

**MINISTRY OF HEALTH OF UKRAINE**  
**O.O. BOGOMOLETS NATIONAL MEDICAL UNIVERSITY**

**“Approved”**

at the methodological conference of hygiene  
and ecology department

**Head of the department**

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M.D. Bardov V.G. \_\_\_\_\_

**GUIDELINES**  
**FOR STUDENTS**

<i>Subject</i>	Hygiene and ecology
<i>Module № 1</i>	Assessment of the environment and its impact on the population health
<i>Submodule № 7</i>	Hygiene of emergency situations
<i>Topic of the lesson</i>	Organization of sanitary inspection of nutrition and water supply in emergencies.
<i>Course</i>	6
<i>Faculty</i>	medical
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Kiev

## **1. Learning objective**

1.1. Describe physiological and hygienic as well as moral and psychological importance of rational food for the units in field conditions during elimination of consequences of emergencies.

1.2. Acquire the technique of medical control of the food adequacy and safety for the units under field conditions during emergencies.

1.3. Learn about medical service and means of civil units as to medical examination of foodstuffs in field conditions.

1.4. Master methods of food sanitary examination, sampling, determination of food quality and freshness, indication of poisoning and contamination; to make up an expert's report based on results of examination.

## **2. Basics**

2.1. You should know:

2.1.1. Concept of "rational nutrition", conditions of its provision.

2.1.2. Health disorders and diseases, which may occur under non-observance of any of the conditions of rational nutrition.

2.1.3. Methods of prophylaxis of alimentary, infectious diseases, helminthiasis, food poisonings, morbid affections through food by poisonous substances (PS), radioactive substances (RS), bacterial substances (BS).

2.1.4. Hygienic characteristics and food quality requirements.

2.1.5. Criteria (guidelines) of food expert assessment.

2.1.6. Administrative and staff units and medical service laboratory means for food examination in field conditions.

2.2. You should have the following skills:

2.2.1. To assess ration for personnel of the units using different methods:

- by calculation methods, according to apportionment of foodstuffs (menu-schedule);

- by means of study of foodstuff assortment for a daily ration, foodstuff storage conditions, food cooking and realization;

- by method of check-weighing (by weighing of foodstuffs when loading them into a cauldron, by weighing of ready meals);

- by means of study of food state of human organism of personnel of the units (according to somatoscopic, somatometric, physiometric, biochemical, clinical indices);

- by express method (using devices) and by means of laboratory analysis of foodstuffs and ready meals.

2.2.2. To organize and carry out medical control of adequacy of food for personnel of the units (and for affected population) and to take necessary prophylactic measures to provide adequacy of food.

2.2.3. To take medical measures in case of the beginning of alimentary, infectious intestinal diseases, helminthiasis, food poisonings, morbid affections through food by strong effect poisonous substances (SEPS), radioactive substances (RS); to investigate causes of their beginning, to take preventive measures.

2.2.4. To carry out food sanitary examination.

2.2.5. To sample food for express and laboratory analyses, indicate food infection by poisonous and radioactive substances with the help of ПХР-МВ and ДП-5В devices and according to general (organoleptic, sanitary and chemical) food quality and spoilage indications;

2.2.6. To draw the expert's conclusion based on results of food medical examination.

### **3. Self-training question**

3.1. Rational (full-value) nutrition, conditions of its provision. Physiological norm of food as a basis of food sufficiency and adequacy to the needs of human organism.

3.2. Organization of food for rescue teams and civil units in field conditions during emergencies, types of food (collective, group, individual). Food stations, types of field kitchens, types of other facilities.

3.3. Food in conditions of contamination of area and objects with strong poisonous substances, radioactive substances, infection with bacterial substances.

3.4. Food concentrates, dry rations, rations for survival as foodstuffs for personnel of the units during critical period of disasters, at other emergencies.

3.6. Duties of medical staff, methods and instruments of sanitary control of the adequacy and safety of food for personnel of the units and for affected population in field conditions during emergencies.

3.7. Methods of assessment of nutritional status of human organism (somatoscopic, somatometric, physiometric, biochemical, clinical and others).

3.8. Health disorders and diseases caused by quantitative and qualitative inadequacy of daily ration, food irregularity, inconformity of quality of foodstuffs and ready meals to enzymatic potentiality of digestive system (notion of enzymatic constellation).

3.9. Foodborne infectious diseases, helminthiasis, food poisonings, methods of their investigation and prophylaxis under field conditions during emergencies.

3.10. Hygienic characteristics of basic foodstuffs, canned goods, food concentrates.

3.11. Indices that characterize freshness, commodity quality of food substances, signs of food spoilage, epidemiological and toxicological danger.

3.12. Sources, factors and mechanisms that determine foodstuffs infection, by poisonous, radioactive substances and bacterial means.

3.13. Medical service sub-units of the units which functions are to carry out foodstuffs medical examination.

3.14. Basic means (laboratory kits and instruments) aimed for foodstuffs medical examination in field conditions.

3.15. Stages of food medical examination and possible variants of expert's reports at different stages of the examination.

### **4. Self-training assignments**

4.1. Daily ration for rescue team men, which are engaged in removing the demolished buildings after earthquake, includes proteins – 100 g (including animal protein - 30 g), fats - 90 g, carbohydrates - 380 g. Calculate and assess if such ration is sufficient, knowing that energy expenditures of the man amount to 4500 kcal. (Take into consideration that 10% of food is not assimilated).

4.2. Company of 350 rescuers during salvage operations had *for breakfast* at food station the following: boiled meat of perished during the earthquake cow, boiled pearl-barley, bread, and tea; *for dinner*: soup made of concentrated product, rissoles of meat of the same perished cow, porridge, compote, bread. In 2-4 hours after dinner 40 rescuers began to feel abdominal pains, diarrhea set in, temperature increased to 37.5-38.7<sup>0</sup>C. 10 persons complained of slight indisposition. There was no fatal case. Describe in detail the duties of medical officer in such situation. Fill in (conventionally) an emergency report about food poisoning:

Registration Form № 58

1. Number of rescue team unit or EMERCOM (Emergency Control Ministry) unit – \_\_\_\_\_
2. Diagnosis – \_\_\_\_\_
3. Date of food poisoning, time of manifestation of symptoms after food intake – \_\_\_\_\_
4. Place of food intake – \_\_\_\_\_
5. Number of victims – \_\_\_\_\_, are hospitalized – \_\_\_\_\_ of them
6. Severity of disease – \_\_\_\_\_
7. Offending foodstuff (meal) – \_\_\_\_\_
8. Cause of the poisoning – \_\_\_\_\_
9. Taken measures: \_\_\_\_\_

Signature of medical officer \_\_\_\_\_

4.3. During inspection of herring stock in woods in the emergency area (no electricity) mildew, odor nuisance and mucilage has been found out. Draw up a substantiated expert's conclusion and recommendations.

4.4. As the result of a consignment of wheat flour (40 tonnes) laboratory analysis there were revealed weevil. Draw up a substantiated expert's conclusion and recommendations.

4.5. During sanitary inspection of 50 carcasses from refrigerators of the stockhouse in the earthquake area that took place 8 days ago, mucilage of the surface, grey color and odor nuisance have been found out. Ammonia test is positive. CuSO<sub>4</sub> –test – broth is slightly cloudy, and in smear there are solitary microbes in sight. Draw up a substantiated expert's conclusion and recommendations

**5. Structure and content of the lesson** (duration of the lesson 160 min + 10 min break)

- 5.1. Preamble – 5-10 min.
- 5.2. Test control for assessment of students' knowledge datum level – 10-15 min
- 5.3. Theoretical training – 30-40 min.
- 5.4. Typical situational tasks “Krok-2” solution – 30-40 min.
- 5.5. State exams situational tasks solution – 30-40 min.
- 5.6. Test control for assessment of students' knowledge final level – 10-15 min.

Appendix 1

## **Organization of medical and sanitary control of food for personnel of the units during emergencies**

Medical and sanitary control of the food for personnel of the units is accomplished by:

- the system of preventive measures: design and construction of objects designed for foodstuffs, which satisfy the requirements of hygienic regulations (such as storage facilities for foodstuffs, stationary and mobile kitchen equipment, refrigerating units, special-purpose transport); working out of technique and equipment to conserve and preserve food, to produce containers, packages and etc.;

- the methods of medical control of adequacy of food for personnel of the rescue teams and civil units;

- the system of regular sanitary inspection that includes sanitary inspection of objects designed for foodstuffs and sanitary examination of foodstuffs and ready meals for freshness and safety, which is the most important thing in conditions of disasters and other emergencies.

The objects for medical and sanitary inspection in field conditions are:

- food stations for rescue teams, units and population within emergency zone, during emergency situations;

- food stations (FS) within teams and units;

- stationary (within a disaster area), mobile foodstuff storage facilities;

- stationary (within a disaster area) and mobile food production plants;

- transport assigned for foodstuff transportation;

- food stations at halting places of medical evacuation (at railway junctions, motor road junctions and other transport nodal points) and so on;

- level of health of the personnel, which work at objects designed for foodstuffs (cooks, duty details to cook-houses and other support personnel).

Medical and sanitary control in field conditions during emergencies is organized by:

- local sanitary and epidemiologic maintenance of the region of disaster;

- medical service of civil units;

- medical officers of medical station of a regiment;

- military medical laboratory (MML), sanitary and epidemiologic laboratory (SEL) of a division;

- mobile sanitary and epidemiologic laboratory (MSEL) of “A” or “B” type of sanitary and epidemiologic group (SEG) of an army, SEG laboratory.

Devices for control of adequacy of food for personnel of the units and execution of medical examination of foodstuffs in field conditions:

- laboratories of local sanitary and epidemiologic stations, patient care institutions, laboratory kits of the civil units;
- basic laboratory instruments of medical and chemical service, kits and devices to take samples of foodstuffs or ready meals, dosage meters DM-5A, DM-5B (ДП-5А, ДП-5В); medical-veterinary device for chemical investigation MV-DCI (ПХВ-МВ); hygienic laboratory HL-1 (ЛГ-1), medical field chemical laboratory MFCL-54 (МФХЛ-54), bacteriological laboratory BL, basic hygienic laboratory HL-2 (ЛГ-2), bacteriological laboratory BL, virological laboratory VL, toxicological laboratory TL, radiometric laboratory in boxes RLB-2 (РЛВ-2).

Specific features, which are peculiar to basic laboratory kits and devices for field conditions:

- kits designed for express research with use of standardized reagents, indicators, references;
- kits and devices standard for all services, rescue teams and civil units;
- kits and devices, which have small-size and are resistant to impacts (shaking) during transportation.

Appendix 2

### **Conditions of rational nutrition and methods of medical control of adequacy of food**

Among the conditions of rational nutrition are the following:

1. Quantitative adequacy – correspondence of caloric content of food for a daily ration with energy expenditures of human organism.
2. Qualitative adequacy, favorable balance – proper content of energetic, plastic, catalytic food materials (proteins, fats, carbohydrates, mineral salts, micronutrient elements, vitamins, flavoring substances) for a daily ration in optimal quantities and optimal proportion.
3. Rational eating pattern – number of food intakes, correspondence of food intakes with biological rhythms of human organism, distribution of a daily ration for single food intakes, food intake intervals.
4. Correspondence of food quality to enzymatic potentiality of digestive system (digestibility and high absorbency).
5. Epidemiologic safety and toxicologic harmlessness of food (absence of causative agents for foodborne infectious diseases with, germs of helminths, poisonous substances).

Methods of medical control of adequacy of food:

- calculation methods – according to menu-schedule using food standards – rations for rescue teams and civil units (Appendix 3) and tables of chemical composition of foodstuffs;
- methods of sanitary inspection of conditions of procurement, transportation, storing, cooking and realization of foodstuffs and ready meals;
- check-weighing methods (check-weighing of foodstuffs when issuing them from a storehouse to a cook-house, when loading them into a cauldron, for instance, of a field kitchen, check-weighing of ready meals);
- methods of express analysis and laboratory analysis of foodstuffs and ready meals for caloric content, content of proteins, fats, vitamins and other;

- methods of study of nutritional status of human organism of personnel of the units (according to anthropometric, physiometric, somatoscopic indices, data of biochemical, clinical studies).

## Appendix 3

### Food Standards for the Units

(basal ration of the units of Emergency Control Ministry \*)

Name of foodstuff	Mass for 1 person per day (24 hours), gram

#### Food value of the ration

Energy value (caloric content) – \_\_\_\_\_ kcal/day

Proteins – \_\_\_\_\_ gram, including animal protein – \_\_\_\_\_ gram

Fats – \_\_\_\_\_ gram.

Carbohydrates – \_\_\_\_\_ gram.

Vitamins A, B<sub>1</sub>, B<sub>2</sub>, B<sub>6</sub>, PP, B<sub>12</sub>, C – \_\_\_\_\_

Calcium – \_\_\_\_\_

Phosphorus – \_\_\_\_\_

Iron – \_\_\_\_\_

\*) The ration is issued during the lesson to be examined and evaluated as to hygiene standard.

## Appendix 4

### Health disorders depending on the inadequacy and poor quality of food

- diseases caused by starvation, quantitative and qualitative malnutrition (marasmus, quashiorkor, hypovitaminosis, avitaminosis and others);

- diseases caused by overeating (obesity, podagra, hepatitis, cholecystitis, pancreatitis, cholelithiasis);

- diseases caused by food irregularity (gastritis, gastric ulcer, duodenal ulcer, coprostasis and etc.);

- diseases caused by wrong cooking of foodstuffs (gastritis, stomach ulcer, hypovitaminosis and others);

- food poisonings: of microbial origin (toxicoinfections, bacterial toxicoses, mycotoxicoses), of non-microbial origin (by food, poisonous by its nature; by food, which became poisonous as a result of violation of rules of storing and other rules, by food, contaminated by poisonous substances ( by pesticides, by salts of heavy metals and so on);

- enteric, bacillary, viral, zoogenous infections (typhoid fever, paratyphoid A, B, dysentery, hepatitis type A, poliomyelitis, enterovirus diseases, brucellosis, foot-and-mouth disease, tuberculosis and etc.; geo- and bihelminthosis (ascarid, whipworm, beef tapeworm, pork tapeworm, porkworm, fish tapeworm, Trematoda and others);

## Appendix 5

## **Organization of food for personnel of the units and medical control of food adequacy and safety during disasters and other emergencies**

During the first, the most critical period of any catastrophe or other disaster, individual food for personnel of the units, which came to help the victims and affected population and to eliminate the consequences of a catastrophe, is to be organized. Such food is realized using dry rations, sub caloric food allowances, rations for survival.

Dry rations are portions of meal, which are always packed, and intended for one person per day, which consists of:

- rusks or pieces of dry bread;
- different canned goods (three 200-gram pieces), sugar – 45 g, tea – 1 g, concentrated products to cook soups, porridges, which need no long-lasting cooking. Caloric content of dry rations is within 3 200 - 3 500 kcal.

Sub-caloric food allowances (1 100 - 1 150 kcal.) include reduced quantity of carbohydrates, fats, and sufficient amount of proteins, vitamins, mineral substances, micronutrient elements.

“Rations for survival” are rations in the form of bricks or large tablets that have low caloric content (800 - 1 000 kcal.), and minimally required quantities of proteins, fats, and other nutrients. They are intended to be eaten during short-term period (during 2-3 days) in the most difficult conditions of catastrophes or disasters.

The second form of organization of food for personnel of the units is a group food by means of food concentrates, which need no long-lasting cooking.

Such food concentrates are produced as a single food: “minced meat”, “minced fish”, “dried sour clotted milk” etc.; as a single dish: “wheat and vegetable soup”, “potatoes stewed with vegetable powder” etc.; as standard field food allowances per 2, 10, 20, 50 persons – dry bricks for breakfast, dinner, supper – in single package.

Such food concentrates are ready to be eaten after boiling in water during 10 minutes.

The third form of organization of food for personnel of the units under conditions of emergencies is a collective one: at food stations (FS), where food is cooked in field-kitchens (fig. 55.1, 55.2, 55.3) from usual foodstuffs, sometimes they use there some food concentrates instead of usual foodstuffs, if necessary usual foodstuffs are not available.

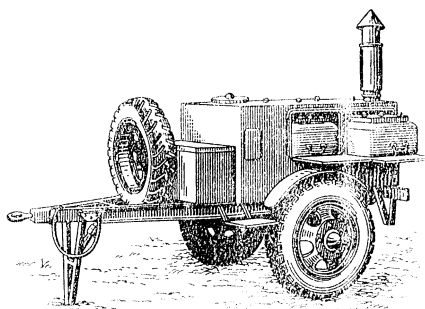


Fig. 55.1 Travelling kitchen – trailer TK-125

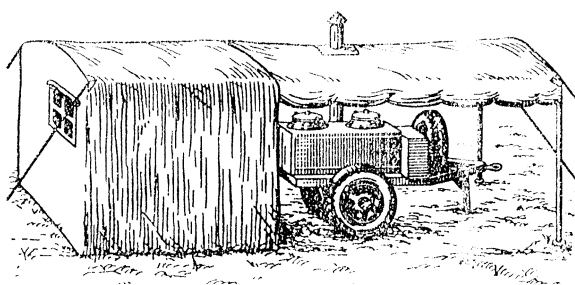




Fig. 55.2 Travelling kitchen – TK-2-49 in framed tent

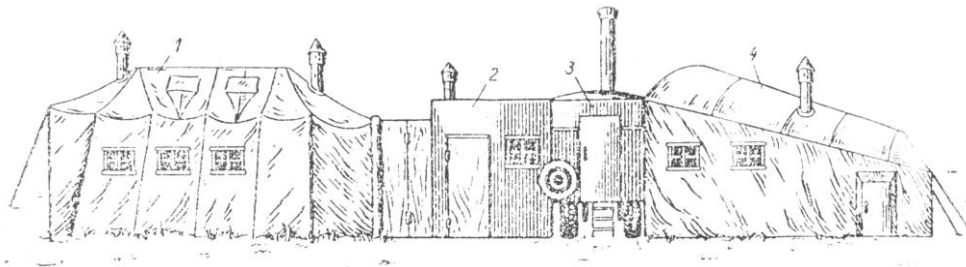


Fig. 55.3 General view of field-kitchen and mess

(1 – mess; 2 – lobby; 3 – kitchen-trailer; 4 – room for subsidiary work)

Measures of medical control of food for personnel of the units in conditions of emergencies

1. Control of organization and observance of sanitary regulations for taking of foodstuffs from storage facilities, available stored food from population, captured foodstuffs, and foodstuffs used as a result of catastrophes (injured animals, ruined storage facilities for foodstuffs).

2. Control of observance of sanitary regulations for loading, transportation, and storing of foodstuffs in stationary, mobile storage facilities, issuing of foodstuffs to cook-houses, battalion food stations.

3. Control of observance of sanitary regulations for cooking of foodstuffs, regarding period of storage and realization of ready meals.

4. Control of upkeep of storage facilities for foodstuffs, special-purpose transport, field equipment to produce food, field-kitchens, kitchen utensils, implements; measures against rodents, pest control.

5. Physical examinations and surveys of cooks, attending personnel of foodstuff storage facilities, duty detail to cook-house with respect to carriage of bacilli, control of observance by them personal hygiene and etc.

6. Monitoring of delivery to the personnel of a full set of foodstuffs and meals according to the standards for ration to provide adequate food.

## Appendix 6

### Procedure of investigation of food poisonings

Procedure of investigation of food poisonings includes:

1. Organization and rendering of immediate first aid to patients, organization of their hospitalization (if necessary).

2. Drawing up of necessary documents (emergency report to Sanitary and Epidemiologic Station (SES) or to the rescue teams sanitary and epidemiologic units, appointment card to hospital, appointment card to laboratory together with the materials of victims), and others (see Appendix 7).

3. Formation of groups for investigation: sanitary inspector of SES, medical officer of the institution or unit, where the poisoning happened, or doctor of patient care institution to which the victims appealed, representative of administration or the unit commander, cook.

4. Compiling of plan of investigation.

5. Questioning of victims (patients) and persons, which consumed the same food, but have not got a disease, and cook-house personnel, with recording in questionnaires (schemes 3, 4 of Appendix 7).

6. Sanitary inspection of cook-house, field food station and its personnel, examination and referral to analysis of offending food debris, and study of the results of laboratory analyses, drawing up of documents.

7. Drawing up of conclusion (report) about the results of investigation (document 5 of Appendix 7).

8. Organization of taking of health-improving and prophylactic measures. Situational task concerning case of food poisoning is appended (Appendix 8).

Appendix 7

Documents to be drawn up during investigations of food poisonings

Registration Form № 58

***Emergency report about infectious disease, food poisoning, acute occupational poisoning***

1. Diagnosis \_\_\_\_\_

2. Family name, name, patronymic \_\_\_\_\_

3. Man, woman (underline) \_\_\_\_\_

4. Age \_\_\_\_\_

5. Address: \_\_\_\_\_ St., Apt \_\_\_\_\_

6. Name and address of place of work (study) \_\_\_\_\_

7. Date of beginning of disease \_\_\_\_\_

8. Date of the first appeal (on account of this disease) \_\_\_\_\_

9. Place and date of hospitalization (or № of order) \_\_\_\_\_

10. In case of poisoning – specify the place of poisoning, where with is poisoned \_\_\_\_\_

11. Taken primary anti-epidemic measures and additional information \_\_\_\_\_

12. Date and time of primary signal about the disease (by telephone and etc.) to SES. \_\_\_\_\_

Family name of the person, who informed about this case \_\_\_\_\_

Who received the report \_\_\_\_\_  
(appointment, family name)

13 Name of the institution, where the report was sent \_\_\_\_\_

Registration № \_\_\_\_\_ in register \_\_\_\_\_

14. Date and time of the report sending \_\_\_\_\_

15. Date and time of receipt of the report by \_\_\_\_\_

SES \_\_\_\_\_  
Registration № \_\_\_\_\_ in SES register \_\_\_\_\_

Signature of clerk,  
who received the report \_\_\_\_\_

***Appointment card to SES laboratory, laboratory of clinic, field laboratory***

\_\_\_\_\_  
(address)

The following is referred to investigation on account of food poisoning:

- vomit mass in amount of \_\_\_\_\_ ml from (family name, name, patronymic of the patient) taken in \_\_\_\_\_ (date) at \_\_\_\_\_ o'clock.
- gastric lavage fluid in amount of \_\_\_\_\_ ml \_\_\_\_\_
- feces \_\_\_\_\_ and urine \_\_\_\_\_
- blood for hemoculture from vein \_\_\_\_\_ ml, drawn at \_\_\_\_\_ o'clock (for serological reactions \_\_\_\_\_, botulinic toxin \_\_\_\_\_)
- samples of offending foodstuffs (name and amount) \_\_\_\_\_

\_\_\_\_\_  
\_\_\_\_\_  
Clinical presentation of poisoning \_\_\_\_\_  
(list of basic symptoms)

\_\_\_\_\_  
\_\_\_\_\_

Date \_\_\_\_\_ time \_\_\_\_\_

Sample preservation methods for bacteriological analysis \_\_\_\_\_

Signature of person, who has taken and  
referred the samples \_\_\_\_\_

Investigation scheme of group of food poisonings according to clinical signs

Family name, name, patronymic (or number of patients with identical symptoms)	Basic symptoms																	
	nausea	vomiting	diarrhea	abdominal pains	chest pain	headache	shiver	temperature	state of cardiac performance	general weakness, vertigo	visual impairment	dry mouth	constipation	spasms	cyanosis	muscle pain	pain in joints	other symptoms (name)

Results of questioning are to be denoted by sign “+” or “-”.

Questionnaire of victims to ascertain used food (foodstuff), which caused poisoning

Family name, initials or number of patients, which used this dish, foodstuff	Unit	The day before disease					During the day of disease							
		Breakfast	Dinner			Supper	Breakfast	Dinner			Supper			
			1 course	2 course	3 course			1 course	2 course	3 course				

Results are to be denoted by sign “+” or “-”. Name the dish, which was used for food by all diseased people.

Report about the results of investigation of food poisoning

1. Name of collective (unit, team) \_\_\_\_\_
2. Date of food poisoning \_\_\_\_\_
3. Place of food intake (canteen, Food Station, field-kitchen; group, individual food) \_\_\_\_\_
4. Total number of victims \_\_\_\_\_ have been hospitalized \_\_\_\_\_ of them, have died \_\_\_\_\_ of them
5. Severity of disease \_\_\_\_\_
6. Clinical signs \_\_\_\_\_
7. Offending foodstuff (where it came from) \_\_\_\_\_
8. Possible (or exact) cause of the food poisoning \_\_\_\_\_
9. Results of laboratory examination of these materials \_\_\_\_\_
10. Measures taken to eliminate the food poisoning, to prevent such poisonings in future \_\_\_\_\_

Signatures of the officials,  
which take part in the investigation

\_\_\_\_\_  
\_\_\_\_\_

Date

\_\_\_\_\_

Appendix 8

**Case of mass food poisoning among the rescue team personnel eliminating the consequences of the catastrophe (situational task)**

In June 1989 on the 12-th day after earthquake (in Spitak, Armenia) at midnight 5 rescue team members eliminating the consequences of this earthquake appealed to medical station with the following complaints: about one hour before they felt severe abdominal pains, bad general weakness, headache, attack of vomiting. All the patients had rapid – up to 120-130 per min., deficient pulse. Temperature increased to 37.8-39.8<sup>0</sup>C. Two of them had diarrhea, sural pain and gastrocnemius cramps, dry mouth.

One hour later the other members of the team began to appeal to medical station. By morning the number of patients amounted to 49 people. Next morning at 10 o'clock two rescuers died. Disease state felt some more people of the team and they had liquid stool, but they did not appeal to medical station.

Investigation of the case was started in the morning before breakfast. It was ascertained that menu for the day of beginning of the disease in food station for the rescue team (field-kitchen) included:

- Breakfast: fried fish with boiled pearl-barley and sauerkraut;
- Dinner: 1 course – borsch cooked in meat broth;  
2 course – meat rissoles of beef with boiled pearl-barley;  
3 course – apple compote (apples were unripe, collected);
- Supper: canned fish (cod in tomato) with millet porridge, tea.

When questioning some patients, it was ascertained the following:

- two rescuers missed breakfast (as they went on detachment);
- one rescuer missed supper (as he had supper with the natives in another place);
- one rescuer refused to eat borsch for dinner, as he is gastritis patient, and borsch seemed to be too sour to him;
- the rest of rescuers of the team either diseased or healthy ones ate all dishes.

The greater part of the patients stayed too long eliminating ruins and had dinner 2.5 hour later than the rest of the personnel of the team. There are no diseased people among the personnel of the field-kitchen.

When carrying out inspection of the food station, no serious violations of sanitary regulations was ascertained. Camp tables, kitchen boards for food preparation, cooking battery, and kitchen implements were sufficiently clean, but there were many flies. Personnel of the field-kitchen quite exactly know sanitary regulations for food preparation in field conditions. It is necessary to note that medical officer did not provide training for the personnel for a long time, and situation after the earthquake did not allow that.

In the course of investigation it was ascertained that cabbage was delivered to the food station in zinc-coated buckets, fish was of local haul, and meat was of injured during the earthquake and later slaughtered cow; meat was preserved for several days in refrigerated truck. In addition, it was ascertained that there was no hot water in the food station, running water was quite warm thanks to the hot weather and was used by the kitchen personnel to wash dish and kitchen implements.

Meat was minced; meat rissoles were cooked on roasting pan and preserved in oven to be dispensed for dinner. However, it was found, that semi-prepared rissoles for the rescuers, which stayed too long eliminating ruins, were preserved on the table under kitchen sheet and were cooked later, immediately before dispensation.

The whole batch of foodstuffs for the day, when poisoning happened, was received overnight. According to the words of doctor's assistant of this medical station who inspected the field food station being on duty that day, quality of foodstuffs was good: meat was from the refrigerator, fish was of the latest haul, cabbage was in pickle, tasted sour; preserved food had three years shelf life and there was no can blowing. Physical examinations of the cook-house personnel were made timely; the results of these examinations were satisfactory, without negative notes.

Task: fill in all tables, analyze this mass poisoning, draw the conclusions and give recommendations concerning prophylaxis of such poisonings in future.

## **Objects, tasks, stages of medical examination**

The *objects of foodstuffs medical examination* in field conditions in the emergency situations are:

- ready meals and food of regular consumption (bread, flour, macaroni, cereals, meat, fats, alcoholic drinks etc.);
- foodstuffs of long-term storage (dry rations, food concentrates, field rations, canned food);
- foodstuffs of local provision from population and storehouses in the emergency area;
- imported foodstuffs.

*Tasks of foodstuffs medical examination* are following:

- assessment of foodstuffs quality, its correspondence to certificates, sanitary standards, terms of realization;
- revealing of signs of spoilage and assessment of its degree for the purpose of prevention of food poisonings, foodborne infectious diseases, helminthiasis (regular, periodic, sporadic expert examination);
- foodstuffs express medical examination when investigating causes of food poisonings and infectious diseases in conditions of disasters and in other emergency situations;

Foodstuffs medical examination in field conditions is an essential measure for food supply problem solution for rescue teams and affected population during disasters; necessity and selection of methods of disinfection, degassing, deactivation, utilization or extermination of food consignment is the responsibility of medical service units or civil units.

### **Stages of foodstuffs medical examination in field conditions and variants of expert's reports**

*I stage:*

- collection of information, food object sanitary examination on the spot (food storehouse, food stations, storage on the spot);
- food package indication on poisoning by poisonous substances (PS) using medical-veterinary device for chemical investigation MV-DCI (fig. 56.1), and by radioactive substances (RS) using field roentgenometer-radiometer ДП-5А, ДП-5В (fig. 56.2);
- assessment of organoleptic signs of food quality or spoilage (except for taste);
- substantiation and drawing up of a preliminary expert's report.

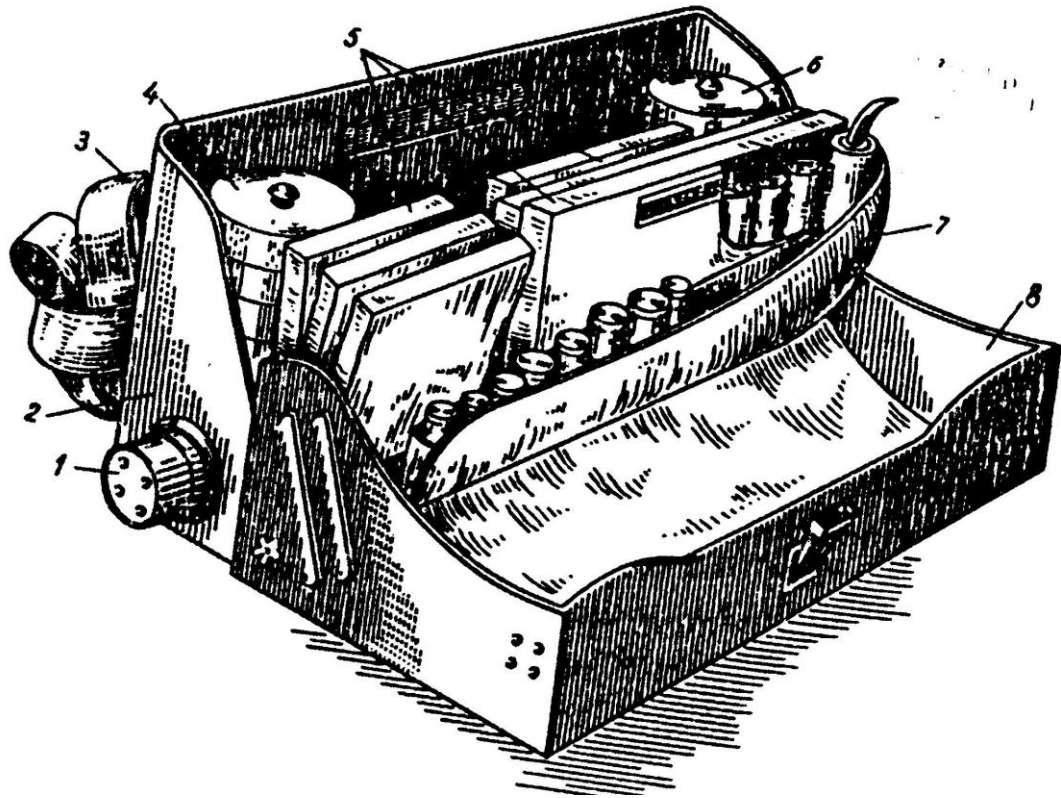


Fig. 56.1 Medical-veterinary device for chemical investigation MV-DCI  
(according to N.I.Karakcheyev)

(1 – manual pump; 2 – metal box; 3 – belt; 4 – vessel for foodstuffs dry air extraction and analysis; 5 – indicator tubes in paper cartridges; 6 – water sample vessels; 7 – chemical agents in a cloth cartridge; 8 – cover)

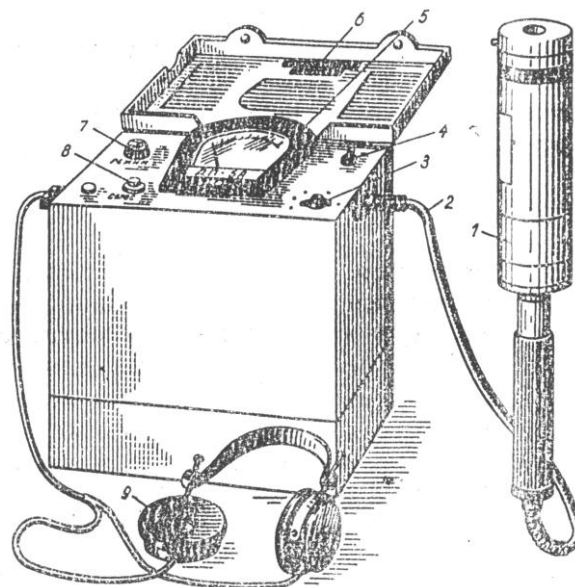


Fig. 56.2 Roentgenometer-radiometer ДП-5А (according to N.I.Karakcheyev)

(1 – probe; 2 – cable; 3 – band selector; 4 – toggle of scale illuminator 5 – microammeter; 6 – radioactive strontium-90; 7 – controller „mode”; 8 – button; 9 – headphones)

Variants of preliminary expert's report may be:

a) Product is good for use without restrictions;



- b) Product is unsuitable for use and should be exterminated;
- c) Product of doubtful quality, requires laboratory expert examination.

*II stage:*

- doubtful quality foodstuffs sampling (minimum 10 samples from each consignment of food) for bacteriological, sanitary and chemical analysis;
- packing of samples, accompanying paper work;
- samples' transportation to laboratory.

*III stage:*

- laboratory research:
  - sanitary and toxicological using medical field chemical laboratory МИХЛ-54 (MFCL-54); (in sanitary-epidemiological laboratory), toxicological laboratory (TL) (in sanitary-epidemiological laboratory);
  - sanitary-bacteriological and virological using kits of "Bacteriological laboratory (BL)" and "Virological laboratory (VL)";
- radiometric research using radiometric laboratory in boxes РЛВ-2 (RLB-2) (fig. 56.3);
- sanitary and chemical, organoleptic research using hygienic laboratory HL-1 or basic hygienic laboratory HL-2.

These investigations may also be done in the laboratory of the nearest sanitary-epidemiological station (SES).

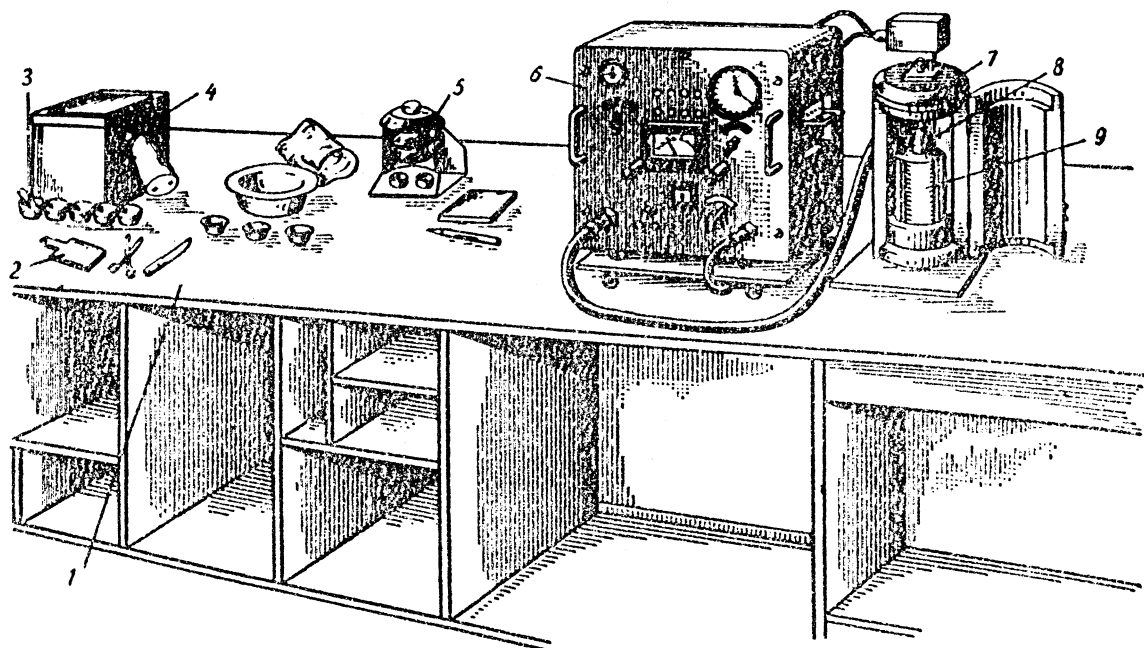


Fig. 56.3 Radiometric laboratory in boxes RLB-2 all-out

(1 – table made of boxes from instrument set and field furniture; 2 – board for handling of foodstuffs; 3 - porcelain mortars with pestles for making homogeneous mass for sampling; 4 – box for grinding (desk box); 5 – press for producing cuvette from foil; 6 – calculating machine ДП-100-М; 7 – lead housing; 8 – end-window counter; 9 – holder (stacked) for reagents of end-window counter)

#### *IV stage:*

Substantiation and drawing up of a final expert's conclusion, variants of which may be:

1. food substance is good for use without restrictions;
2. food substance is quasi-good for use, it's use is terminable, or by its mixing with clean product in ration (to reduce contamination levels to allowable ones);
3. food substance is liable to special treatment (degassing, deactivation, sterilization) with a repeated expert examination;
4. food substance is unsuitable for use and should be exterminated (when infected by persistent poisonous substances PS, when radioactive contamination exceeds the allowable levels 10 times and more, when spoilage exceeds allowable levels, at decay);
5. food substance is unsuitable for use, it may be used for fodder;
6. food substance is unsuitable for use, it may be used for technical purposes or processed into fertilizer.

Appendix 10

#### INSTRUCTION

on determination of foodstuffs and water contamination by poisonous substances using device of chemical investigation MV-DCI (ПХР-МВ) (fig. 56.1)

The instrument ПХР-МВ (MV-DCI) is used on the I stage of medical examination and allows to determine Sarin, Soman, Vi-gases, Mustard gas, Lewisite, Trichloroethyl, Cyanogen chloride, Hydrocyanic acid, phosgene, diphosgene both in foodstuffs and water; poisonous substances – arsenic derivatives, alkaloids, salts of high-density metals – only in water. Besides, the instrument makes it possible to sample foodstuffs and water for bacteriological analysis.

Before foodstuffs and water sampling it is necessary to inspect food object in order to reveal contamination signs.

Food substance sample must be taken from the surface of the places of a vivid, extreme contamination into the 2-3 cm depth by cutting with scissors or forceps-scissors and by using a scoop. The fractured sample is placed into the vessel of the instrument for 2/3 of the value, and water – into the Drexel test-tube, filling it up to 1, 2 or 3 ml, depending on PS.

Indication tube for given PS is broken off from both sides notching by a round knife on the end surface of the pump-handle. The upper (marked) end of the tube is connected to a short (rubber) tube of the vessel with the sample, and the lower end – to the pump.

Definite number of slow intakes by the pump (different for each PS) should be done. Color and intensity in the indication tube is compared to the standard from the cassette for corresponding PS.

Thus, 30 intakes are done for Cyanogen Chloride and Hydrocyanic acid. In the presence of PS the lower part of the reagent in the tube changes its color into crimson or purple-red color. For Sarin, Soman and Vi-gases – 30-60 intakes should be done after breaking off the upper ampoule with liquid reagent. 5 minutes later another ampoule is broken off. (The ampoules are broken off by the needles in the pump handle according to the number of mark rings on the ampulle and pump handle). Red or pink

color means positive test result, yellow color – negative test result. Sensitivity is  $5 \times 10^{-7}$  mg/l or mg/kg (for other PS look an instruction to the instrument).

Appendix 11

## INSTRUCTION

### **on determination of radioactive contamination of foodstuffs and water using field roentgenometer- radiometer FRR-5A or FRR-5B (ДП-5А, ДП-5В) (fig. 56.2)**

1. A selector is turned from the position “Switch-Off” to the position “Mode”. With the help of the handle of potentiometer “Mode” galvanometer pointer is set on the black triangle and the instrument is warmed up for 2-3 minutes.

In the instrument ДП-5В a pointer is automatically set in the range of the black sector (if required the battery is replaced).

2. Natural background of the instrument is determined. For this the probe with the detector is placed farther than 1 m from any surface (on cable length), a band selector is moved on 0.1, in 1 minute a background is read from the upper scale, mR/h and is multiplied by range (0.1). If the meter pointer overscales, the metering is repeated in the less sensible ranges.

3. For metering radio-activity of the sample the probe with the detector is placed parallel to its surface at the 1 cm distance from it, the place of the most severe contamination is detected and in 1 minute scale data are read and multiplied by the range, then the background that was measured before is taken away.

Note: samples of water, liquid and loose foodstuffs, ready meals are placed into a mess kit for metering. Bread is metered in loaf, meat – on a carcass or half-carcasse, food concentrates – in packings or also in a mess kit. 1 kg of fish – in fillet 25×25 cm.

Measurement result is compared to standards (handed out on practical lesson).

Appendix 12

## INSTRUCTION

### **on determination of the organoleptic, sanitary and chemical quality and spoilage indices of foodstuffs and concentrates in field conditions**

1. Organoleptic study starts from the assessment of the appearance of the product or concentrate, packing and label condition. Attention is paid to terms of product realization, packing or brick deformation, change of color, consistency, presence of mould, beetles, insects etc.

2. Organoleptic indices – odour, taste, aftertaste are determined at negative result on PS, RS, BS contamination test of dry samples (natural, on breaking and on grinding) and then at test boiling: we weigh 10 g of concentrate put into chemical vessel, add 100 ml of distilled water, heat it up to a boiling point on an alcohol lamp and then also evaluate odour, taste and aftertaste.

3. For determination of the concentrate's acidity, 10 g of it are poured over by 250 ml of distilled water at agitating and then it is filtered. 25 ml of filtrate is placed into a flask for titration, 3 drops of phenol-phthalein solution are added and 0.1 N is titrated (using pipette with rubber syringe) by NaOH till the solution changes color into pink. The result of titration is multiplied by 10 for translation into degrees.

At results assessment one should take into consideration that acidity of good quality rye dried crust must be within 20-21° degrees limits, of wheat crackers and crunchies – 12-13°, soup concentrates, porridges – 8-10°, millet porridges – 1°.

4. For determination of amount of metal filings, 5 g of flour, concentrate or other development type are ground, poured out by an even layer on the paper, oil-cloth and then a magnet passes over it: metal filings get together on the magnet.

5. In order of storage pests detection in flour and cereals, the product is planed thoroughly by a glass, observed through the magnifier at good lighting. Discovered insects or their larvae are identified using a storage pests atlas prepared by the department.

6. For determination of methyl alcohol presence in alcoholic drinks, 1 ml of the development type is poured into a test-tube. Clean coil from copper wire is heated on the alcohol lamp and put it into a sample. Odour nuisance of formalin testifies presence of methyl alcohol concentration higher than 50% in the drink. If there is no formalin odour, wire coil is heated two times more, each time putting it into the sample. Then one tea spoonfull of reactive mixture of hydrochloric acid of phenyl-hydrazine with red blood salt and one drop of concentrated hydrochloric acid is put into the sample. If the content of methyl alcohol is higher than 0.5%, the sample will color into pink-red, if there is no methyl alcohol in it – into yellow.

## **6. Literature**

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## **7. Equipment required for the lesson**

1. Tables:
  - Conditions of rational nutrition;
  - Methods of medical control of the food adequacy;
  - Basal ration for the units of Emergency Control Ministry and hygienic characteristic of the basal ration.
2. Standards of food concentrates, dry rations, rations for survival.
3. Forms of documents, which are to be drawn up when investigating food poisonings:
  - emergency report (Registration Form № 58);
  - appointment card to field laboratory (HL-1, HL-2) or to laboratory of Sanitary and Epidemiologic Station for samples of offending food, discharges, vomit mass of the victims;
  - plan of investigation of group food poisonings according to clinical symptoms;
  - questionnaire of the victims to ascertain a meal (foodstuff), which caused the poisoning;
  - report about the results of investigation of food poisoning.
4. Situational self-training tasks for students regarding the cases of food poisonings during the lesson.
5. Kids and instruments for foodstuffs and finished food sampling for laboratory analysis.
6. Roentgenometer – radiometer RRM -5A, RRM-5B (ДП-5А, ДП-5В).
7. Medical- veterinary device for chemical investigation MV-DCI.
8. Food samples for expert examination: bread, crackers, cereals, canned food, food concentrates of some foodstuffs and meals, flour.
9. Laboratory utensils: flasks, pipettes, test-tubes, alcohol lamp.
10. Magnifying glass, magnet, spiral from copper wire, pharmaceutical scales, balance weight.

11. Reagents: 0.1 H solution of NaOH, phenol-phthalein, mixture of hydrochloric acid phenyl-hydrazine with red blood salt (in a vial with a spoon), strong hydrochloric acid in a dropper, distilled water.
12. Atlas with the pictures of storage pests.
13. Student's self-training task at the lesson.

## **Topic Sanitary inspection organization of water supply and biosafety questions during emergency situations.**

### **1. Learning objective**

1.1. State sanitary and epidemiologic, as well as moral and psychological, importance of medical provision of water supply for rescue units and refugees under field conditions during emergency situations.

1.2. Learn functions, methods and instruments of medical, engineering, chemical services during water supply source selection.

1.3. Acquire the technique of sanitary examination of water supply sources, field technique for determination of drinking water quality, draw up conclusions according to the results of the examination and assessment of water quality.

1.4. Get familiarized with organization of field water supply for rescue units and refugees in emergency situations and tasks of the engineering, chemical and medical services regarding its realization.

1.5. Learn means and methods of water purification, disinfection, desalination and decontamination in field conditions during emergency situations.

1.6. Master methods of medical control of water treatment quality in field conditions.

### **2. Basics**

2.1. You should know:

2.1.1. Hygienic, epidemiologic importance of drinking water, drinking water standards and their peculiarities in field conditions and other emergency situations; water supply rates in field conditions for rescue units and refugees, their substantiation.

2.1.2. Hygienic characteristic of different water supply sources.

2.1.3. Drinking water quality indices and quality indices for water of water reservoirs, their standardization.

2.1.4. Water quality indices; types of water treatment, methods and means of water purification, disinfection and desalination – their peculiarities at centralized and decentralized water supply.

2.1.5. Methods of sanitary and hygienic control of water supply in settlements with centralized and decentralized variants of water supply.

2.2. You should have the following skills:

2.2.1. To make sanitary examination of water supply sources.

2.2.2. To evaluate discharge of water supply sources.

2.2.3. To take water sample for analysis.

2.2.4. To assess organoleptic, sanitary and chemical indices of water quality and its pollution.

2.2.5. To draw up conclusions and make recommendations according to the results of sanitary examination and analysis of water.

2.2.6. To determine chemicals activity for water chlorination, determine chlorine dose for water disinfection according to chlorine demand.

2.2.7. To disinfect water by hyperchlorination method; dechlorinate water by physical and chemical methods (filtration through adsorbents, sodium thiosulfate).

2.2.8. To assess purification, disinfection and desalination efficiency.

### **3. Self-training questions**

3.1. Specify the services of rescue and non-governmental units, which select water supply sources and name the instruments they use to make examination of water supply sources.

3.2. Give water supply quantitative rates for the units in field conditions; specify their dependence upon climatic conditions and emergency situations.

3.3. Specify and substantiate peculiarities for drinking water standards during emergency situations.

3.4. Describe the staff, equipment and instruments of water investigation group, procedure and methods of the water supply sources examination.

3.5. Explain the meaning of sanitary and epidemiologic, sanitary and topographic, sanitary and technical examination of water supply sources.

3.6. Explain how to evaluate discharge of a well, river.

3.7. Give characteristic of organoleptic, physicochemical, bacteriological and other indices of drinking water quality and water quality from water reservoirs.

3.8. Organizational structures of rescue and non-governmental units, assigned for field water supply for personnel and affected population.

3.9. Organization of field water supply for rescue and non-governmental units. Water supply and water distributing points.

3.10. Types of water treatment in field conditions, their characteristics.

3.11. Methods and basic means of water purification, disinfection, desalination and decontamination in field conditions.

3.12. Medical service duties on organization and control of water supply of the units; laboratory facilities and methods of water treatment quality control in field conditions.

### **4. Self-training assignments**

4.1. Calculate discharge of a shaft well, if 20 buckets of water have been drawn during 10 minutes, and previous level of water has restored during 30 minutes from the moment when water drawing has been stopped. Estimate if there is a sufficient amount of water in this well for daily water supply of the 600 personnel unit.

4.2. Calculate discharge of a river, which width is 10 m, maximal depth is 3 m, if a dropped match travels distance equal to 1 m during 20 sec. Estimate maximum quantity of the unit personnel for its sufficient water supply, if water supply station will be deployed on this river.

4.3. Calculate, how much dry chloride of lime one should weigh for water disinfection in the water reservoir PДB-1 000 (RDW-1 000) according to chlorine demand, if for titration of 200 ml of water 6 drops of 1 % solution of this lime were put in and 2 drops of 0.7 % sodium hyposulfite solution were used up (its one drop fixes 0.04 mg of active chlorine).

4.4. Calculate, how much 20 % dry chloride of lime one should weigh for water disinfection in the reservoir PДB-5 000 (RDW-5 000) by hyper chlorination method (on the basis of 15 mg/l of active chlorine).

## Appendix 1

### **Organization and carrying out of investigation of water supply sources during emergency situations**

Hygienic importance of water in field conditions is the following:

- physiologic (participation in metabolism, human heat exchange etc.);
- as means for a human organism tempering;
- as cleansing means for clothing, plates and dishes; it is necessary for cooking, washing body and etc.;
- as means for disinfection, sterilization.

Epidemiologic sense of water:

- participation in transmission of the following infectious diseases: alimentary (bacterial, viral, animalcular, zoonosis), transmitting (anaphylogeny water reservoirs), helminthiasis and etc.

Peculiarities of requirements for drinking water in field conditions during emergency situations: strong requirements – water safety in epidemiologic sense and toxicologic sense, and only desirable requirements – good organoleptic properties of water and optimal mineral composition.

There are the following water supply rates in field conditions: 10 l of water in temperate climatic zone, 15 l - in hot climatic zone (for drinking, washing, cooking, washing plates and dishes in the kitchen, washing personal dishes) per adult person. In especially hard conditions of catastrophes water supply rates are – 2.5 l and 4 l per an adult respectively. There are the following special water supply rates in field conditions: for bath (30 l for a person), doing the laundry, washing the clothing (45 l for 1 kg of clothing), for technical needs, for fire-fighting.

Objective of water investigation is the following – obtaining of technical as well as sanitary and epidemiologic information, which is necessary to solve adequately the problem of sufficient water supply for the units (and for affected population) with high quality water by the easiest and the most reliable way. Regarding the organization, the investigation is to be carried out with participation of: representative of engineering service of the unit (a commander of investigation group), representatives of medical service, and chemical service. Investigation group must have the following equipment: medical-veterinary device for chemical investigation MV-DCI (ИХР-МВ) (Fig. 55.1), field roentgenometer-radiometer FRR-5A (ДП-5А) or FRR-5B (ДП-5В) (Fig. 55.2); hydrochemical kit HCK (ИГХ) for sanitary analysis of water.

There are following stages of investigation of water sources:



- collection of available data about hydrogeological characteristic of the investigated area (questioning of population, topographical maps, and other information);
- working out of itinerary for the investigation;
- examination of water sources at the places of their location: sanitary and epidemiologic (detection of existence of cases of acute contagious enteric infections among the population and epizootic diseases among the domestic and wild animals), sanitary and topographic (detection of the potential pollution objects around the water source taking into consideration their distance from water source, relief); sanitary and technical (equipment of the water source – borehole, well, catchment, its condition, necessity of repair and etc.);
- water sampling and making of water analysis on the spot for chemical pollution, radioactive contamination, organoleptic as well as sanitary and chemical indices as to pollution, referral of water samples to bacteriological examination;
- making decision regarding the place of water supply station deployment and sanitary protection zone;
- drawing up of the message about the results of the investigation.

During the investigation and when making choice about water supply sources, we should take into consideration the following parameters: quantity of personnel of the units (and quantity of population within area of a catastrophe), water supply rates in field conditions, quantity and discharge of water supply sources, quality of water of the sources, availability of basic means for water intake, purification, disinfection, and other means for water treatment, accumulation of water in reserve, transportation, as well as deployment of draw-off points. In case of need, we should solve the problem of arrangement of improvised means of water treatment using materials at hand (for example, to arrange a fabric-charcoal filter using usual barrel with wood charcoal and cotton fabric).

We should also solve the problem of personnel quantity, required to provide continuous work of water supply stations and draw-off points and to ensure their protection, as well as make examination of health level, make physical examination of the personnel, which will take part in work of water supply stations and draw-off points of the units with respect to carriage of bacilli, and helminths-carrying.

## Appendix 2

### **Instruction on determination of water quality during selection of water supply sources under field conditions**

1. Determination of the presence of poisonous and radioactive substances (PS and RS) in water is to be executed according to the instruction to the topic for the study on medical examination of foodstuffs (Topic № 55, Appendices 1, 2).

2. Organoleptic, as well as physical and chemical, indices of water quality are to be determined using hydrochemical kit from sets of hygienic laboratories HL-1 (ЖГ-1), HL-2 (ЖГ-2).

Water samples for analysis are taken using bathometer (Fig. 16.1), bottle with plummet, pot, bucket.

Temperature of water is measured using chemical thermometer immediately in a water reservoir, a well. Vessel of the thermometer is to be wrapped in some layers of bandage. Increase of water temperature of ground water springs indicates that surface polluted waters penetrate to waterbearing stratum. Usually, temperature of ground waters changes within the limits of 7-14°C, and temperature of surface waters varies depending on the season.

Transparency of water is determined using cylindrical vessel with flat bottom, which is to be placed over Snellen font № 1 (such font is most often used for books), and it is evaluated in centimeters, or characterized by words as: transparent, opalescent, turbid, with sediment.

Odour is detected when having agitated water sample in bottle covered with glass plate at temperature equal to 15-25°C and after water being heated up to 60°C. We can attribute odor qualitatively as: marshy, earthy and etc. and evaluate in points according to 5-point score. Odor having 3 and more points indicates that water is polluted noticeably.

Taste of water is to be determined only when having ascertained that it is not contaminated by poisonous substances PS, radioactive substances RS, bacterial substances BS and it is characterized by words as: refreshing, sour, salty, sweet, and bitter. We can also differentiate aftertaste as: metallic, astringent and others. Taste and aftertaste are also evaluated according to 5-point score.

Color (coloration) of water is determined using field colorimeter FC-56M (ПК-56M) (fig. 56.1), which is equipped with disk references with coloured pieces of glass, or using comparator with references in the form of plates. To determine the color we insert into comparator two tubes of 15 cm height - one with water to be analyzed and another with distilled water; then we put the plate with the colored pieces of glass under the tube with distilled water and find the reference, which coincides with color intensity of analyzed water that is evaluated in degrees. Coloration of water should not exceed 36 degrees.

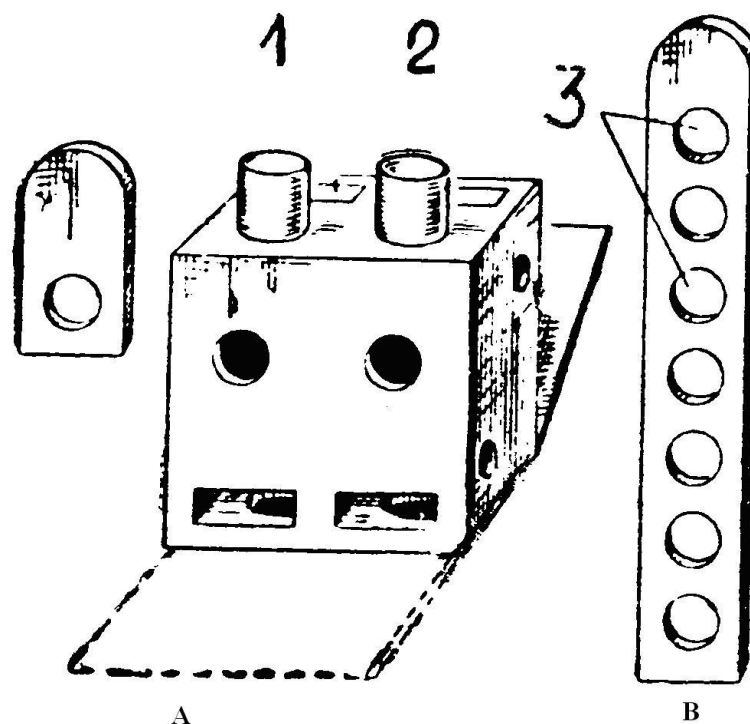


Fig. 57.1 Comparator FC-56M (ПК-56М); (a) for field investigations with plate (b) (1, 2 - sockets for colorimetric tubes; 3 - round orifices for reference of colors of different intensity)

Water (pH) reaction is determined by using indicator paper pretreated with universal indicator, which is wetted in analyzed water and compared with standard scale. pH value of natural waters changes within the range from 7.0 up to 9.5.

We can determine ammonia nitrogen using simplified technique (see below) or using colorimeter (comparator) with references for ammonia. For this purpose we take 5 ml of water in tube, replenish with 5 drops of Rochelle salt 50% solution and 5 drops of Nessler's reagent, then we measure and compare color. Content of ammonia in pure water is less than 0.1 mg/l. (MAC = 2 mg/l).

We can also determine nitrite nitrogen using simplified technique, which is given below, or by means of colorimeter or comparator with references for nitrites. For this purpose we take 5 ml of water in tube, replenish with 5 drops of solution of Griess reagent or add several crystals of dry Griess reagent, and heat this mixture on alcohol lamp. We measure and compare color with references for nitrites. Content of nitrites in pure water is equal to 0.005 mg/l (MAC = 3.3 mg/l).

Possible colors are given in the Tables 1, 2.

**Tabulated quantitative determination of ammonia nitrogen in water  
(State Standard 1030-41)**

We pour 10 ml of water to be analyzed into the tube, replenish with 7 drops (0.3 ml) of Rochelle salt 50% solution and 7 drops (0.3 ml) of Nessler's reagent. Then we mix, and in 10 minutes determine the ammonia nitrogen content comparing the coloring power in the tube with one given in the Table 1.

Table 1

<i>Coloration on the lateral view against a white background</i>	<i>Coloration on the top view against a white background</i>	<i>Content of ammonia nitrogen, mg/l</i>
No	No	less than 0.004
No	Extremely faintly yellowish	0.008
Extremely faintly yellowish	Very faintly yellowish	0.02
Very faintly yellowish	Yellowish	0.04
Faintly yellowish	Light yellowish	0.8
Light yellowish	Yellow	2.0
Yellow	Intensely yellow	4.0
Distinctly yellow, turbid	Brown, turbid	8.0
Intensely brown, turbid	Brown, turbid	10.0

**Approximate quantitative determination of nitrite nitrogen in water  
(State Standard 1030-41)**

We pour 10 ml of water to be analyzed into the tube, replenish with 10 drops of solution (0.5 ml) of Griess reagent or add several crystals of dry Griess reagent. Then we heat the tube on alcohol flame during 5 minutes. Pink coloration is to be compared with one given in the Table 2.

Table 2

<i>Coloration on the lateral view against a white background</i>	<i>Coloration on the top view against a white background</i>	<i>Content of nitrite nitrogen, mg/l</i>
No	No	less than 0.001
Minimum perceptible pinkish	Extremely faintly pink	0.002
Very faintly pink	Faintly-pink	0.01
Faintly-pink	Light-pink	0.02
Light-pink	Pink	0.04
Pink	Strongly pink	0.07
Strongly pink	Red	0.2
Red	Scarlet	0.4

### Appendix 3

#### **Organization of field water supply for rescue units during emergency situations**

Field water supply for rescue units during emergency situations is provided by special subdivisions of engineering service of the units by means of:

- deployment of water supply points – plots at the water sources, where basic means of water extraction, elevation, purification, disinfection, if necessary – decontamination and degassing are deployed, stockpiling and distribution among subdivisions of the units (if necessary - preserving) is carried out.
- deployment of water pumping points – plots in the area of units' quartering, where there are means deployed for water reserves storage, which is delivered from water supply points and for its delivery to personnel of units (and refugees after disasters);
- individual water supply with water disinfection using boiling or special tablets ("Pantothenatecide", "Aquasept" etc.).

Characteristics of drinking water requirements in field conditions at emergency situations are the following:

- strictly indispensable conditions - epidemiologic and toxicological safety of the water;
- desirable, but not compulsory requirements – good organoleptic properties, optimal mineral composition. Weakening of the last two requirements is based on short terms of consumption of such water by personnel of units: until termination of rescue operations in emergency.

When choosing water sources during organization of water supply points, first of all, one should use artesian wells if they remained intact and there is energy for water raising or, if there are facilities for water-well drilling. Secondly, one should use well and spring water with its compulsory prior disinfection, or imported disinfected and

preserved water. Thirdly, open circulating water reservoirs or lakes, but with water purification and disinfection.

Types of water treatment in field conditions: disinfection, purification (water clarification), and necessarily desalinations, decontamination and degassing.

The following methods of water disinfection in field conditions in emergency situations are used:

- physical: boiling, and at filtration station (MFS-2,5; MFS-10 (BΦC-2.5, BΦC-10)) – ultraviolet irradiation;
- chemical: chlorination. Formerly silver ions were used.

There are 4 methods of water chlorination (according to chlorine demands, hyperchlorination, with preammonation, post-critical doses of chlorine). In field conditions hyperchlorination and chlorination according to chlorine demands are used.

For water chlorination in field conditions they use:

- chloride lime  $3\text{CaCl}(\text{OCl})\times\text{Ca}(\text{OH})_2$ , which contains 30-35 % of active chlorine when it is fresh ;
- 2/3 of calcium hypochlorite subsalt TTHCHS-  $3\text{Ca}(\text{OCl})_2\times 2\text{Ca}(\text{OH})_2$ , active chlorine content of which achieves 47-57 %;
- “Pantothenatecide” tablets – parasulphodichloramide of benzoic acid with soda and salt  $\text{COOH C}_6\text{H}_4 \text{NCl}_2$ . When fresh, it contains 3.5 mg of active chlorine and it is intended for standard bulk of 0.75 l;
- “Aquasept” tablets – sodium salt of isocyanuric acid, contains 4-4.5 mg of active chlorine and it is intended for 0.75 l of water.

A dose of chloride lime or (TTHCHS) for water disinfection in accordance to chlorine demand is defined by test chlorination of equal water volumes in three glasses (from the special set for water chlorination and coagulation control (CCC)) by different doses of chlorine within the limits of expected chlorine demand (most often 3-5 mg/l) so that chlorine residual after 30-minutes exposition was within 0.3-0.5 mg/l. In the absence of CCC set or required reagents chlorine demand may be defined by water chlorination in three buckets, putting in 1, 2, 3 table-spoonfulls of 1 % solution of chloride lime, and to choose such dose, at which after 30 minutes exposition one will feel the slightest but distinct smell of chlorine.

Water hyperchlorination method in field conditions is used in cases when it is necessary to receive disinfected water very quickly (exposition of disinfection reduces by half), when water is turbid, dirty or it is suspected of being infected by pathogenic microorganisms (adverse epidemiological situation), when laboratory means for definition of water chlorine demand are not available and at water purification and disinfection by standard chlorine-vitriolic method by Klyukanov (that will be described below).

Chlorine doses that are used for water hyperchlorination:

- without suspect of being infected by pathogenic microorganisms – 10 mg/l;
- when infected by vegetative forms of pathogenic microorganisms – 20 mg/l;
- when water is infected by spore forms of pathogenic microorganisms – 150 mg/l. Chlorination exposition: 15 min. in summer, 30 min. in winter, and when infected by spore forms of microorganisms – more than 2 hours.

From the known methods of water purification (water precipitation, filtration, coagulation with filtration) in field conditions coagulation with filtration applying basic or improvised filters is used.

For the purpose of water desalination and decontamination the following methods were developed:

- distillation – disengagement of water from dissolved salts, including radioactive ones, but the method doesn't suit for the first period after nuclear accident, when big amount of radioactive iodine concentrates in foodstuffs and sublimates together with steam. Besides, distilled water needs to be enriched with salts.

- ion-exchange filtration – water filtration through cationites and anionites, which also allows to disengage water from dissolved salts, including radioactive ones in it (fig. 57.1, 57.2);

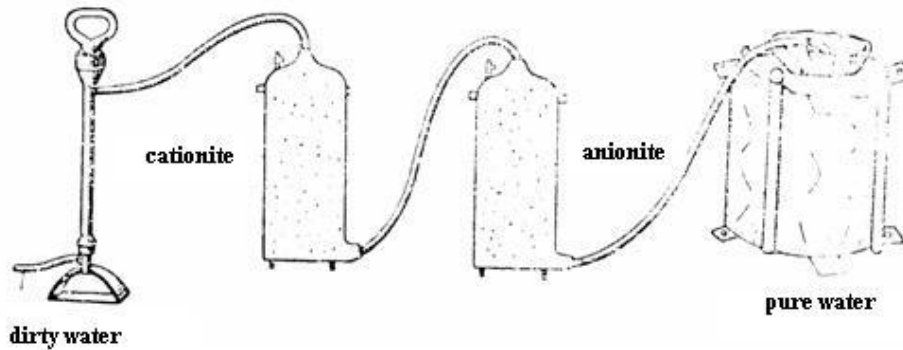


Fig. 57.1 Scheme of water desalination and decontamination by ion exchange with the help of FCF-200 (TYΦ-200)

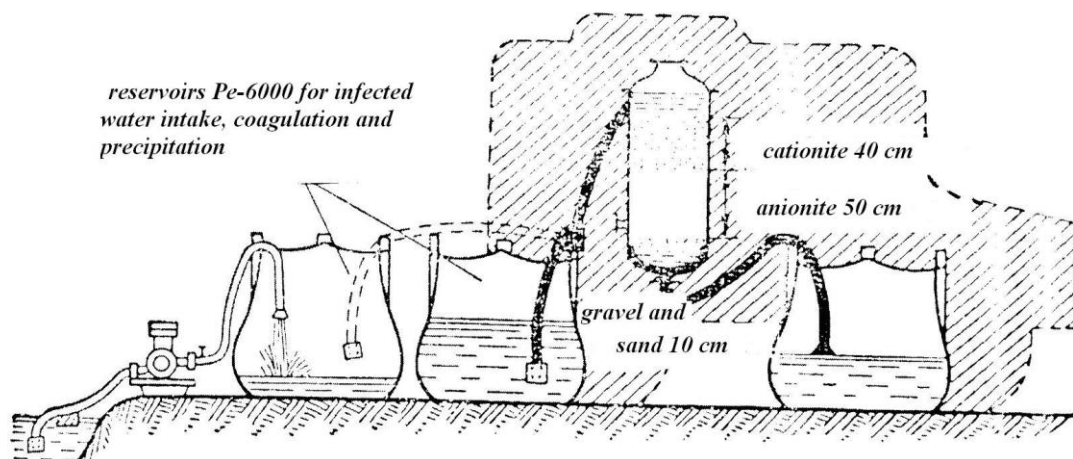


Fig. 57.2 Scheme of water desalination and decontamination by ion exchange using MAFS-3 (MAΦC-3)

- if the carriers of water radioactivity are the suspended in water particulate pollutant particles, partial decontamination may be carried out by coagulation with filtration.

The essence of the standard Klyukanov's chlorine-vitriolic method of water purification and decontamination consists of simultaneous introduction of coagulant 150 mg/l and chloride lime or TTHCHS in dose 10 mg/l of active chlorine (50 mg/l of chloride lime with active chlorine content more than 20 %) (fig. 57.3).

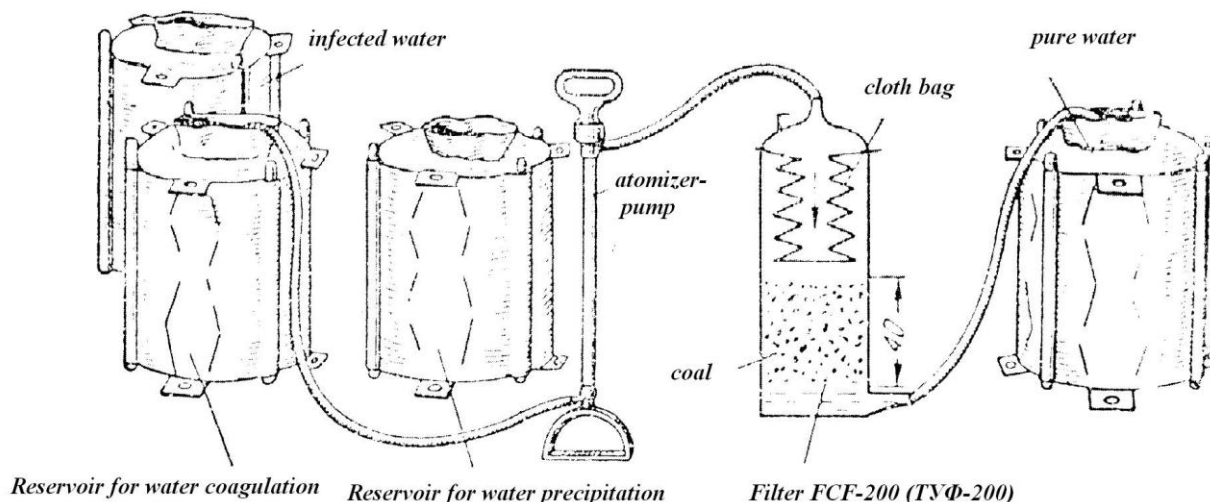
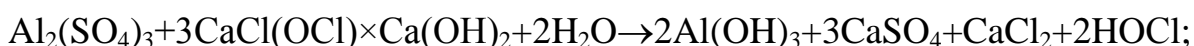


Fig. 57.3 Scheme of water purification by coagulation, precipitation and filtration using filter FCF -200 (TYΦ-200)

At the same time coagulation occurs irrespective of water alkalinity (i.e. amount of salts of bicarbonates) according to the reactions:

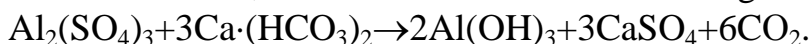
a) with chloride lime:



b) with 2/3 of calcium hypochlorite subsalt:



In case of common coagulation the reaction takes place with calcium and magnesium bicarbonates, which concentration must be higher than 2 mg/equiv./l:



If there are little calcium and magnesium bicarbonates in water, for successful coagulation one should add soda into water. There is no need to do that using the method by Klyukanov.

To basic means of water supply for engineering subdivisions of rescue units one can refer:

- facilities of ground water production: small-pipe well SPW-1 (MTK-1); shaft well digger SWD-40 (KLIK-40); rotary drilling apparatus - RDA (YPB-3AM);
- water raising facilities: manual piston pump БКФ-4 (MPP-4); manual sucker-rod pump MSRP-25 (PШП-25); machine sucker-rod pump MSRP-40 (MШП-40); monoblock pump MP-600 (M-600); electric pump EP-1 (ЭП-1);
- water treatment facilities: fabric-charcoal filter FCF-200 (TYΦ-200); military filtration station MFS-2,5; MFS-10; ВФС-2,5, ВФС-10 modernized autofiltration station MAFS-3 (MAΦС-3); field desalination plant FDP-4 (ΠOY-4), desalination field station DFS-2 (OΠC-2);
- reagents: coagulant  $\text{Al}_2(\text{SO}_4)_3$ ; chloride lime; TTHCHS, "Pantothenatecide" and "Aquasept" tablets; cationit-carboferrogel, anionit-sulfonated coal;
- water accumulation and transportation facilities: reservoirs for water RDW-50, -100, -1000, -5000 (PДB-50, PДB-100, PДB-1 000, PДB-5 000); water tank-trucks

WTT-15, -28, -40 (АВЦ-15, АВЦ-28, АВЦ-40); stationary tanks, field water-pipes (Fig. 57.4).

Tasks of the medical service of water supply control of the rescue units in field conditions during emergency situations include:

- quality definition of preparations for water chlorination (active chlorine content in them); determination of chlorine preparation doses for water decontamination; determination of coagulant doses for water purification; water indication on contamination by poisonous substances (PS), radioactive substances (RS), bacterial substances (BS); selection of methods of water decontamination, degassing; water quality evaluation at water resources selection and after water treatment;

- participation in place selection for water supply and water pumping points deployment, determination of sanitary protection zones around them; water purification quality control, decontamination of water treatment facilities after their exploiting (filters, reservoirs, inventory);

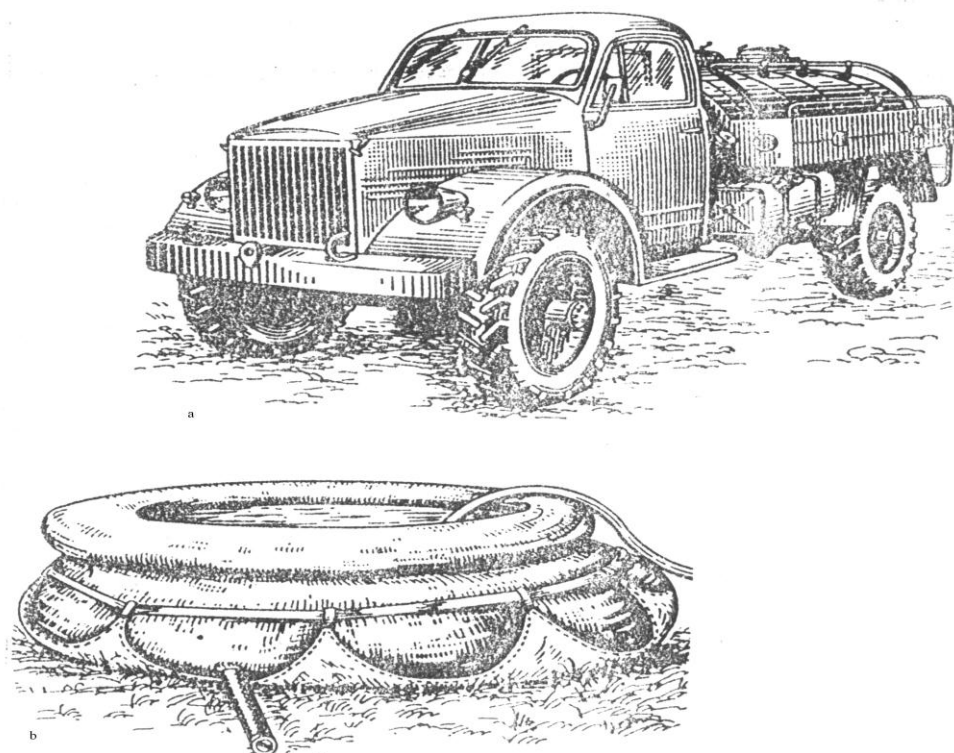


Fig. 57.4 Water transportation and storage facilities  
(a - water tank-truck WTT-28 (АВЦ-28); b - reservoirs for water RW-5000 (РДВ-5000) in flexible container)

- health control of the persons that participate in water supply for units (bacilli- and helminthi-carrier control etc.).

Laboratory facilities for water treatment quality control in field conditions that medical service of teams and formations of the Emergency Control Ministry are equipped with consist of:

- hydrochemical kit HCK for water quality assessment at water supply sources exploring; kit for water chlorination and coagulation control CCC; field roentgenometer-radiometer FRR-5A, 5B (ДП-5А, ДП-5В); medical-veterinary device for chemical investigation MV-DCI (ПХР-МВ) etc.;



- laboratory systems in boxes: army hygienic laboratory HL-1 (JIГ-1), primary hygienic laboratory HL-2 (JIГ-2), bacteriological laboratory BL (JIБ), medical field chemical laboratory MFCL-54 (MIIXJI-54), toxicologic laboratory JIT (TL), radiometric laboratory in boxes PJTY-2 (RLB-2) etc.

Note: In the absence of basic facilities for water filtration one can make improvised fabric-charcoal filter from wooden or metal barrel: at the bottom of a barrel a stop-cock or a plug are installed; in the bottom, at the height of 15-20 cm a wooden trellis is placed; then a fabric bag with charcoal, which was carefully washed by pure water beforehand and then an empty “accordion-like” gathered fabric bag are placed on. Water after coagulation in the reservoir is filled into the filter by the bucket or runs by gravity if placing the filter below the reservoir for coagulation and the reservoir for filtered water accumulation – below the filter.

Appendix 4

### **Instruction on active chlorine determination in preparations for water disinfection by field (drop) method**

#### *1. Determination of active chlorine in chloride lime or TTHCHS*

1 % solution of chloride lime is made ready. For that, 1g of lime becomes triturated in the porcelain mortar with small portions of distilled water, every time pouring it off into 100 ml graduated cylinder and bringing it to 100 ml; then the solution is settled or filtered.

Into a retort or a glass for titration 30 ml of distilled water, 10 drops of 1 % solution of chloride lime (individual pipette), 5 drops of hydrochloric acid (1:2), 10 drops of 5 % solution of KI and 10 drops of 1 % solution of starch are introduced. 0.7 % solution of sodium thiosulfate (hyposulphite) is titrated (by dripping) till decolouration. One drop of such hyposulphite solution fixes 0.04 mg of chlorine. Number of drops that was spent for titration corresponds to percentage of active chlorine in chloride lime. Lime with chlorine content less than 20 % isn't suitable for water disinfection.

#### *2. Active chlorine definition in “Pantothenatecide” and “Aquasept” tablets*

One tablet from a batch, which is subjected to control, is dissolved in 50 ml of distilled water in the glass. After its full dilution 5 drops of HCl (1:2), 10 drops of 20 % solution or several crystals of dry KI, 10 drops of 1 % solution of starch are introduced. Titration is carried by dripping 0.7 % solution of hyposulfite (one drop of such solution fixes 0.04 mg of chlorine) till decoloration. Active chlorine content in fresh tablets is within 3.0-3.5 mg. Tablets with active chlorine content below 1.5 mg aren't suitable for water disinfection.

#### *3. Determination of chloride lime dose (or TTHCHS) for water disinfection based on chlorine demand by test chlorination method*

Each of three glasses gets filled with 200 ml of water, which is subjected to disinfection. 2, 4, 6 drops of 1 % solution of chloride lime are dripped into each glass

(by individual pipette) correspondingly. It is stirred up, left for 30 minutes for chlorination.

After 30-minutes exposition chlorine residual is determined. For that, 2 drops of HCl (1:2), 10 drops of 5 % KI solution, 10 drops of 1% solution of starch are introduced into each glass and stirred up. Samples with blue color are titrated by dripping (stirring up after each drop) 0.7 % solution of hyposulfite till decoloration.

Chlorine residual is calculated by multiplying drops number that were spent for titration by 0.04 and quintupling (for 1 liter of water). For further calculations the sample, in which residual chlorine is found within 0.3-0.5 mg/l, should be taken as an operational one.

For example, 2 drops of hyposulphite solution were spent for titration of the third sample, where 6 drops of 1 % solution of chloride lime were introduced. Chlorine residual will be equal to  $2 \times 0.04 \times 5 = 0.4$  mg/l, i.e. it is within the limits of the norm of 0.3-0.5 mg/l. Further calculations: 6 drops of 1 % solution of lime is brought into 200 ml of water, but a need for 1 l is 5 times more, i.e. 30 drops that is  $30/25 \text{drops} = 1.2$  ml. There are 10 mg of lime in 1 ml of 1 % solution, therefore in 1.2 ml - 12 mg. Hence, for water disinfection in the reservoir PДB-5 000 (RDW-5 000) it is necessary to weigh  $12 \times 5000 = 60\ 000$  mg = 60 g of lime of the given sample.

#### *4. Hyperchlorination of water*

It is carried out on the basis of 10 mg/l in case of water contamination by vegetative forms of bacteria and 100-150 mg/l – contamination by spore forms of microorganisms. For dechlorination of chlorine residual, water is filtered through activated charcoal or sodium thiosulfate (hyposulfite) is added on the basis of 3.5 mg per 1 mg of chlorine residual. In field conditions it is combined with water purification (decoloration) by coagulation with desilting and filtration (chlorine-vitriolic method after Klyukanov). For that standard doses of coagulant (aluminium sulphate or ferrous chlorine) - 150 mg/l and active chlorine - 10 mg/l are introduced into the bottle with the treated water, leave it for 30 min., and then filter through the model of the fabric-charcoal filter.

#### *5. Water decontamination*

It is carried out at the lesson with water samples that were artificially contaminated with radionuclide by coagulation with filtration (if water radioactivity carriers are suspended radionuclides), by ion-exchange filtration (through cationites and anionites) or distillations, if radionuclides are in the water in a dissolved condition on the laboratory models: column with cationite (carboferrogel) and anionite (sulfonated coal) and at the laboratory distillation plant with Liebich refrigerator. Treated water is tested for radioactivity by radiometer.

#### *6. Water desalination*

During the lesson it is demonstrated using the columns with cationite and anionite and at the plant with Liebich refrigerator.

## **5. Literature**

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## 6.2. Additional:

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## 6. Equipment required for the lesson

1. Field roentgenometer-radiometer FRR-5A, (ДП-5А) or FRR-5B (ДП-5В), a pot.
2. Medical-veterinary device for chemical investigation MV-DCI (ПХР-МВ).
3. Hydrochemical kit HCK (НГХ) for sanitary analysis of water.
4. Situational task with information about sanitary and epidemiologic, sanitary and topographic, sanitary and technical examination of water source.
5. Topographical map or situational plan of water source and its surroundings.
6. Simulation of water samples from water source, prepared in laboratory.
7. Chemical thermometer, cylindrical vessel, Snellen font №1, chemical bottle, test-tubes.
8. Indicator paper, pretreated with universal indicator, pH scale.
9. Field colorimeter ПК-56М with references of coloration, ammonia, nitrites.
10. Alcohol lamp.
11. Reagents: Nessler's reagent, Rochelle salt 50% solution, Griess reagent.
12. A kit for water chlorination and coagulation control CCC: three 200 ml glasses, test-tubes, pipettes, a porcelain mortar with a pestle, 100 ml cylinder.
13. Reagents (in droppers): 1% solution of chloride lime (or TTHCHS), hydrochloric acid 1:2, 5% solution of KI, 1% solution of starch, 0.7% solution of sodium thiosulfate, "Pantothenatecide", "Aquasept" tablets, distilled water.
14. Core sample with cationit and anionit for water desalination and decontamination.
15. Laboratory distiller with Liebich refrigerator for water desalination and decontamination.
16. Water sampling imitation: for definition of chlorine demands, for hyperchlorination, for desalination and decontamination (contamination by radionuclide I131).
17. Tables: with a picture of water supply point, fabric-charcoal filter FCF-200 (ТУФ-200), military filtration station MFS-2.5 (БФС-2.5), MFS-10 (БФС-10), modernized autofiltration station MAFS-3 (МАФС-3), improvised field filters.