnel resources. In the city centers there is an accumulation of economic and cultural potentials, the global urbanization is real. In this connection, many factors of the city environment can long, independent influence and capable to cause infringements in a status of population health. The original microclimate of cities, the intensive rhythm of the city life, the raised chemical, physical and mental loading change conditions of accommodation and a health status.

The person spends the most part of the life in various premises in which, alongside with reliable protection against a cold, heat, an atmospheric precipitation and maintenance with necessary convenience, there can be the conditions rendering harmful influence on a health status. Crude district in which is a build-

ing, non-observance in housing construction of the hygienic norms established by a science, misuse of premises, a unsatisfactory leaving of them — all this can adversely be reflected on population health.

Connection between the increased morbidity and bad living conditions is established for a long time. The insufficient area, absence of rational ventilation, bad illumination by natural light promote spread of respiratory infection and helminthic diseases. Cold and crude premises play a role in aetiology of catarrhal diseases. The uncomfortable dwellings do not provide necessary rest, restoration of forces and work capacity, the organizations of normal life of family, to education of children prevent.

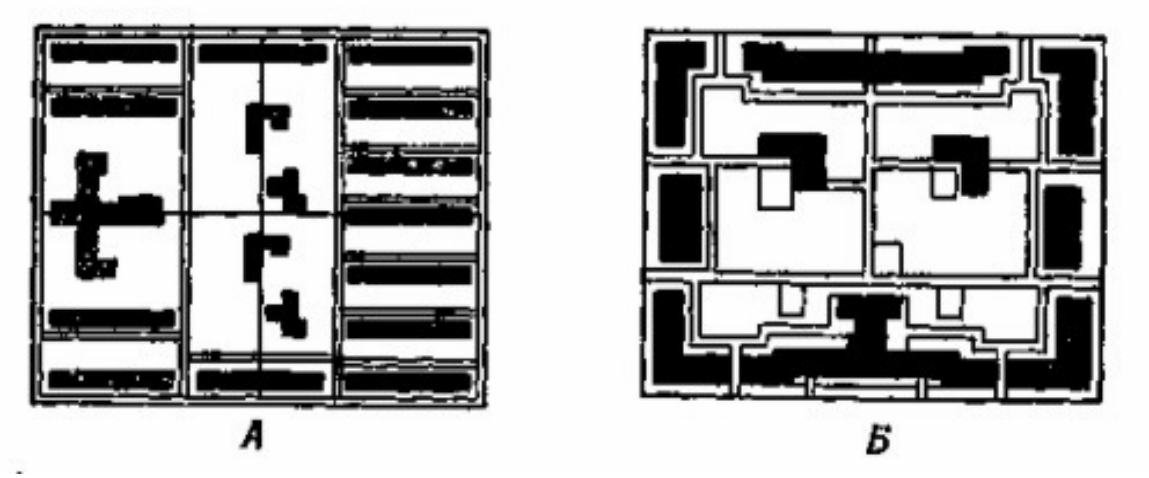
Hygienic conditions in inhabited and public buildings in many respects depend on a sanitary accomplishment of settlement. Natural features, a site of city or settlement, their lay-out, system of building, gardening and other external factors render the big influence on light exposure of premises natural light, on air quality in them, a thermal regimen and rest.

Choice of the ground area. Under construction of settlements and separate buildings the place should be removed dry, not boggy, not polluted and slightly raised, for maintenance of a drain of waters. The level of standing of underground waters from a surface of the ground should be not less than 1,5 m. Presence is desirable within the limits of settlement of an open reservoir and a large forest improving sanitary conditions of life.

Lay-out and building of settlement. By the rules accepted in modern town-planning, the ground area divide on zones: inhabited, industrial, transport (stations, quayes, warehouses) and suburban, and also plan an arrangement of streets, the areas and green files. Under inhabited and medical-improving zones the best territories of a place, whenever possible near to the rivers, lakes, parks are given, thus the direction of prevailing winds is taken into account. The residential zone separates from industrial one by sanitary breaks. On an arrangement of streets and quarters distinguish two basic systems of a lay-out: chess, at which street settle down perpendicularly to each other, and radial — the main streets go from city centre to periphery, and streets crossing them form rings.

Basic structural unit a vein of building in cities is the microdistrict consisting of several quarters with an aggregate number of the population up to 18 thousand. Within the limits of microdistrict presence is provided: schools; kindergartens, a day nursery; shops; dining rooms; athletic fields; green zones of quiet rest; libraries, a cinema and other establishments necessary for satisfaction of population needs. Polyclinics, consultations intend for one or several microdistricts, depending on their sizes; theatres, hospitals, sports constructions, etc. — for all residential area. The main requirement to a lay-out of microdistricts and quarters is the free accommodation of buildings providing normal conditions of illumination and airing of territory and premises. If the building is free the various grouping of buildings and open spaces is supposed. Are widely is used line

building when houses are under construction in parallel each other, and ribbon building at which they settle down longitudinal axis along street with obligatory breaks (figure 2). It is applied and the mixed building — with an arrangement of houses on perimeter of quarter and inside it.



***а** — lower case building, **б** — ribbon building*

Figure 2 — Systems of quarters building

For a hygienic estimation of air comfort the air cube is use. The principle of restriction of accumulation is put in a basis of definition of an air cube and norm of air exchange of a premise of products of live ability of the person. The air cube is defined by the area of a premise and height. While people is a premise in air flying products of a man metabolism, having unpleasant smells (a smell of sweat and products of decomposition, joint of the ammonia, flying salts of fat acids, joint of skatol, indol — all that makes air as speak, «stuffy») appear and collect. These flying products have received the name «anthropotoxins» and they first of all influence on state of health and ability for work: long stay in the circumstances the head man starts to be sick, the attention worsens, there is a drowsiness, apathy, the nausea can appear (down to vomitting), sometimes even there are faints. That is why it is necessary to watch a chemical compound of air.

The most convenient criterion of an estimation of a chemical air compound is concentration in it of carbonic gas; it maximum concentration limit (MCL) it is equal 0,1% or 1‰. Such concentration is completely harmless, but all changes of parameters of the air environment occur in parallel: present gradually heat up air, humidify and litter it by anthropotoxins. By the that moment when concentration of carbonic gas reaches 0,1%, air appears is heated so up, humidified and soiled anthropotoxins, that all this in a complex creates very adverse working background — worsens state of health and reduces ability of work. That volume, which person is capable «to spoil» for 1 hour, size enough constant, and it has received the name «volume of ventilation». By definition — volume of ventilation — necessary quantity of air in m^3 for normal gas exchange in an hour. It is calculated by formula:

$$L = \frac{K}{p - q},$$

where L — volume of ventilation in one hour;

k — quantity of litres of the carbonic gas exhaled by one person in hour of quiet work (for the adult — on the average 22,6 l, for the schoolboy approximately it is so much litres, how many years to the schoolchildren);

У — maximal permissible concentration of carbonic gas, i.e. 0,1%;

q — concentration of carbonic gas in an atmosphere (for city — 0,04%).

The simple arithmetic calculations show, that for the adult person the volume of ventilation in hour is equal, on the average, 37,7 m^3; for the first-grader it is equal 10–12 m^3, for the graduate of school — 25–30 m^3. It is that air volume which is necessary for normal gas exchange, good health state and high workability) per hour. The actual volume, falling one person in a premise is **«air cube»** which is defined by the relation of a premise volume to quantity of people in this room. Average of filling; standard class of schools (the area — 50 m^2, height — 3,3 м) — 35 pupils. From here we receive, that an actual air cube, as well as in 1-st, and in graduation class, it is equal approximately 5m^3, i.e. its size is much less, than necessary size of ventilation volume per hour.

Air exchange which intensity will be connected by the relation of volume of ventilation to an air cube is necessary for normal work during a lesson. This relation has received the name «necessary frequency rate of air exchange », — how many time for 1 hour should be updated completely (to be replaced) air that during one hour it corresponded to specifications.

$$K = \frac{L}{V},$$

where K — frequency rate of air exchange, time;

L — volume of ventilation per hour, m^3 / hour;

V — volume of a room, m^3.

In 1-st class air exchange during a lesson should be minimum twice; necessary frequency rate of air exchange is equal graduation classes — 5–6 time. Change of air, or ventilation, can be the natural, caused difference of temperatures inside and outside of a premise (a thermal pressure), force and a direction of a wind (a wind pressure), and the artificial, special devices caused by application (fans, ejectors). Artificial ventilation can be input (when fresh air move in a premise), extraction ventilation (when from a premise bad air) and mixed (input and extraction).

Natural ventilation. Natural ventilation of premises mean seepage external air through various cracks in windows, doors and partly through interstice of building materials, and also airing through windows, fortochka. The exchange of air occurs owing to a difference of temperature of external air and air of premises and pressure of a wind. For strengthening of natural ventilation in

multi-storey buildings arrange in internal walls exhaust channels who are deduced on an attic in exhaust mine(shaft), whence air acts outside under roof. This system of ventilation works on natural draft due to the pressure difference formed in channels owing to a temperature difference, causing a current of warmer air of premises upwards. In a cold season the exhaust system on natural draft can provide a 1,5-fold exchange of air at one hour, per warm time efficiency of it is insignificant because of a small temperature difference between external air and air of room.

Artificial ventilation. This ventilation is arranged in various public buildings, on manufacture and also when it happens one natural ventilation insufficiently (at its small intensity or impossibility widely to use because of danger of formation of cold currents of air). Then the exchange of air is made with the help mechanical of boosters the various capacity (fans), providing necessary air exchange in rooms without dependence from external temperature and force of a wind. Distinguish local and central artificial ventilation.

Local ventilation are the usually electric fans of the exhaust action established in windows or apertures of walls in rooms with raised air pollution (kitchen(cuisine), shower-baths, lavatories, industrial rooms), and also in a number of rooms if there is no central ventilation (for example, it is applied in breaks between employment in audiences, sports halls). At the exhaust fans excluding from premises spoiled air, inflow of pure air it is designed for its receipt through window leaves, windows and cracks, but it is possible suction and through doors from the next rooms, corridors.

The central ventilation as against local is arranged for all building, works constantly or a significant part of day and provides an opportunity of heating entered external air and its dust clearing. Depending on purpose of premises this ventilation can be input, exhaust or forced-air and exhaust (figure 3).

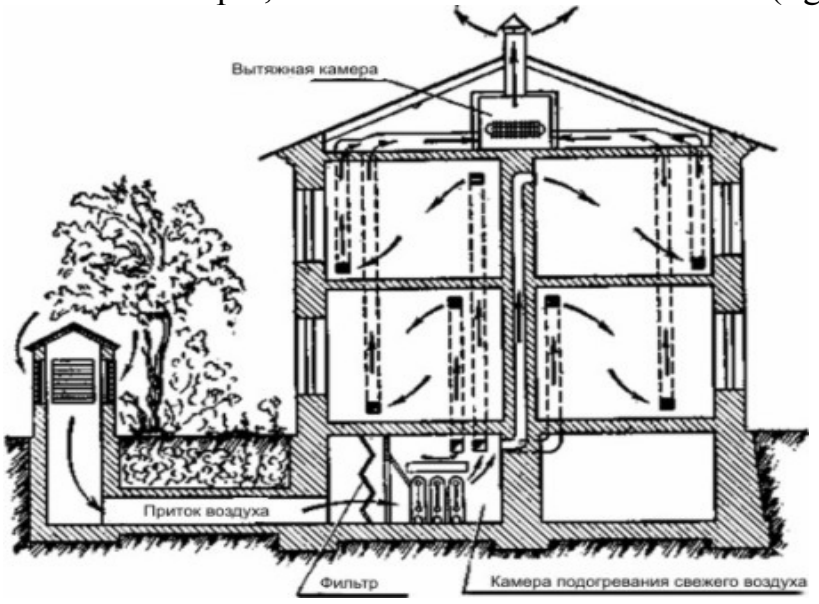


Figure 3 — System of a input and exhaust ventilation

External pure air (for example, from a garden) gets with the help of fans (sometimes on significant distance from a building) and acts in input the chamber where it is cleared of a dust by transmission through fabric or other filters. In a cold season it is warmed up to 12–14° (in some cases and it is humidified) and moves in premises on channels in internal walls. Apertures of input channels to exclude direct influence of colder currents of air, are done in the top part of walls and are covered with lattices. For removal of spoiled air the second network of channels (exhaust) which apertures settle down in the bottom part of opposite internal walls is laid; channels from each premise are deduced on an attic in the general collector from which air leaves outside with the help of the fan. At forced-air and exhaust system ventilation provides an opportunity of prevalence of an air flow above its extract. It is important for sports halls, operational in hospitals and some other premises as thus in them of air receipt is excluded from the next rooms. In shower rooms, massage rooms, kitchens, lavatories make one mechanized extract. The central artificial ventilation provides necessary intensity of air exchange in rooms and helps to maintain normal temperature and humidity of air. Last years receives the increasing spread most a perfective aspect of artificial ventilation — *air-conditioning.*

It is necessary to take the most of external meteorological factors планировочными decisions for creation of thermal, light and air comfort inside inhabited and public buildings; in educational audiences; medical-improving halls; chambers; industrial rooms. Radiant heat, infra-red radiation, ultra-violet and visible light, window apertures, distance up to opposite located buildings, will promote sufficient insolation buildings, light exposure inside rooms. For an average strip of breadth and a longitude in which Belarus is located, the most comprehensible is orientation of window apertures from the east through the south to the west, the axis of a through corridor can be focused from the north on the south. At a unilateral lay-out of an arrangement of educational classes, audiences, working rooms, chambers, the studies, the opposite side is used for lateral system of illumination, an arrangement of halls, recreational spaces, rooms of rest and as system of natural aeration, receipt of air in industrial rooms. The distance up to an opposite building should be not less than half of high building, for observance of normative factors of natural illumination (KNI; angle of an aperture and falling). A primary direction of a wind on territory of Republic Belarus in a year cycle (wind rose) are western, northwest and southwest. For maintenance of air comfort inside rooms it is necessary to take into account this factor as for airing territory, rooms and cleanliness of air streams. Sleeping areas, administrative, teaching and educational, medical and improving to have it is necessary with windward sides. For maintenance of natural light and air comfort the height of room and depth is normalized, their ratio should be 1/2, depth of a room should not be more than two heights.

At such ratio the minimal angle of falling of natural light in the most remote point of room 27º will be observed. Maintenance of air cube is reached by hygienic normalization of the area of a room on one staying in a room and heights of a room.

Light regimen in educational premises. Sight brings to the man the greatest quantity (80–85%) information on world around, thus light not only provides normal ability to live of an organism, but also the certain vitality and a rhythm. Force of biological influence of light on an organism depends on length of a wave of a spectrum, intensity and quantity of radiation. Long light starvation results in weakening of immunobiological organism reactance, to functional infringements of nervous system. Light influences mentality of the person, being the emotional factor. Not without reason the old English proverb says: «Where the sun seldom looks, there the doctor» frequently looks. Adverse conditions of illumination conduct to reduction of ability for work; cause development of diseases of organ of vision.

Illumination can be natural (energy of a sunlight) and artificial (basically it is incandescent lamps and luminescent lamps). Incandescent lamps, as well as the sun, generate light ad exemplum of heating (heating of an incandescent filament to temperature of a luminescence); in luminescent lamps electric and chemical energy turns to light radiation, by-passing a stage of transition in thermal energy (a lamp of a cold luminescence). When in a premise there is simultaneously natural and artificial illumination, speak about the mixed illumination.

At normalization of artificial illumination first of all pay attention to its sufficiency and uniformity. Sufficiency is provided with quantity of used lamps and their capacity. Artificial illumination or on a level of light exposure on a workplace, determined luxmeter, or on specific capacity of a light stream which is defined by the relation of total lamps capacity to the area of a floor is normalized. The norm of light exposure on a workplace for incandescent lamps is equal 150–300 lx, a gymnasium — 100 lx, for luminescent lamps these figures are equal accordingly 300 lx and 200 lx. The norm of specific capacity of a light stream for incandescent lamps in a class is equal 40–48 Wt/m^2, a sports hall — 32–36 Wt/m^2. Specific capacity of a light stream for luminescent lamps should be in a class of 20–24 Wt/m^2, in a gymnasium — 16–18 Wt/m^2. Speaking about artificial illumination, it is necessary to touch halogen illumination. It is considered, that halogen light for the present moment is the most perfect from artificial ways of illumination as it has a visible spectrum, eliminates light starvation, reduces visual exhaustion, raises ability for work.

Independent work of the student, practical skills

— To define room length, depth, height — to write down the data in the report.

— To calculate the room area and volume of a room in m^3, to write down the data in the report.

— To define length, height and the area of one window, the area of the glazed surface, to write down the data in the report.

— To give the descriptive characteristic to color registration of a room, to write down the data in the report.

— To define orientation of window apertures, the basic axis of a building, to write down the data in the report.

— To write down in the report presence ventilating apertures, its sizes.

— To calculate light factor (LF), to estimate.

— To define a light angle, to estimate.

— To define an aperture angle, to estimate.

— To calculate a ratio of height of a room and depth, to estimate.

— With the help of luxmeter to measure light exposure in lx, to estimate.

— To define factor of natural illumination, FNI, to estimate.

— To calculate specific capacity of artificial light exposure (Wt/m^2), to estimate.

— To calculate an air cube, to estimate.

— To calculate frequency rate of air exchange, to estimate.

— To define isolation regimen, to estimate.

Further the student works on points 4, 5, 6, 7, 8 of the researches report.

<u>Technique of carrying out of measurements</u>

— ***Definition of light factor***. Light factor (LF) represents the ratio of the glazed surface of windows to the floor area. It in simple fraction is expressed, which numerator — size of the glazed surface, and a denominator — the area of a floor. The numerator of fraction is resulted to 1, for this purpose both the numerator, and a denominator divide into size of numerator.

Example. In the room two identical windows, the area of the glazed surface of one window — 1,5 m^2, the area of a floor — 24 m^2. The general light area will be equal:

1,5 m^2 * 2 = 3 m^2.

The light factor will be equal: $3/4 = 1/8$

— ***Definition of size light angle***. The light angle (α) is formed by two lines which are starting with a point of measurement. One line goes to the top edge of the glazed part of the window aperture, the second — a horizontal line (figure 4). Minimally allowable size of a light angle is not less 27°. For definition of a light angle measure distance from a point of supervision up to a window and distance from a point of crossing of this line up to the top edge of the glazed part of a window aperture, (i.e. two cathetuses). The light angle can be calculated a protractor after construction of a rectangular triangle which cathetuses are known, and under the table of natural trigonometrical sizes (the table 2).

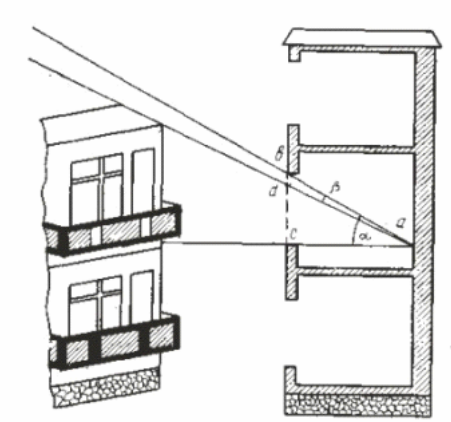


Figure 4 — Definition of a light angle and definition of aperture angle

The table 2 — The table of natural trigonometrical sizes

tg α	α	tg α	A	tg α	α
0	0	0,30	17	1,00	45
0,01	1	0,36	20	1,15	49
0,03	2	0,44	24	1,39	53
0,05	3	0,50	27	1,60	58
0,08	5	0,58	30	2,05	64
0,12	7	0,65	33	2,47	68
0,18	10	0,70	35	3,07	72
0,25	14	0,80	39	4,01	76
—	—	—	—	5,67	80

By ratio of an opposite cathetus to adjoining find a tangent of a light angle:

$$\frac{вс}{ac} = tg < \alpha$$

.

Then on table 2 define size of angle.

Example. Distance of a workplace up to a window of 3,2 m. Distance from a point of crossing of this line with a window up to the top edge of the glazed part of a window — 1,6 m. The tangent of a corner will be $1{,}6 \diagup 3{,}2 = 0{,}5$, that corresponds to size of a light angle 27°.

— ***Definition of an aperture angle***. The aperture angle (β) is formed by the line which is starting with a point of measurement to the top edge of the glazed part of a window, and a line conducting to the top point of the shading subject, located outside of a building (figure 4). The size of aperture angle should be, not less than 5°. For definition of an aperture angle find distance from a point of measurement up to a window across and height of a window up to a point of crossing with the top line directed to the top point of the shading subject (CD). Then define size of a corner DAC. The aperture angle will be equal to a difference of corners BAC and DAC.

Example. Distance from a workplace up to a window of 2 m, height of a window before crossing with a line directed to the top point of the shading subject, 1,4 m. The corner of falling is equal 39°.

The tangent of a corner DAC will be $1{,}4 / 2{,}0 \approx 0{,}7$, that makes a corner 35°.

The size of a corner of an aperture (bad) will be 39° - 35° = 4°.

— ***Definition of light exposure***. Light exposure of workplaces is defined with the help of the special devices named luxmeter (figure 5).

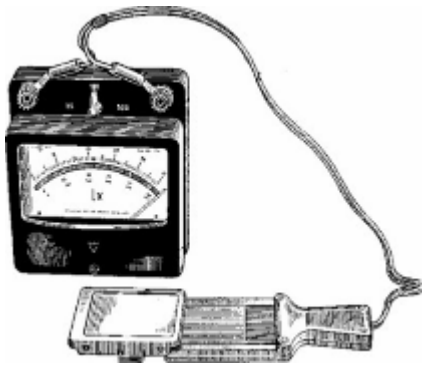


Figure 5 — Luxmeter Ч-16

— ***Definition of factor of natural light***. Factor of natural light (FNL) — percentage of light exposure of a point indoors (Ei) to simultaneous light exposure of the external point taking place on same horizontal plane (Ee) and covered by a diffused light of all firmament:

$$FNL = Ei / Ee \cdot 100\%.$$

— ***Approximate calculation of light by a method of power density (a method of watt)***. Calculation is based on dependence of average horizontal light exposure of a premise on a total light stream of light sources and on the sizes of a premise. As the size of a light stream of sources depends on their capacity, on size of so-called power density (the quantity of energy expressed in watts to unit area) it is possible to judge unit of the shined area light exposure roughly. At use in lighting installation of incandescent lamp or luminescent calculation on a method watt make as follows: 1) define total capacity of all light sources in watts; 2) measure the area of a premise; 3) divide total capacity of light sources into the area of a room and receive specific capacity, Wt/m^2.

— ***Definition of frequency rate of air exchange by the formula.***

$$L = \frac{22{,}6}{p - g} \qquad K = \frac{L}{V},$$

where L — necessary volume of ventilation, m^3 per hour (specification);

22,6 L — quantity CO_2 exhaled per hour by 1 man;

p — allowable maximal contents $_{CO2}$, in room — 1‰;

g — contents CO_2 in atmospheric air — 0,4‰;

K — necessary frequency rate of air exchange;

V — cubic metres of interior space, m^3 for one person (the facts).

— Definition of isolation type of premises.

Isolation type is a duration and intensity of illumination of a building by the direct sun rays, dependent on geographical breadth of a place, orientation of a building on cardinal points, shading of windows by the next houses, sizes windows, etc. Distinguish 3 basic of type isolation regimen of premises of a moderate climatic zone in which Belarus is located. (table 3)

The table 3 — Types of buildings isolations

Isolation regimen	Orientation on the cardinal points	Time of isolation, hour	% isolation areas	Thermal reaction	
				Kj/m^2	Kcal/m^2
Maximal	SE, SW	5–6	80	3300	550
Moderate	W, E	3–5	40–50	2110–3300	500–550
Minimal	NE, NW	3	30	2110	500

The best orientation for hospital chambers, classes, group rooms of children's establishments — SE, SW; allowable orientation — SW, E; adverse — NW, N, NE.

— Measurement of thermal radiation by Kalitin's actinometer.

Actinometer (from Greek. actis — the beam and meteo — to measure) serves for measurement of that part of radiation which, being absorbed by a skin, other surfaces is perceived by us as heat. In practical work apply *Kalitin's actinometer* (figure 6).

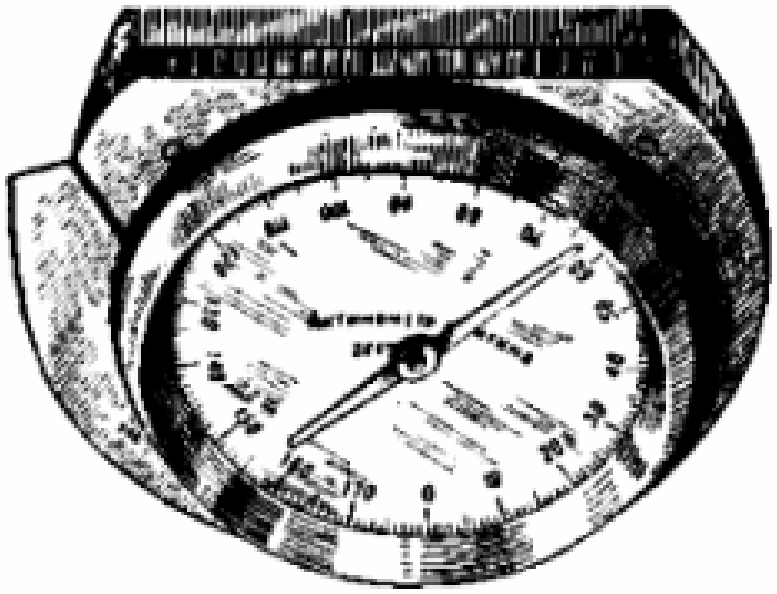


Figure 6 — Kalitin's actinometer

Bacterial pollution. Sampling of air by electric aspirator Migunov's.

The device can be applied for simultaneous selection of 4 tests of air: 2 tests with a speed from 1 up to 20 l per min and 2 tests with a speed from 0,1 till 1 L per min (figure 7).

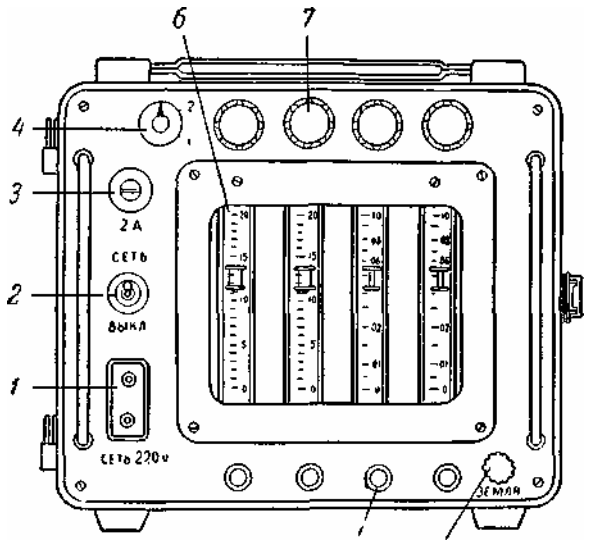


Figure 7 — Elektroaspirator Migunov

Sampling of air for bacteriological research. Sampling of air for bacteriological research can be made: 1) method based on shock action of an air jet, 2) filtrational method and 3) sediment method, which is based on a principle of sedimentation of bacteria from air on a surface of a nutrient medium of Petri cup.

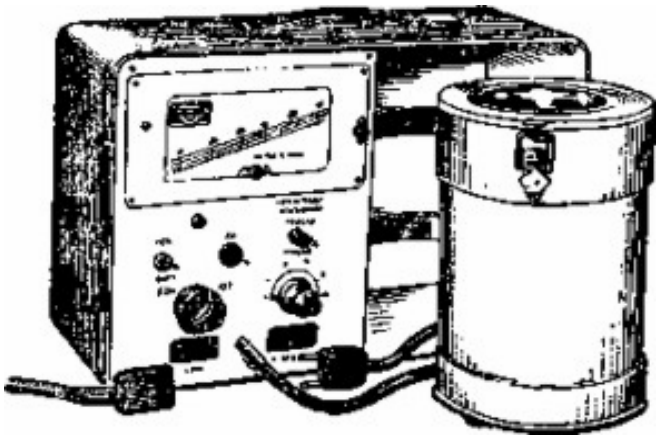


Figure 8 — Krotov's device for bacteriological research of air

The most reflecting the valid contents of bacteria in air are the methods based on shock action of an air jet.

From lines of the devices offered for this purpose, now it is necessary to count J. A. Krotov's most perfect the device (figure 8). The device includs 3 basic units.

After independent work on mastering practical skills:

— To solve a situational task.

Situational tasks

№ 1. In chamber 60 m^3 are 3 persons, airing occurs due to a window leaf. *To find an air cube, volume of ventilation, frequency rate of air exchange. Assess, give recommendations.*

№ 2. In an educational audience the area of 50 m^2, height 3,2 m, are engaged 30 persons. *Define necessary frequency rate of air exchange. Estimate. Give recommendations.*

№ 3. There are 10 persons in a sleeping room. The area of room 24,0 m^2, height — 3,2 m. *Define necessary frequency rate of air exchange. Estimate. Give recommendations.*

№ 4. In room in volume of 75,0 m^3, live 7 persons. *Define necessary frequency rate of air exchange. Estimate. Give recommendations.*

№ 5. *Define necessary volume of chamber for 4 persons under condition of double air exchange at one hour, according to hygienic norms.*

№ 6. The Educational room the area of 24 m^2 has 4 fixtures, each of which consist of 2 luminescent lamps on 40 Wt. *To define and estimate light exposure of a room by method of specific light exposure.*

№ 7. Area assistant — 40 m^2. It is shined with 6 incandescent lamps, everyone on 100 Wt. *To define and estimate light exposure of room by method of specific capacity.*

№ 8. Define the angle of light falling on working tables if one of them is in 1m, and another — in 3m from a window. The height of a window is equal 1,5 m. *Estimate the received result. Give recommendations.*

№ 9. *How many incandescent lamps (capacity 150 wt) are necessary to suspend in a room by the area 85m^2 to provide light exposure of workplace in 48 Bm/m^2. What capacity of a bulb you will advise to put in educational classes the area of 60 m^2 with a power consumption no more than 12,5 Wt on 1 m^2 of the floor area.*

№ 10. Room of a hostel is shined with two symmetrically located lusters in which there is on 5 incandescent lamps capacity 75 Wt everyone. *Whether light exposure of a room, if the area of it 40 m^2 is sufficient. Estimate. Give recommendations.*

№ 11. *Estimate light factors in rooms if they appeared in bedrooms — 1:9, in classes — 1 : 7, lavatories, washrooms — 1:8. Recommendations.*

№ 12. Area of chamber — 30 m^2, the area of the glazed part of windows 5 м^2, light exposure in chamber 200 Lx, outside of a building 20000 Lx. *Estimate natural light exposure in chamber by calculation of light factor and KNI.*

№ 13. *Define quantity of luminescent lamps capacity 60 Wt everyone if it is necessary to create in the small operational area of 40 m^2 light exposure with a level of 24 Wt/m^2, estimate this light exposure.*

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TOPIC 3: THE HYGIENIC ESTIMATION OF DRINKING WATER QUALITY

Total time: 4 hours.

The urgency: for a long time connection between population diseases and character of water supply is marked. The role of water in distribution of sharp intestinal infectious diseases has been especially brightly revealed.

Undoubtedly big role in decrease of population diseases by intestinal infections belongs to the centralized water supply. Studying microchemical structure of water has allowed to reveal a real opportunity of adverse its influence on population health that had the end result hygienic normalization of a chemical compound of potable water. Normative standard **Sanitary Norms and Rules 10–124 RB 99 «Potable water and water supply of the occupied places. Hygienic requirements and quality control»** are guided without fail at designing and realization of sanitary and sanitary-engineering actions at organization of water supply. **Sanitary Norms and Rules** guarantee the water safety in the epidemic relation (bacteriological parameters), its harmlessness on a chemical compound and favorable organoleptic water properties. There are grouping of hygienic specifications on functional purpose.

The purpose: To be able to give a hygienic estimation of water quality according to results of sanitary — bacteriological and sanitary — chemical analyses.

Tasks: To teach of students to a technique of use **Sanitary Norms and Rules** «Potable water», to be able to prove the norms providing epidemic water safety, harmlessness on a chemical compound and favorable organoleptic properties.

Starting knowledge and skills

To know:

1. Physiological-hygienic value of water, norm of water consumption, water schedule in various conditions of life and activity of the man.
2. Hygienic requirements to quality of drinking water and parameters qualities: organoleptic evaluation, a chemical compound, epidemiological safety.
3. The hygienic characteristic of various sources of water supply.
4. Systems of water supply, basic elements of the centralized system, means of clearing, disinfecting and special methods of improvement.
5. The basic documents regulating quality of drinking water.

To be able:

1. To take water from a local source and waterpipe for laboratory research, to make the accompanying forms.
2. To carry out prevention infectious and noninfectious diseases (caries, dental fluorosis, etc.), connected with use of poor quality water.

For full mastering a theme it is necessary to repeat from:

a) Nonorganic chemistry a theme: «the Chemical water compound»;

b) Normal physiology: «Physiological value of water»;

c) Microbiology: «Microbiological methods of water research».

Control questions from interdisciplinary sciences:

1. What physiological value of water?
2. What role of water in spreading of infectious diseases?
3. Water as the factor of infectious diseases. Examples.
4. What requirements exist to a chemical compound of water?
5. What do you know about microbiological methods of water research?
6. Method of take-off and transportation of water tests for laboratory researches?
7. To list microbiological parameters of water pollution.

Volume of independent work of students

To draw up a conclusion about water quality and about an opportunity of it using for the drinking purposes. To use the data of the situational task received from teachers.

The basic educational questions

1. Water in the nature, its physiological, epidemic, hygienic value for the man.
2. Quantitative norms of water supply, the factors determining them.
3. The factors determining quality of water: physical and organoleptic properties of water, a chemical compound of water.
4. Hygienic requirements to quality of drinking water at the centralized water supply. Sanitary Norms and Rules N 10-124 RB 99 «Drinking water and water supply of the occupied places».
5. Sources of water and their hygienic characteristic.
6. Systems of water supply. Facility of the centralized system of water supply. Sanitary protection of sources and systems of water supply.
7. Sanitary-and-hygienic requirements to the facility of mineshaft and tubular groundwater well, captation, springs.
8. Hygienic requirements to quality of drinking water of local water supply.
9. Biogeochemical endemia, connected to change of a chemical compound of water. The chronic intoxications caused by the raised contents in water of residual quantities of chemical substances.

Auxiliary materials to a theme

Sanitary inspection of water supply conditionally is divided into two kinds — precautionary and current.

Precautionary sanitary inspection is carried out at a stage of a choice of a water source, designing of systems of the centralized water supply, the device of water sources at decentralized water supply and at a stage of their reception in putting into operation.

The current sanitary inspection is carried out while in service systems of water supply and separate water sources.

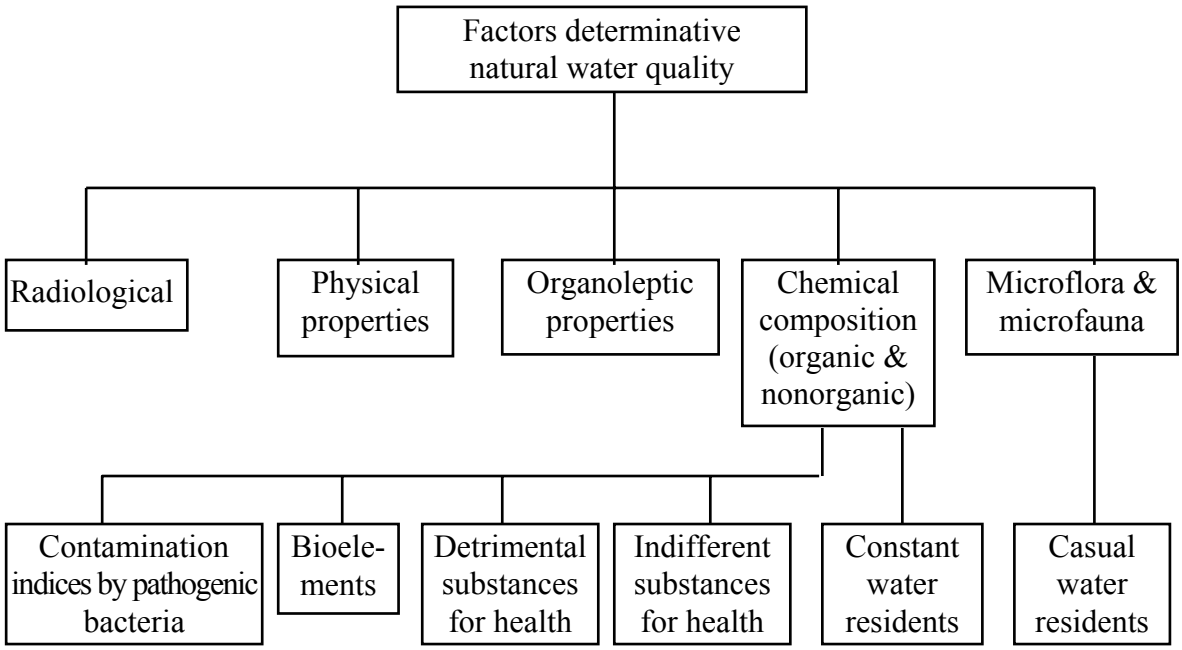
First of all as a water source choose existing water systems of nearby settlements if water in them satisfy the requirements of Sanitary Norms and Rules (SN&R), the quantity of it is enough, and connection to a network is possible and is economically determined. Further is choosed middle pressure water, non-pressure water, subsoil waters, including infiltration, and in last turn — superficial flowing and standing reservoirs.

After consideration of waterpipe project pass to acquaintance with the materials concerning a zone of sanitary protection in which validity and an opportunity of the organization of such zone should contain.

The current sanitary inspection is carried out as sanitary inspections of the familiarization, planning or emergency (special) order and as the daily control. The degree of security by water, elements of a technical condition of the waterpipe constructions, validity of processing methods and quality assurance of submitted water, calculations of sanitary protection zones and observance in them of an appropriate regimen, presence of the sanitary passport and observance of rules of its conducting, certificates of the previous inspections and performance of the recommendations ordered in them is found out.

The major element of the current sanitary inspection is the work of water supply systems, the water quality control in a water supply system. Periodicity of sampling and their quantity is defined by the head physician of the Center of Hygiene and Epydemiology (CHE). In case of discrepancy of water to requirements SN&R N10-124, and in repeated research it proves to be true — the reasons are established and of a measure on their elimination take.

THE HYGIENIC ESTIMATION OF DRINKING WATER QUALITY



The water quality estimation schema

1. Water quality is defined not only by properties of it at present, but also an opportunity of their preservation during all time of water source operation, (its reliability), it is necessary to find out a sanitary-engineering condition of a water source, a condition of a sanitary-topographical arrangement on the place and sanitary-epidemic conditions.

2. To compare the data about a chemical compounds and microbic semination to corresponding specifications SN&R.

3. To carry out the analysis:

a) content of the general number of microorganisms (microbic number) and the microorganisms accompanying some kinds of pathogenic microbes (Escherichia coli);

The judgement about absence or presence of pathogenic microbes is born on the basis of the indirect data that speaks complexity and duration of carrying out of research, and also insufficient reliability of results in case they appear negative.

b) The substances are indices of possible water pollution by pathogenic microorganisms (the compounds containing nitrogen, the organic substances causing oxidability, chlorides, the phosphates, the dissolved oxygen and biochemical need of water in oxygen (BNO), hydrogen sulphide, a parameter of concentration of hydrogen ions (pH));

c) Toxic substances for the man. To number of natural substances, according to SN&R are referred molybdenum, arsenic, nitrates, lead, selenium, strontium and fluorine. Here it is possible to relate and the natural radioactive substances causing background activity of water. All these substances can be technical origin also;

d) The substances having positive biological value, which presence in water it is desirable in the certain concentration (fluorine, iron, manganese, copper, zinc and silicon).

Quality norms of drinking water

1. Drinking water should be safe in the epidemic and radiating relation, is harmless on a chemical compounds and to have favorable organoleptic properties (table 1–4).

2. Quality of drinking water should correspond to hygienic specifications before its coming in a distributive network, and also in marks of water pumping of an external and internal water supply system.

3. Safety of drinking water in the epidemic relation is defined by absence in it of pathogenic bacteria, viruses and the elementary microorganisms, by its accordance to specifications on microbiological and parasitologic parameters submitted in table 1.

Table 1 — Sanitary Rules & Norms 10-124 RB 99
Quality of drinking water

The name of a parameter	Unit	The specification
Thermotolerant coliformed bacteria	Number of bacteria in 100 sm^3	Absence in 300 sm^3
The general coliformed bacteria	Number of bacteria in 100 sm^3	Absence in 300 sm^3
The general microbic number	Number of forming colonies of bacteria in 1 sm^3	No more than 50
Colifags	Number of plaque forming units (PFU) in 100 sm^3	Absence
Spores of sulphite reducing clostridia	Number of spores in 20 sm^3	Absence
Cysts of lamblia	Number spores in 20 sm^3	Absence

Table 2 — Specifications of the most widespread chemical substances in drinking water

The name of a parameter	Unit	Specifications (maximum concentration limit), no more	Parameter of harm	Class of danger
Hydrogen parameter	Units	Within of the limits 6–9		
General mineralization (the dry residuum)	Mg / dm^3	1000 (1500)		
Rigidity general	mml/dm^3	7,0 (10)		
Oxidability permanganate	Mg / dm^3	5,0		
Surface-active substances (SAS), anionic	Mg / dm^3	0,5		
Iron (Fe, totally)	Mg / dm^3	0,3 (1,0)	organolept	
Copper (Cu, totally) Molybdenum (Mo, totally)	Mg / dm^3 of mg / dm^3	0,10,25	organolept	3 2
Nitrates (NO_3^-)	Mg / dm^3	45		3
Lead (Pb, totally)	Mg / dm^3	0,03	san-toxic	1
Sulfates (SO42-)	Mg / dm^3	500	organolept	4
Fluorides (F-)	Mg / dm^3	1,5	san-toxic	2
Chlorides (Cl-)	Mg / dm^3	350	organolept	4

Table 3 — Maximal permissible concentration of the harmful chemical substances formed in water during its processing

The name of a parameter	Unit	Specifications (maximum concentration limit), no more	Parameter of harm	Class of danger
Chlorine: — residual free	Mg/dm^3	Within the limits 0,3–0,5	organolept	3
— residual connected	Mg/dm^3	Within the limits 0,8–1,2	organolept	3

If in drinking water was revealed the several chemical substances concerning 1 and 2 classes of danger and normalized to a sanitary — toxicological harmful index, the sum of ratio of the found out concentration of each from them in water to size its maximal concentration limit should not be more than 1.

Calculation is done under the formula:

$$\frac{C_{1akt}}{C_{1lim}} + \frac{C_{2\,akt.}}{C_{2lim}} + \frac{Cn_{\,akt}}{Cn_{\,lim}} \leq 1,$$

Where C_1, C_2, C_n — concentration of individual chemical substances 1 and 2 classes of danger: actual and limit.

Table 4 — Organoleptic water properties

The name of a parameter	Unit	The specification, no more
Smell	Marks	2
After-taste	Marks	2
Chromaticity	Degrees	20 (35)
Turbidity	UTF (units of turbidity on formazan; or mg/l (on coaline)	2, 6 (3,5) 1, 5 (2)

Radiating safety of drinking water is defined by its conformity to specifications on parameters of the general ά- and β-activity, submitted in the table 5:

Table 5 — Parameters of radiating safety of drinking water

Parameters	Unit	Specifications, no more	Parameters of harmful
General ά-radio-activity	Becquerel /l	0,1	Radiactiv
General β-radio-activity	Becquerel /l	1,0	Radiactiv

Materials for the control over mastering of a theme

To solve a situational task in the organizations of water supply of settlements. To give the conclusion about opportunity of water using for the economic-and-nutritional purposes.

Task

In territory of city settlement the hospital (150 beds) is placed.

Water supply of settlement is provided with subsoil waters with the help small-tube shaft. In territory of hospital there is a local waterpipe. The analysis of water spent during different seasons of year shows, that composition of water changeable, thus during the warm period of year the following parameters are marked:

Smell and after-test — 2 marks, turbidity — 1,8 mg/l, chromaticity — 30, the dry rest — 850 mg/l, general rigidity — 5,5 mg — eq/l, nitrogen of ammonia — 0,2 mg/l, nitrogen of nitrites — 0,004 mg/l, nitrogen of nitrates — 20 mg/l, chlorides — 320 mg/l, oxidability — 6 mg O^2/l, fluorine — 0,75 mg/l, iron — 1 mg /l, microbic number — 400.

Give conclusion about opportunity to apply water for drinking purpose.

Laboratory work

The task 1. To study techniques of sanitary-and-hygienic inspection of a water source.

The task 2. To study rules of water sampling for laboratory researches.

Stages of work:

Sampling of water for the sanitary analysis from various sources of drinking water supply

Each test of water irrespective of it target should have number and goes to laboratory with the accompanying document in which specify: the name of a water source, when, in what point and who takes test, temperature of water, a condition of weather, features of a test taking (from what depth, duration of spooling waters, etc.).

At inspection of the water sources investigated for the first time, water is investigated during all seasons of a year; variability of compozition of water is one of adverse sanitary parameters of water.

For the general sanitary estimation of an open reservoir of water test take at the upper and lower bound of water consumption area (with stream of a reservoir) on depth of 0,5–1 m, in the middle of a reservoir and on distance of 10 m from coast. At the control of seating of mass bathing the water test take directly near the bank on which the beach is located, and on distance of 5–10 m from it, on depth 0,5 m.

For the chemical analysis of water of test take in quantity 2–5 l depending on completeness of the analysis in pure large bottle which rinse in addition on a place researched water. Large bottle with a cargo lower on depth from which it is required to sample then a fuse open with the help of the cord attached to it.

Taken water tests must research as soon as possible (in the first 2 o'clock) as at standing, it is especial in the summer, the water composition changes owing of physical and chemical processes and ability to live of bacteria.

For the bacteriological analysis of water test take in special sterile utensils in quantity 400–500 ml (for detection of pathogenic microbes — 1–3 L) from depth of 15–20 cm from a surface of a reservoir or is deeper in the same places, as for chemical research. Taken tests investigate not later than in 2 hours; if it is impossible, it is supposed to prolong term till 6 hours under condition of water storage in ice to detain saprophyte development and to keep pathogenic microflora.

For helminthologic researches of open water reservoirs the test take near the bunk and in the middle, from a surface and from various depth, in quantity till 10–15 l. In each point of test take repeatedly at different o'clock and seasons of year.

Stages of work:

Definition of a water smell

The smell of water is defined at usual temperature and at heating up to 60ºC.

Of 150–200 ml fill a flask in capacity on 2/3 with researched water. Having closed hour glass, it intensively stir up and then, quickly having opened, define a smell. Has qualitatively begun to smell characterize as «chloric», «earty», «marsh», «oil», «aromatic», «uncertain», etc. The smell quantitatively is estimated on five-ball system (table 6). At definition of a water smell the hand and a dress of the observer should not have extraneous smells (parfume and so forth), air of a premise should be clean.

Table 6 — Scale of intensity of a smell and after-test of drinking water

Marks	Intensity of a smell or after-test	The characteristic of intensity
0	No	Absence of smell sensation or after-test
1	Very weak	Smell or the after-test which is not giving in to detection, but determined in laboratory by the skilled analyst
2	Weak	Smell or the after-test which is not to attract attention of the consumer, which can be found out if draw on it attention
3	Appreciable	The smell or the after-test which is easily found out and giving occasion to concern to water with ill-will
4	Distinct	Smell or the after-test paying attention and doing water unpleasant for drink
5	Very strong	Smell or after-test so strong, that makes water useless for drink

Taste of water is defined only at confidence, that it is safe (there are no poisonous substances and bacterial pollution). The oral cavity is rinsed with 10 ml of researched water, not swallowing it, and is determined taste which characterized as «saltish», «bitter», «sour», «sweet». After-test can be «fish», «metal», «uncertain», etc. Intensity of after-test also is estimated in marks.

A transparency of water determine usually on Snellen's typed font. Researched water shake up and up to the top pour in the colorless cylinder divided on height on centimeters and supplied below with a tube with a clip. The bottom of the cylinder should be smooth. Under the cylinder on distance of 4 cm from its bottom place Snellen font and try to distinguish letters through a water column. If a font to read it is not possible, water slowly let out (release) through a tube in cup Petri until letters do not become clearly visible. The height of a water column in centimeters specifies a degree of its transparency. Drinking water should have a transparency not less 30 cm. The degree of a transparency can be characterized also in its reciprocal — turbidity.

Quantitatively turbidity it is defined with the help of the special device — turbidimeter in which researched water compare to the standard solution prepared from fossil meal or coaline in distilled water. Water turbidity express in milligrams of the weighed substance on 1 l water.

Color of water are defined qualitatively by comparison of colouring of the filtered water (in quantity not less than 40 ml) with colouring of equal volume of

distilled water. Cylinders with tests examine above a white sheet of a paper, characterizing researched water as «colorless», «weak-yellow», «brownish», etc.

Quantitative definition of chromaticity is carried out by comparison of intensity of tested water colouring with a standard scale that allows to express it in standard units-degrees of chromaticity. As a standard solution apply a platinum-cobalt or chrome-cobalt scale. The basic solution of a scale has chromaticity 500º. For preparation of a scale take a number of calorimetric cylinders in capacity of 100 ml and pour in them the basic solution and distilled water about 1 ml of chemically pure sulfuric acid (specific gravity 1,84) in 1liter water in the quantities resulted in table 7. The lower line of the table specifies chromaticity of the standard in degrees at given desaturation.

Table 7 — Scale for definition of water chromaticity

Number of cylinder	Quantity f the basic solution, ml	The acidified distilled water, ml	Chromaticity, degree
1	0	100	0
2	1	99	5
3	2	98	10
4	3	97	15
5	4	96	20
6	5	95	25
7	6	94	30
8	8	92	40
9	10	90	50
10	12	88	60
11	14	86	70
12	16	84	80

Then 100 ml of tested water pour in the calorimetric cylinder and, comparing its curing with colouring standards at examining from top to down on a white background, is determined chromaticity in degrees.

Definition of physical and chemical properties of water

Definition of reaction. Natural water usually has alkalescent reaction. Water gets sour reaction at presence humic substances or at descent in a reservoir of the industrial sewage containing acids.

Qualitatively reaction (pH) is defined by the indicator. For this purpose in a test tube pour researched water and immerse in it a strip of a display paper. After extraction of a piece of paper immediately compare its colouring to standards of a scale of the universal indicator, corresponding to sizes pH from 1,0 up to 10,0.

The task 3. To teach to define water rigidity and the maintenance of iron.

There are basic and additional methods of water quality improvement (table 8).

Table 8 — Aimed, methods and means of water quality improvement

Aimds	Methods	Means
Clearing	Precipitation	Precipitation tank
Decolouration	Coagulation; fltering	Coagulants, filters
Disinfecting	Boiling; chlorination; ozonization; irradiation UV and ionizing irradiation	Boilers, chlorine and chloric preparations, batcher; ozone, ozonizers; UV installations
Neutralization	Sorbtion; boiling, ozonization	Carbons, filters; boilers; ozone, ozonizers
Demineralization	Distillation; ionic exchange, coagulation	Water-desalinating plant, ionites; filters; membranes
Deactivation	Filtering; distillation; an ionic exchange, coagulation	Filters; water-desalinating plant; filters, coagulants
Deironing	Aeration; oxidation by permanganate or chlorine	Coolers; precipitation tank; filters-oxidizers
Deodorization	Aeration; ozonization, coagulation	Cooling towel-sediment bowls; ozone, ozonizers; coal; filters
Defluorination	Dilution; an ionic exchange	Water without fluorine; ionites; filters
Fluoridation	The addition of fluorin-ecntaining salts	Fluorin-containing salts; installations for batching
Removal of after-test and smell	Sorbtion with carbon, ozonization, chlorination with preammonation	The activated carbon, solution of ammonia
Removal phyto- and zoo- plankton	Filtering through microfilters and through hydrocyclones	Drum-type microfilters and hydrocyclones

The report of research of organoleptic water properties.

1) Water t°.

2) The smell at room temperature is defined by two persons.

N — it is no more 2 marks.

Chlorinated — no more 1 mark.

Aromatic, marsh, putrefactive, wood, earty, fish, grassy, uncertain.

Similar — chloric, phenolic, oil.

Absence of a smell — 0 marks — is not present a smell.

In laboratory by the skilled analyst — 1 mark, very weak.

The consumer finds out — 2 marks, weak.

It is swept up, we feel, a disapproving response — 3 marks, appreciable.

The attention pays to itself, it would not be desirable to drink — 4 marks, distinct strong, drinking water is not suitable — 5 marks, very strong.

3) Taste and smack at temperature 20^0C, disinfected water N is no more 2.

In the small portions take in a mouth, not swallowing

0 marks — absence of smack,

1 marks — very weak smack,

2 marks — weak smack,

3 marks — appreciable smack

4 marks — distinct smack

5 marks — very strong smack

In addition: salty, bitter, sour, sweet, alkaline, ferruterous, chloric, knitting, metal.

4) Transparency and turbidity. Snellen's print №1, transparency in cm.

Transparency — 30 c m and more

Turbidity — with the help turbidimeter — comparison with the standard in mg/l.

In tap water — no more than 1,5 mg/l.

5) Chromaticity — in conditional degrees - comparison with the standard - the control over application of platinum-cobalt scale. N potable water no more than 20º, it is supposed up to 35º.

6) Chemical compound of water — appearance — the description.

In 1 turn — hydrogen sulphide, iron, nitrites, mineral salts of mg/l, rigidity, alkalinity mg/eq/l, cations K^{++}, anions — CL^{-}.

7) PH of water — hydrogen ions. Neutral PH-7,0, with the help of a litmus strip.

TESTS FOR SELF-CHECKING KNOWLEDGE OF STUDENTS

Theme «Hygienic estimation of drinking water quality»

Variant 1

1. What source is the best for drinking water supply?
1) Groundwater.
2) Surface.
3) Middle pressure water.
4) Middle non-pressure water.
5) Artesian water.

2. What state of drinking water are estimated?
1) Chemical.
2) Organoleptic.
3) Microorganisms.
4) Risk for health.
5) Radionuclides.

3. What do use for contamination control area of water supply?
1) Exclude the enter to this zone for everybody with police control.
2) Exclude the enter only for children.
3) Inhibitory action for house-building without police control.

4. Maximal concentration level for general microbic number for dr. water?
1) 100 colonies in 1 ml.
2) 50 — in 1 ml.
3) 1000 — in 1 litre.

5. Basic methods of quality water improving
1) Sedimentation.
2) Filtration.
3) Disinfection.
4) Deironing.

6. What is the neutralization?
1) Clearing from microorganisms.
2) Clearing from toxic chemicals.
3) Improving of organoleptic water properties.

7. Substances – testators of organic pollution
1) Oxidability.
2) Nitrate.
3) Nitrite.
4) Ammonia.

TESTS FOR SELF-CHECKING KNOWLEDGE OF STUDENTS

Theme «Hygienic estimation of drinking water quality»

Variant 2

1. What source is the best for drinking water supply?
1) Groundwater.
2) Recreational water.
3) Streams.
4) Lakes and ponds.

2. What state of drinking water are estimated?
1) Chemical components and microorganisms only.
2) Organoleptic.
3) Microorganisms.
4) Risk for health.
5) Radionuclides.
6) Chemical components.

3. Basic methods of quality water improving:
1) Sedimentation.
2) Fluorination.
3) Disinfection.
4) Deironing.

4. Maximum concentration level for coliformed bacteria in dr. water?
1) 1 colony-forming cell in 1ml.
2) 3 — in 300 ml.
3) 1 — in 300 ml.

5. What is the desinfection?
1) Water clearing from microorganisms.
2) Water clearing from toxic chemicals.
3) Improving of organoleptic water properties.

6. Substances — testators of organic pollution
1) Oxidability.
2) Nitrate.
3) Iron.
4) Ammonia.

7. What substance does connected the well-water methemoglobinemia with?
1) Nitrite.
2) Iron.
3) Nitrate.

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3. Sanitary rules and norms № 10-124 RB 99. Drinking water and water supply of populated area.

4. Lecture material.

The table 4 — Relative air humidity depending on indications of dry and damp thermometers (by the aspiration psychrometer)

A — indications of the dry thermometer, ºC

A	Indications of the damp thermometer, ºC																								
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
8	29	40	51	63	75	87	100																			
9	21	31	42	53	64	76	88	100																		
10	14	24	34	44	54	65	76	88	100																	
11		17	26	36	46	56	66	77	89	100																
12			20	29	38	48	57	68	78	89	100															
13			14	23	31	40	49	59	69	79	89	100														
14				17	25	33	42	51	60	70	79	89	100													
15					20	27	36	44	52	61	71	80	90	100												
16					15	22	30	37	46	54	63	71	81	90	100											
17						17	24	32	39	47	55	64	72	81	90	100										
18						13	20	27	34	41	49	56	65	73	82	91	100									
19							15	22	29	36	43	50	58	66	74	82	91	100								
20								18	24	30	37	44	52	59	66	74	83	91	100							
21								14	20	26	32	39	46	53	60	67	75	83	92	100						
22									16	22	28	34	40	47	54	61	68	76	84	92	100					
23										18	24	30	36	42	48	55	62	69	76	84	92	100				
24										15	20	26	31	37	43	49	56	63	70	77	84	92	100			
25											17	22	27	33	38	44	50	57	63	70	77	84	92	100		
26											14	19	24	29	34	40	46	52	57	64	71	77	85	92	100	
27												16	21	25	30	36	41	47	52	58	65	71	78	85	92	100
	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29									
28	13	18	22	27	32	37	42	48	53	59	65	72	78	85	93	100										
29	11	15	19	24	28	33	38	43	49	54	60	66	72	79	86	93	100									
30		13	17	21	25	30	34	39	44	50	55	61	67	73	79	86	93									
31		10	14	18	22	27	31	36	40	45	50	56	62	67	73	80	86									
32			12	16	20	24	28	32	37	41	46	51	57	62	68	74	80									
33			10	14	17	21	25	29	33	38	42	47	52	58	63	69	74									
34				12	15	19	22	26	30	34	39	43	48	53	58	64	69									
35				10	13	16	20	24	27	31	35	40	44	46	54	59	64									
36					11	14	18	21	25	29	32	37	41	45	50	55	59									
37						13	16	19	22	27	30	34	38	42	46	51	55									
38						11	14	17	20	24	27	31	35	39	43	47	51									
39							12	15	18	21	25	28	31	35	39	43	47									
40							11	14	17	19	23	26	29	33	36	40	44									

Учебное издание

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ГИГИЕНА ОКРУЖАЮЩЕЙ СРЕДЫ
(на английском языке)

Учебно-методическое пособие
для студентов 2 курса факультета по подготовке специалистов
для зарубежных стран

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