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THE PROTECTION AND RATIONAL USE OF WATER AND SOIL

Tutorial

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This tutorial covers the issues of rational use and protection of water resources, the nature and classification of water use; patterns of water consumption and drainage in industries and methods of valuation of water and wastewater. The fundamentals of calculating water use for the needs of circulating and repeated water supply, to a large extent determine the level of water, sanitation and protection from contamination of surface water, rational use and reproduction of natural resources.

The textbook is designed for students majoring on 5b073100 - life Safety and environmental protection

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Preface

The current deficit in Kazakhstan in water resources (about 60% of water received from other countries), requires an economic use in agriculture of both surface and groundwater. This water typically needs to be pre-processed to meet the requirements of their quality.

By the water supply Kazakhstan takes the last place among CIS countries. The runoff of most large rivers are formed outside the Republic, which leads to significant dependence of its economy from neighboring countries. Water scarcity, exacerbated by their unsustainable use and pollution, causes of environmental degradation, the drying up of lake and river ecosystems, growth of the disease population [9]. Among the urgent problems the important place occupied by rational use of water resources and improvement of water supply systems.

At present in Kazakhstan operate hundreds of different systems of water supply, water provided by a large number of consumers spread over a large area, i.e., group water pipelines. Such group water pipes, as Bulaevskii, Presnovsky, Ishimskiy, by their parameters are unmatched in the CIS.

But despite the great work done by water management organizations of the Republic, providing consumers with water is still not resolved before the end of the problem and does not meet the growing needs.

Centralized water supply covers 30% of settlements of the Republic, mainly the Northern regions of Kazakhstan, where 20% of the population.

Install water requirements depend on the role of its use, including drinking purpose and industrial water supply. The most fundamental requirement is that the drinking water taken by the person inside, do not violate the normal functioning of the body, i.e. it should be safe in physiological terms, as well as harmless to human health in Toxicological terms.

The quality of water in natural sources is determined by the presence in it of substances of inorganic and organic origin, and microorganisms, and is characterized by physical, chemical, bacteriological and biological indicators.

However, it should be noted that in the present pollution of water sources, poor sanitary conditions and increased wear of networks and constructions of water supply to have a 100% drinking water, appropriate regulatory requirements, without carrying out recovery work for the end user in most settlements is unrealistic

The absence or inadequacy of measures taken to eliminate the lowering of water quality can lead to the following undesirable phenomena:

- deterioration in the health of the population of individual regions of the Republic;
- increase the cost of purification of drinking water;
- possible irregular migration the population of several regions in connection with the deterioration of sanitary-ecological environment;
- drinking to the loss of value of deposits of underground waters and open reservoirs.

Permissible concentration in drinking water of substances that affect the properties shall not exceed the following standards (mg/l): dry residue, 1000-1500, chlorides – 350, sulfate – 500, iron – 0.3-10, manganese-0.1, copper – 1.0, zinc – 5, the residual aluminium – 0.5.

Permissible concentrations of toxic substances, mainly found in natural waters and add to the water during its treatment should not exceed (mg/l) beryllium is 0.0002, molybdenum – 0.5, iron – 1, nitrates – 10.

When using water in industry she except these requirements should be harmless for staff health, should not degrade product quality, cause corrosion of equipment and reduce technical and economic indicators of the production process.

An integral part of the General problem of environmental protection is rational use and protection of water resources. The main problem in the protection of the hydrosphere is associated with the deterioration of water quality due to discharge into natural waters both industrial and domestic wastewater. Along with this, a huge amount of clean water from the reservoirs is consumed for the dilution of wastewater to the maximum permissible concentration (MPC).

Industrial enterprises can have a significant impact on the environment in the area of their arrangement, as on the General state of the biosphere and its component such as hydrosphere.

The development of the industry is the need to prevent negative impact of production wastewater on the water bodies. In connection with the extraordinary variety of composition, properties and costs of wastewater of industrial enterprises requires the use of specific methods and structures according to their local, provisional and full cleaning.

As part of the engineering communications of every industrial enterprise there is a complex sewer networks and constructions, by means of which the retraction of the factory waste water, and facilities for pretreatment of wastewater and recovery of valuable substances and impurities.

1 The Influense on human activities on water quality

The water quality due to both natural and anthropogenic factors. The greatest influence on the quality of water has human activities, manifested in the intensive development of industry, energy, agriculture, transport and public utilities. The main sources of pollution are: industrial and domestic wastewater, diffuse pollution sources (mineral fertilizers, pesticides, smoke emissions, etc.).

Great harm to bodies of water cause industrial effluents containing toxic substances acting negatively on aquatic ecosystems. The greatest number of contaminants in the absence of the desired degree of purification comes from oil refining, chemical, pulp and paper, metallurgy, textile and other industries. The volume and composition of industrial waste depends on the production capacity of each enterprise and adopted it technology.

In terms of further agricultural intensification, increasing importance is given to the application of fertilizers and use of various pesticides. However, when fertilizer application and especially using pesticides is not always considered negative effects on water quality in rivers and streams. Significant damage can cause thermal and nuclear power plants discharging thermal water in natural and artificial reservoirs, breaking thermal, hydro chemical and hydrological regimes.

Of great importance in the deterioration of natural water quality are pollution from the atmosphere. In some cases they make up 15-20% of the total load of the reservoir pollution. Among the pollutants of natural waters should also include transport, water transport, timber rafting and the corresponding work, landfills, mining etc. On water quality are largely influenced by water management activities, including reclamation work. Especially on hydro chemical and hydro biological regimes of streams and water bodies, creating reservoirs. To municipal wastewater treat human waste water as organized and concentrated, and unorganized and dispersed. The significant role of storm runoff, the concentration of impurities which especially in the initial period, can reach very high values.

Contaminants can be divided into: mineral, organic and bacterial.

Mineral contamination: sand, clay, solutions and emulsions of salts, acids, alkalis, mineral oils and other substances.

Organic contamination can be of vegetable or animal origin. Distinguish easy oxidable connection such as household, food and other waste water and hard oxidable solutions, as a rule, products of the chemical industry.

Bacterial contamination: various microorganisms in the form of yeast and mold fungi and bacteria, including pathogens. The latter are exclusively of animal origin.

From all kinds of contaminations, the most common oil products and phenolic compounds, which have a negative effect on water and living aquatic organisms even in low concentrations.

Pollution of reservoirs surface-active detergents (surfactants) leads to the formation of persistent foam and a significant deterioration of health indicators. The greatest danger for natural waters and living organisms are all radioactive waste. Therefore, their discharge into water bodies is unacceptable.

All harmful substances affect the organoleptic, general sanitary, toxic and management of water quality, modifying physical properties (transparency, color, smell, etc.) and chemical composition. You can see that the floating formation and deposition, new bacteria, viruses, fungi. As a result, the water quality of rivers and reservoirs may be unsuitable for water consumption and water use.

1.1 The Main sources of water pollution

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The development of the productive forces as one of the important problems put forward the protection of the environment and particularly water sources, from contamination. The main task of protecting the water basin includes both water management and wastewater treatment to the level of requirements to their discharge into water bodies.

Great harm to bodies of water cause industrial effluents containing toxic substances acting negatively on aquatic ecosystems. The greatest number of contaminants in the absence of the desired degree of purification comes from oil refining, chemical, pulp and paper, metallurgy, textile and other industries. The volume and composition of industrial waste depends on the production capacity of each enterprise and adopted it technology.

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The water quality of water bodies is assessed by physicochemical, biological and microbiological parameters, analysis of which allows to establish compliance or noncompliance in question of the watercourse, reservoir requirements water users water users, under current legislation. The criterion for the permissibility of downloading water sources of contamination include substances maximum allowable concentration (Mac) of harmful substances in water objects and their general sanitary feature. Requirements to water quality of rivers, lakes, seas, designed in the form of maximum permissible concentrations for water sources, water reservoirs, located within settlements in the area and also for water bodies of commercial fishing importance. Approved sanitary rules of intake wastewater into water bodies separately for rivers and inland waters and the sea. In these papers the MPC for a large number of harmful substances (more than 500), and current hydrological conditions of the water quality assessment.

Under current Kazakhstan regulations permitted on discharges of polluted substances (sewage, etc.) defined for each production, town or village on the basis of MPC of harmful substances in the area of water use – water use.

In most countries the discharges of wastewater are described, and the permissible load on water bodies, establish legislative bodies.

Each of these systems has its positive and negative sides. Therefore, at present research is being conducted on the development of a combined system of limitation of discharges.

A method of constructing a comprehensive assessment of surface water quality is characterized using the quality index (AQI), describing its set of core indicators, depending on the water uses on the basis of existing norms of "Rules of surface water protection", developed also the methods of constructing sub-indices:

- common sanitary standards - I_{oc};
- specific contaminants $I_з$.

1.2 Methods of assessing the quality of natural waters and sewage

The water quality of water bodies is assessed by physicochemical, biological and microbiological parameters, analysis of which allows to establish compliance or noncompliance in question of the watercourse of the reservoir with the requirements of water users - water users, under current legislation. The criterion for the permissibility of downloading water sources of contamination include substances maximum allowable concentration (Mac) of harmful substances in water objects and their general sanitary feature. Requirements to water quality of rivers, lakes, seas, designed in the form of maximum permissible concentrations for water sources, water reservoirs, located within settlements in the area and also for water bodies of commercial fishing importance. In Kazakhstan rules of permissible discharges of substances contaminated (sewage, etc.) defined for each production, town or village on the basis of MPC of harmful substances in the area of water use – water use.

The quality of natural waters and wastewaters judged by their physical - chemical and microbiological characteristics, and natural water and hydrobiological characteristics. The composition of indicators, which are to be determined, prescribed, taking into account local conditions in accordance with applicable regulations and to the task. All groups of hazards that determine the quality of water in water bodies presented general sanitary, sensory, toxic and biological indicators.

The transparency of water depends on its color and turbidity. A measure of light transmission is the height water column through which you can still see a white Board of a certain size or to read the font of a particular type. The results indicate in centimeters, noting that the method of measurement.

The color of water is determined in an unfiltered water sample by comparing a test portion with a standard color produced in solution chloroplatinate potassium and cobalt chloride or a solution of potassium dichromate and sulphate of cobalt.

The total impurity is the sum of all dissolved and suspended solids, which are the evaporation of water sample, drying the sediment at 105^0C to constant weight and subsequent weigh-in.

Solute – a substance defined by evaporation of the filtered sample, drying the sediment at 105^0C to constant weight and weighing.

Suspended matter – substances remaining on the filter during filtration. They are determined either directly after filtration, sample drying at 105^0C precipitate to constant weight and weighing, or indirectly by difference between the total impurity content and the amount of dissolved substances.

The amount of reaction water set pH electrometric or colorimetric methods, measuring the potential of occurring on the measuring electrode. The most accurate electrometric method.

Dissolved in water find oxygen iodometric method, based on the reaction of dissolved oxygen with a hydroxide of manganese. Fast and fairly accurate is the electrometric method with the use of the automatically acting device (umbrella) working on the diffusion-electrochemical principle (has a membrane, electrodes and electrolyte solution). The result of the determination of dissolved oxygen expressed in milligrams O2 per 1 liter of water .

Biochemical oxygen demand (BOD) determined by standard dilution method in the original or, respectively, the diluted sample by difference between the oxygen content before and after incubation under standard conditions (incubation 5.7 or 20 days at +200C without access of air and light).

The ammonia is determined by direct colorimetric measurement in potable and surface waters by reagent Nessler, or by distillation with colorimetric or volumetric extension (the definition in surface and waste waters). Ammonia expressed in mg N in 1 l

Nitrite in drinking, surface and waste waters, determined using a colorimetric method with sulphanilic acid and N-naphthylamine. The content of nitrite are expressed in mg N in 1 l

The total number of saprophytic bacteria is determined by the temperature of cultivation +370C, which describes the direct consumption by bacteria of organic substances. Bacteria of group of intestinal sticks are indicator parameters of fecal contamination. Characteristics give water if-titer and coli-index. The first of them characterizes the smallest volume in milliliters, which revealed one colony of bacteria. If the index gives the inverse of the coli-titer.

Pollution of rivers and water bodies with harmful substances.

A significant amount of pollution discharged with wastewater of cities and towns and industrial enterprises. Runoff over time (days, weeks, years) is uneven, having, as a rule, daily maximums (morning and evening) night minimum. The composition of wastewater depends on the source of pollution and changes over time, with daily variations of the content of various ingredients is 3-4 or more times. Pollution contained in waste water can be divided into suspended, colloidal (particles from 0.1 to 0.001 mm) and dissolved substances. Bacterial condition of rivers and reservoirs depend on the content of these disease-causing (pathogenic) and indicator bacteria, indicating the possible presence in the wastewater of pathogenic microbes. Urban wastewater contains up to 40% weighted to 10-20% colloidal and up to 40-50% of the dissolved substances.

In assessing the quality of natural waters need to know the incoming load of pollution. For domestic wastewater the amount of pollution per capita per day is determined in accordance with SNAP in grams: for suspended solids – 65; for to 60-75; nitrogen ammonium salts - 8-9; for phosphate, and 1.7; for chlorides - 9.

The process of self-purification due to a combination of the action of many factors, including solar radiation, the activity of microorganisms and aquatic vegetation.

1.3 Measures to prevent depletion and pollution of natural waters and improve their quality

Throughout the history of the development of society the relationship between humans and nature characterized by the extraction of the valuable components necessary for the existence and development of people. This finds expression in the production of agricultural products, mining, and production of industrial goods, procurement of timber and valuable vegetation, catching fish, hunting animals and birds. All of this leads to disruption of natural communities and their gradual depletion.

Until recently humanity didn't care about the restoration of the natural resources without thinking about the fact that it is not inexhaustible, and that its self-regulating capacity is not unlimited.

To a considerable extent it relates to water resources, land, intensive use of which in some areas also contributed to their intense exhaustion and pollution. The further development of society is unthinkable without strict application of social, environmental and techno-economic activities, it is necessary to prevent serious ecological changes to the natural ecosystems and to create conditions for their normal functioning for a long time. Of particular importance in this regard is the establishment of maximum loads by anthropogenic forcing, both at the individual elements of the natural communities and their complexes.

The progressive pollution of the environment and in natural waters, not only due to the increasing scale of industrial and agricultural production, urban growth, but also to a large extent by the imperfection of their technology.

There are three main ways to combat environmental pollution: the creation of waste-free production processes allowing the disposal of all remaining wastes; reduction of the amount of raw materials consumed for production of a unit of production and thus makes it possible to reduce the total volume of harmful emissions; clean up all the emissions into the biosphere, which entails considerable expenses for the construction and operation of treatment facilities, and recycling the remaining waste.

Permanent system for the implementation of measures aimed at preventing the depletion and pollution of water resources should include the following interrelated topics: greening of industrial and agricultural production and urban economy; the purification of natural and waste water; reclamation measures.

1. The ecological technology of production of various types of products, must adhere to the following guidelines: to place new objects in accordance with the water resources cash and permissible ecological load on the environment; to reduce

energy efficiency; shift to systems of water recycling and sequential water use within a single enterprise; use waste water for the needs of other companies; to adopt the separate system wastewater; recovery of valuable components from waste products and waste waters; to apply the measures of economic impact by the introduction of fees for consumed and discharged water.

The most radical way of protecting water resources from depletion and pollution is the cessation of dumping of sewage into rivers and ponds.

2. In modern conditions is of great importance to the purification of natural and waste waters. It is possible that in the long term as continuous improvement, waste production, the role of the primary purification of waste waters will be slightly reduced, but nevertheless it will retain its value post-treatment waste waters in the realization of the complex program of protection of water resources from contamination.

3. A special place in preventing the depletion and pollution of natural waters belongs to a complex of meliorative actions. By their nature they are different, and the implementation of most of them requires significant resources and time. Among the improvement measures include: the fullest use of bioclimatic potential of each region with the aim of obtaining a sufficiently high and stable yields; crop location crop considering water availability in river basins, regions and districts; optimizing the use of fertilizers and pesticides in order to ensure an adequate level of agricultural production and prevent contamination of surface and underground water; reducing losses of water through seepage, evaporation and non-industrial discharges; the introduction of the most progressive methods of soil moisture; the sustainable use of reservoirs and maintaining them in proper water quality, the implementation of the comprehensive programme to combat the harmful effects of floods, mudflows, landslides, water erosion, etc.; implementation of forest protection measures.

The main ways to improve water quality.

Ways to improve water quality and composition of wastewater treatment plants depends on the requirements that the consumer makes to water quality and natural water quality. These requirements are the following: smell and taste at a temperature of 20^0C for no more than 2 points; chromaticity according to platinum-cobalt scale not more than 20; the transparency of the font is not less than 30 cm; turbidity not more than 2 mg/l; total hardness of water is not more than 7 mg. EQ/l

Drinking water should be: lead not more than 0.1 mg/l; arsenic not more than 0.05 mg/l; fluorine not more than 1.5 mg/l; copper not more than 3.0 mg/l; zinc not more than 5.0 mg/l. In 1 ml water total number of bacteria, determined by the number of colonies after 24 hours of cultivation, when 37^0C not more than 100, and the number of colon Bacillus in 1 liter of water no more than three; the content of iron and manganese not more than 0.03 mg/l; active reaction of water pH must be within 6.5 to 9.5; the water should not chlorphenamine odors.

The optimum temperature of drinking water 7-10^0S (the maximum allowable 35^0C). In water used for drinking water, the dry residue should be not more than 1000 mg/l; the chloride content shall not exceed 350, and sulfates is 500 mg/L.

The main ways to improve water quality for drinking purposes: brightening; bleaching; decontamination.

Water clarification is the removal of the suspended solids. Depending on the desired degree of clarification is used: the settling of water in the clarifiers, hydrocyclones; clarification of water by passing it through a previously formed layer of suspended sludge and the so-called clarifiers with suspended sediment, filtering water through a layer of granular filter or filtration through mesh and tissue.

To achieve the desired effect of water clarification in sedimentation tanks, clarifiers and filter apparatus with a granular filter loading in order intensify the process, i.e. the salts of polyvalent metals. Incidentally, in this case, the water is much discoloured.

Discoloration of water - removing or discoloration of the different coloured colloids or dissolved substances. For this purpose, the water is subjected to coagulation, using various oxidants (chlorine, nitrogen, potassium permanganate) and sorbents (active carbon).

Water disinfection is carried out for destruction of the contained pathogenic bacteria and viruses. The most commonly used chlorination of water, as well as other methods of disinfection (ozonation, bactericidal irradiation, etc.).

Methods and systems for demineralization of water.

For desalination of saline water applied and find all the more common distillation, ion exchange, freezing and electroanalysis.

The process of distillation is the evaporation of highly mineralized water with subsequent condensation of steam, resulting in fresh water. Single-stage evaporator consists of a steam boiler, evaporator, heat exchanger to condense the steam, pumps, piping, control and measuring devices, reamers, etc. the Multistage evaporator unit is several parallel working of evaporators. While the method of distillation is relatively expensive, and installation is difficult to operate.

The use of sewage sludge. The use of sludge (sludge) generated in the treatment process of sewage is of great importance for agriculture and for green spaces of cities. The economy can get it at stations of purification of waste water free.

In the composition of sediments of urban wastewater contains 50-85% of organic substances, of which 80 consists of carbohydrates, fatty and protein. The organic matter content in the digested sediment is reduced to 50%.

Mature sediment is harmless to health and is used as fertilizer. Parameters sludge compared to manure.

It is easy Humanities and increases the permeability of the soil. The contents in the sediment of biogenic elements depends on the dry matter content, nature of sewage treatment, etc.

The use of sewage sludge depends to a large extent on crops. Recommend the use of sludge for fertilization of meadows and grain crops. Especially effective is the use of sludge on mineral soils poor in humin substances if soiling of the grounds not more often than once in five years. Recommended for five years to enter into the soil not more than 20 t of dry matter of sludge per 1 ha. this should take into account the nature and degree of wastewater treatment, the cultures, the content of toxic substances.

2 Water use and water consumption

2.1 Main indicators of water use

The users are the participants of the WMC (water management system), which uses natural water as the raw, in the composition include industrial, agricultural, drinking water, irrigation.

The users are the participants of the water management system using water as a habitat, as the overpass in the composition include rafting, water transport. Water use is water use without selection, resulting in not created return water.

The main indicators of water use:

- the degree of change in the regime of rivers and streams to natural and impact on water quality in the rivers.

In relation to hydropower – this fact is manifested in the increase of the level of water upstream and reduce such at the bottom, intense drawdown of water levels in autumn and winter, the whitening of the water in the upper bays and the erosion of the river bed of the rivers after the dams, change of water temperature.

Aquatic recreation is evident in the oil pollution of the waters of rivers and lakes from motor boats and ships, as well as household waste, releases to water are additional organic substances at the stern of fish swimming.

Water consumption – using water sampling from the river, resulting in formation of return water. The main indicators of water use: the total and irretrievable water consumption for irrigated agriculture; the degree of return (in irrigated agriculture return water in the river is 20-30%); the degree of influence on water quality in the river.

The water management complex.

Under water complex, you should understand technical and social-economic activities on water resources use for development participants in this complex, based on the needs of the national economy.

In the modern view, each water management system must meet the following basic conditions: the most efficient way to ensure the needs of members of the complex as the amount of water used and its quality; to prevent the deterioration of the natural environment and to ensure the protection of watercourses and water bodies from pollution and depletion; to provide the highest economic efficiency for all participants of the complex; to ensure reliable system operation of the entire set water facilities.

Systems and schemes of water supply. The water supply system of buildings and facilities for any purpose must provide consumers with water of a given quality, in required quantity and at the required pressure. Water supply of buildings and individual objects can be supplied from outer water supply network (settlement company) or from its own local (underground or surface) sources of water supply.

Water systems are classified as intended, the service sector, usage water, security of the head with the installed equipment.

The purpose of the system is divided into drinking, production and fire.

Drinking water supply system of buildings is designed to provide consumers with drinking water quality. Consumers water is consumed for drinking, economic-household, sanitary-hygienic and technological needs. In that case, if possible water consumption non-potable quality in the building design, two internal water supply – drinking and technical water, not connected to each other (separate).

In industrial buildings (hot shops) provide special drinking water pipes in which water may be saturated with carbon dioxide, salted or chilled.

Production of the water supply system used to supply water for technological needs of the enterprise management. The quality and quantity of water in the production water shall meet the requirements of production technology. In industrial water supply water can be non-potable quality or specially purified.

Fire water supply system of buildings is designed for extinguishing fires that broke out in the building. The quality of water is not limited, and the number shall be provided in accordance with the requirements and SNaP RK 4.01.-02-2001.

The service sector of the systems are separate, not United with one another (because the quality of water in them may be different); the combined (commercial, fire, industrial, fire or utility and production, which assume the supply of water of identical quality); ensuring that the same water for all their needs: drinking, production and fire. Single system provide water supply only potable quality.

According to the method of use of water are distinguished in the system: once-through, recycling and reuse. In addressing issues of protection and rational use of natural resources with the goal of saving water should be greater use of recycling water systems, using local plants for water treatment and recharge of fresh water to replenish losses that always occur in circulating water systems.

To ensure the head with the installed equipment distinguishes:

a) secured by pressure from a network of external water, i.e. when at the point of connection of internal water to external water supply network of the settlement or the franchisee (the warranty) the pressure is sufficient for normal functioning of all water devices installed on the network of inland water;

b) is not secured by pressure from a network of external water, i.e. a system with water equipment: water tank, pump or pneumatic setup.

System internal water supply system with water tank used in cases where the security head in the hours of maximum water consumption is insufficient, i.e. below the required pressure, and other hours is sufficient ($N_{har} \geq N_{tr}$). In hours of insufficient pressure when ($N_{har} < N_{tr}$) all water devices are provided with pressure from a water tank.

System internal water supply system with booster pump installation is used when the pressure in the outer water supply is constantly or periodically below the required and when in domestic water mode water is characterized by low inequality.

System internal water supply system with booster pumping installation and the water tank is used in cases when warranty the pressure in the outer water supply is insufficient and when significant changes in water consumption in the building.

Booster pumps are activated automatically as a result of falling water level in the tank or regulatory pressure in the network. The water tank appears to the network as regulating capacity.

System with pneumatic booster installation or booster pumps and hidropneumatica used in fire-fighting or industrial water supply. In this system hydro-pneumatic tank performs the function of a water tank and can be used as a spare or as a regulatory capacity.

There are also conditioning water systems, which are used in high-rise buildings over 50 metres (17 and more storeys), when the pressure in the network exceeds the maximum allowed (60 m for drinking water supply and 90 m for fire). Zone height is determined by the maximum allowed pressure head at the lowest point of the network (screwed connections or valves).

Water supply of cities and settlements.

The water utilities are spent to meet the drinking and other needs of the population, work dispensers of consumer services, watering streets, for fire safety purposes.

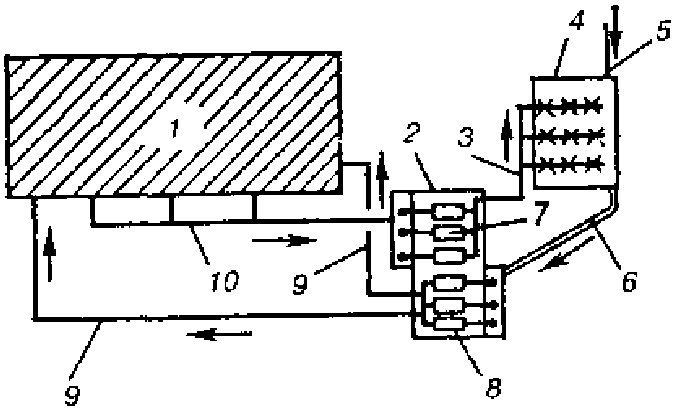
The growth of population density and culture of the cities and towns and increases the amount of water consumed per capita. Norms of drinking water consumption are installed in accordance with applicable regulations depending on the population and the degree of comfort of the buildings. Water consumption in the settlements is changing during the year. The largest volumes of water are consumed in the summer, when the population often use the baths and showers and is watering streets and gardens.

The use of water during the day also uneven. The largest quantity of water consumed in the middle of the day and lowest at night. Every year increases the total length of communications agricultural water supply. Kazakhstan has built about 20 thousand km of trunk and more than 30 thousand km inside the village and local pipelines, many pumping stations, sewage treatment plants and installations for the improvement of water quality. The largest group water pipelines are Ishim, Bulaevskii, Nura, Seletinskiy and several others. The channel Irtysh-Karaganda along with meeting the needs of industrial centers have raised water to the rural population.

Water use in industry.

The development of industrial production is accompanied by the increase of water consumption. In addition to direct supply of industrial enterprises, adopt various schemes of water recycling (figure 2.1), which provide significant savings of natural waters.

Thus, the water used in production is an integral part of production (fully or partially). In addition, it can be used for ancillary purpose, providing a manufacturing process.



1 - plant; 2 - pumping station; 3 - pressure pipe; 4 - special facilities for cooling water; 5 - pipeline for the supply of "fresh" water; 6 - gravity pipe; 7 - the first group of pumps; 8 - the second group of pumps; 9 - discharge pipe; 10 - gravity pipeline.

Figure 2.1- Diagram of circulating water supply of industrial enterprises

Many industries use water as the primary element of the production process: the energy or heat transfer fluid, working environment, etc.; for a number of production water is needed as the technological component when cooking, dilution, leaching, crystallization. Most chemical plants use water as a reagent; in the manufacture of products from cement, clay, lime water is a component. On the territories of industrial enterprises of water is also needed for non-productive purposes: sanitation, for fire fighting.

Enterprises black and nonferrous metallurgy, chemical, pulp and paper etc. industries are more hygroscopic. At the same time increasing the amount of waste water containing salts of zinc, lead, nickel, fluoride and other compounds; once in the receiving water bodies, it pollutes them.

Waste oil refining industry to form on water surface film that prevents the penetration of oxygen. To reduce and prevent pollution of natural waters is necessary to radically change the technological schemes of water circulation on the enterprise. Significant volumes of water are consumed thermal (TPP) and atomic (nuclear) power plants, which have an impact on aquatic ecosystems and, primarily, their thermal regime. To protect water sources from tar-called thermal pollution and it is necessary to actively introduce the TES system water recycling.

In the industry occupies a special place hydropower, which is the main water user in the river runoff. Hydropower increasingly meet energy needs during peak hours. The required water consumption for thermal power plants are usually determined by 1 kW of installed power consumed from 0.16 to 0.45 m^3/h of water. Larger values apply to small turbines medium pressure, lower values for the high pressure turbine. Modern units designed for supercritical parameters of steam temperature 580-600^{0}S and at a pressure of 240-260 kPa. Taking the power of a thermal power plant 2400 MW and the average consumption of water per 1 kW 0.15 m^3/h, will receive the total flow rate of 100 m^3/s (whole river).

To ensure the supply of modern large-scale thermal power plants they are trying to camping on the banks of large rivers, reservoirs, coastal sea area. In this scheme water supply may be flow.

However, in some cases, thermal power plants have to be placed directly at the fields of fuel and very often in conditions of limited water resources (GRES), which causes the necessity of transition to circulating water supply systems.

Use of water energy.

A significant role in the energy balance of the country play a hydroelectric station, which in comparison with other power plants have significant advantages: first of all, there is no constant need of extraction, haulage, preparation and supply of fuel are provided the best conditions for protection of water resources and nature. Unlike other energy resources, hydropower is not limited, but constantly renewed.

The magnitude of the power developed by the flow, can be determined by dependencies:

$$N = 9{,}8 \cdot Q \cdot H, \tag{2.1}$$

where Q - average annual flow rate of river (m^3/s) on this section of the river;

H - the fall of the river at the site, (m).

Hydropower stations differ of their opportunities for full automation, high ratio of water resources, greater agility equipment small piping during operation.

Depending on the topography of the area supplied by water areas and quantities required available pressure of the water supply system are divided into single-band and multiband (two, three, etc.).

Depending on the methods of transportation of water supply systems are divided into pressure and non-pressure. Pressure is system, pipelines, employing full cross-section. Non-pressure piping work a partial cross-section. Their applicability depends on the difference marks the start and end points of the path of water flow, terrain, along the path of flow, distance of flow.

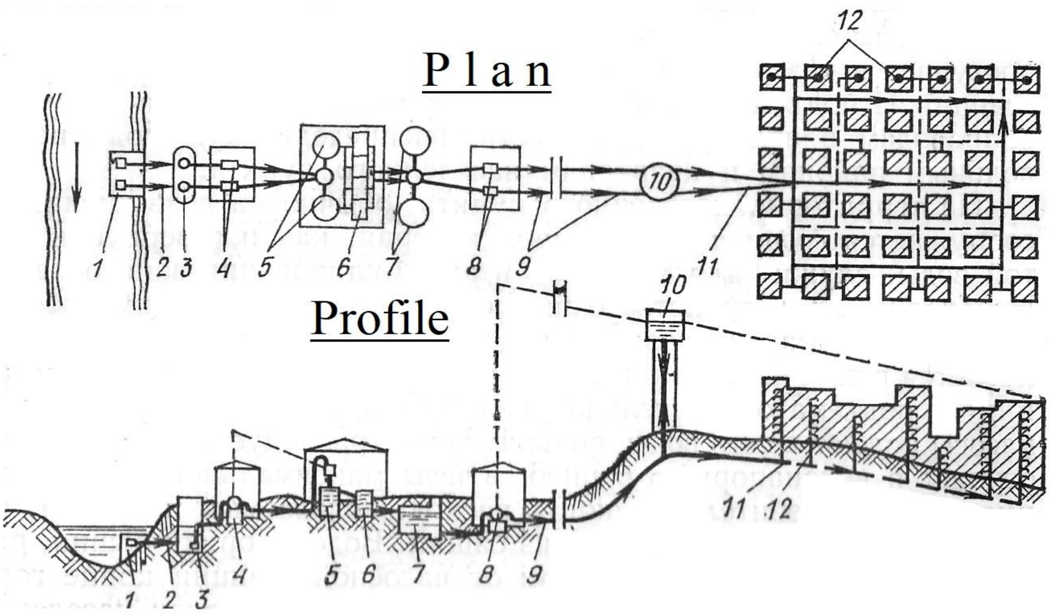
Depending on the type of source water supply systems are divided into water supply, diverting water from surface sources and water pipes, diverting water from underground sources. There are mixed systems, involving water abstraction both from surface and from underground sources.

Scheme and the main elements of water supply systems.

The scheme of water supply of cities and towns is determined by the type of water source, quality of water, terrain, mode of consumption. In General, the water supply system (figure 2.2) includes the following structures.

The scheme of water supply can be significantly simplified, if the water quality of the source is required. Then sewage treatment plant 3, and often associated with the tank 4 and pump station of II lifting 5, may be missing.

This scheme is often possible when using artesian water with high sanitary quality. When the location of the water source above the marks supplied by water areas, the possibility is created to supply water to consumers by gravity.



1 — inlet; 2 — gravity tube; 3 onshore well: 4 — pump station I of lifting; 5 — septic tanks; 6 — filter; 7. spare the clean water tank; 8 — pump station of II lifting; 9 — water; 10 — the water tower; 11 — main pipelines; 12 — distribution piping.

Figure 2.2 - the Scheme of water supply of the settlement

Thus, the mandatory elements of any system are water intake structures, water pipelines and water supply network. The water supply scheme in addition to the sources and composition of the structures also differ and the number of water sources, which may be two or more.

2.2 Norms of water consumption and source of water supply

The norm of water consumption referred to the amount of water consumed for specific needs per unit of time or per unit of manufactured products.

Norms of drinking water consumption. We must distinguish between the norms of drinking water consumption in the settlements and industrial plants.

The amount of water supplied for the showers is determined from the condition that the time of water consumption for one shower mesh is 500 l (duration of use of the shower 45 minutes after the end of the shift).

Norms of water consumption for industrial needs. Many industries (chemical, textile, metallurgical, etc.) spend a significant amount of water.

Usually set norms of water consumption per unit of products produced (1 t metal, 1 ton of fiber, 1 t bread, etc.). These standards are developed by technologists of the respective industries, given the adopted technology.

In the settlements the standards of drinking water prescribed by SNaP RK 4.01.-02-2001 (SNaP 2.04.02.-84) depending on the degree of improvement of housing estates and climatic conditions (table 2.1).

Table 2.1 - Standards of drinking water use in settlements

The degree of improvement of housing estates	The norm per the average rate of water probability (per year), l/day
The building, equipped with internal plumbing and sanitation, no bath	125-160
The building, equipped with an internal water supply, Sewerage and baths with local water heaters	160-230
The building, equipped with an internal water supply, Sewerage and baths and centralized hot water supply system	230—350

Notes:

1) For built-up areas buildings water use from standpipes average daily (per year) rate of water consumption per capita should be taken in the range of 30-50 liters/day.

2) The Norms of water consumption accounted for water consumption for drinking and domestic purposes in residential and public buildings, with the exception of water consumption for holiday homes, sanatoriums and pioneer camps.

3) The Choice of water consumption norms within the limits specified in the table should be performed with respect to climatic conditions, power source of supply, the degree of improvement, the number of storeys of buildings, way of life of the population and other local conditions.

Industrial plants water consumed employees for drinking and sanitary needs and for showers.

Norms of drinking water consumption at industrial enterprises should be adopted in accordance with SNaP RK 4.01.-02-2001.

Design the water supply facilities should according to the rules set out in SNaP RK 4.01.-02-2001, on the basis of approved schemes of location of productive forces in the regions of Kazakhstan, as well as General, basin and territorial schemes of complex use and protection of waters, General plans of cities and rural settlements, General layouts of industrial sites [1].

The design needs to consider the co-operation of water supply systems of objects regardless of their departmental affiliation.

The projects of the water facilities necessary to develop, as a rule, simultaneously with the sewer projects and the mandatory analysis of the balance of water consumption and wastewater.

The quality of the water supplied for drinking and sanitary needs, shall conform to the requirements of the SanPaN of the ROK-3.01.067-97. The quality of the water supplied for manufacturing purposes shall meet the technological requirements, taking into account its impact on the manufactured products and to ensure proper sanitary-hygienic conditions for staff.

Specific average daily (per year) water consumption for household and drinking needs of the population should be taken depending on climatic conditions, the capacity of the water source and water quality, the degree of improvement, height of building and local conditions. Distribution of water consumption by the hour of day in settlements, on industrial and agricultural enterprises should be taken on the basis of the calculated graphs of water consumption.

Water consumption for needs of industrial and agricultural enterprises shall be determined on the basis of consolidated norms, and in the absence of analogous projects.

Fire fighting water shall be provided in the settlements on the objects of the national economy and, as a rule, unite with drinking or industrial water supply.

Consumption of water for extinguishing fires. These standards are also set by SanPaN RK-3.01.067-97. For industrial enterprise determines consumption of water for extinguishing fires in separate buildings. For the calculation taking the highest consumption. The estimated number of simultaneous fires for a combined fire water supply system of the village and located outside of the village industrial enterprises or agricultural production complex take depending on the area of the enterprise territory and number of inhabitants in the settlement.

At several factories and one locality estimated number of simultaneous fires attended in each case by agreement with the organs of State fire supervision.

The estimated fire duration of 3 h. during the period of the fire should be supplied with design flow. To do so, the tanks shall be inviolable three-hour supply of water. Spent the emergency reserve must be restored within 1 - 2 days.

The choice of water source should be substantiated by the results of the topographical, hydrological, hydro-geological, ichthyological, hydrochemical, hydrobiological, hydrothermal and other surveys and sanitary surveys.

As the source water should be considered watercourses (rivers, canals), water bodies (lakes, reservoirs, ponds), sea, underground water (aquifers, underflow, mine and other water). For production water supply of industrial enterprises should consider the use of treated wastewater. As a water supply source can be used liquid reservoir with a supply to them of water from natural surface sources.

The choice of source of drinking water must be carried out in accordance with the requirements of GOST 17.1.1.04-80. The choice of source of product supply should be made taking into account the requirements of consumers to water quality, feasibility, considerations and other factors.

In assessing the sufficiency of water resources surface water sources are required to provide below the place of the water guaranteed water flow required in each season of the year to meet the water demands, downstream settlements, industrial enterprises, agriculture, fisheries, navigation and other water uses, as well as to ensure sanitary protection of water sources.

In case of insufficient water flow in the surface source should provide for the regulation of natural flow of water within a single hydrological year (seasonal regulation) or long-term period (long-term regulation) as well as the transfer of water from other, more abundant surface sources.

For drinking water the most suitable underground water as they have relatively high quality and often do not require treatment. Before using for drinking water from surface sources are usually subjected to cleaning, and before using to water some plants that do not require high quality water, it is subjected to only a simple cleaning up or even not clean.

2.3 Properties of water and the requirements to its quality

Water quality is characterized by its physical, chemical and bacteriological properties.

The physical properties of water are its temperature, color, turbidity, taste and odor.

The temperature of water from surface sources depends on the TEM-temperature of air, speed of water movement and other factors. It can vary within considerable limits. The temperature of the water of underground sources is relatively constant (typically 6 - 8° C).

Under the colour of water and understand its connotation. The hue expressed in degrees chromaticity according to platinum cobalt scale. One degree of the scale corresponds to that of 1 liter of water, 1mg of powder painted platinum.

Turbidity is determined by the content in water of suspended particles and is expressed in milligrams per liter (mg/l). Water of underground sources has a low turbidity. The turbidity of surface water sources depends on their species (different rivers carry water of different turbidity) and the time of year. Especially high turbidity of water during flood periods.

Water sources can have a different taste and smell.

Chemical properties of water are characterized by the following indicators: active response, hardness, biochemical oxygen demand, content of dissolved salts.

Active reaction of water is determined by the concentration of hydrogen ions. Usually it is expressed using pH. At pH = 7 the medium is neutral; when pH <7 acidic environment, and at pH > 7 alkaline environment.

Water hardness is determined by the content of calcium and magnesium. It is expressed in milligram-equivalents per liter (mEq/l). Distinguish carbonate hardness, non-carbonate and total (the sum). Carbonate, or temporary, hardness characterizes the content in water of bicarbonate and carbonate salts of calcium as non-carbonate or permanent hardness content in water non-carbonate salts of calcium and magnesium. Water of underground sources is of greater rigidity and surface water sources is relatively low (3 - 6 mEq/l). Especially large the rigidity of seawater.

Oxidation is determined by the content in water of dissolved organic substances and may serve as an indicator of pollution source of wastewater.

The content in water of dissolved salts (mg/l) is characterized by dense residue. Water from surface sources has a less dense residue than water from the underground sources, i.e., contains less dissolved salts.

The degree of bacteriological pollution of water is determined by the number of bacteria contained in 1 cm3 of water. Water from surface sources contain bacteria, made waste and rain water, animals, etc. the Water of underground sources is usually not contaminated with bacteria.

Distinguish between pathogenic (disease-causing) and saprophytic bacteria. To assess the degree of contamination of water by pathogenic bacteria determine the content of Escherichia coli. Bacterial contamination of water is measured if-titer and coli-index. Coli-titre — the volume of water in cubic centimeters which contains one Escherichia coli. If the index number of the colon Bacillus, contained in 1 l of water.

The requirements for drinking water quality, are determined by the GGST 2874-73. These requirements are divided into two groups .Requirements of the first group are mandatory for all household water systems the centralized water supply. The requirements include the following: smell and taste is not more than 2 points; color not more than 20°; the transparency of the font is not less than 30 cm; the total hardness of water is not more than 10 mg/l.

Requirements of the second group should be observed in the presence of water treatment facilities. These requirements over-happens as follows: the turbidity of the clarified water is not more than 2 mg/l; iron content not more than 0.3 mg/l; active reaction (pH) in the clarification and softening of water is not less than 6.5 and not more than 9.5; the content of residual chlorine not less than 0.3 and not more than 0.5 mg/L. Requirements to quality of production water depend on the nature of production. In a number of industrial enterprises a significant percentage of the production water is used for cooling equipment and products. Thus, the water cooled in the blast and open-hearth furnaces, compressors, turbines, etc. In the cooling water should not contain many suspended particles. It should have a low carbonate hardness (not more than 4-5 mEq/l). In order to avoid overgrowing of pipes due to deposition of salts of temporary hardness cooling water should not exceed 30-50°C. Clogging of the piping can cause the microorganisms with a significant content in the cooling water. The water is intended for boiler feed, shall have a minimum stiffness. To reduce the hardness of water is subjected to softening.

2.4 Improving the quality of natural waters

Water treatment method and composition of treatment facilities depend on the quality of water in the water source, purpose of water supply, capacity and local conditions. The most common purification methods include clarification and disinfection.

Bleaching may be carried out by settling the water in sedimentation tanks, pass it through a suspended layer of sludge in clarifiers and filtration through granular loading in the filters. To improve the process of defending the use of coagulation, i.e., administered in water, chemical reagents (coagulants) that interact with the tiny colloidal particles in the water form aggregates of agglomerated particles in the form of flakes, quickly drop down into the sediment.

Preparation and dosing of reagent is carried out at facilities that are members of the so-called chemical farming. The solution of the coagulant is thoroughly mixed with the treated water in the mixer.

From the mixer the water flows into a flocculation chamber, and then flows into the sump, where it is bleaching, i.e. the loss of flakes with adsorbed on them by the suspended particles. If you use clarifiers with suspended sediment, then the camera flocculation are not happy. The choice of facilities for clarification is carried out according to table 2.2.

Table 2.2 - Selection of facilities for clarification

The main constructions	Terms of use				Productivity the station, m^3/day
	Turbidity, mg/l		Colour, deg.		
	Source water	Purified water	Source water	Purified water	
Water treatment using coagulants and flocculants					
1. Fast filters (one stage filtering) a) pressure b) open	 до 30 до 20	 до 15 1,5	 до 50 до 50	 до 20 до 20	 до 5000 до 50000
2. Vertical sedimentation tanks – fast filters	до 1500	до 1,5	до 120	до 20	до 5000
3. Horizontal settling tanks – fast filters	до 1500	до 1,5	до 120	до 20	св. 30000
4. Contact filter – fast filters (two stage filtration)	до 300	до 1,5	до 120	до 20	любая
5. Clarifiers with suspended sediment – fast filters	≤ 200 до 1500	до 1,5	до 120	до 20	св. 5000
6. Two stages of clarifiers – fast filters	более 1500	до 1,5	до 120	до 20	любая
7. Contact clarifiers	до 120	до 1,5	до 120	до 20	любая
8. Horizontal, radial settling tanks and clarifiers with suspended sediment for the partial clarification of water	до 1500	8-15	до 120	до 20	любая
9. Coarse-grained filter for partial clarification of water	до 80	до 10	до 120	до 20	любая
10. Radial sedimentation tanks for preliminary clarification high turbid water	св. 1500-15000	250-1500	до 120	до 20	любая
11. Tube settler pressure filter plant manufacture (like a "Jet")	до 1000	до 1,5	до 120	до 20	до 800
Water treatment without the use of coagulants and flocculants					
12. Coarse-grained filter for partial clarification of water	до 150	30-50 % исходной	до 120	такая как исходная	любая
13. Radial settling tanks for partial clarification of water	более 1500	30-50 % исходной	до 120	то же	любая

14. Slow filters with mechanical or hydraulic cal regeneration of sand	до 1500	1,5	до 50	до 20	любая

Water disinfection is carried out with the aim of destroying bacteria, mainly pathogenic. The most common methods of disinfection are chlorination, ozonation and germicidal radiation.

Sometimes *special handling is water*. Thus, the underground waters which contain much iron and manganese are subjected to removal of iron and removal of manganese. Feed water of boiler plants and CHP require prior softening. Water some sources of water have to be before serving it to consumers of desalinated, that is, water must be removed dissolved salts. Sometimes the water in the process of purification is necessary to remove dissolved gases, ie, spend it degassing.

To prevent corrosion of pipelines and equipment and loss of salts in the pipes is carried out to stabilize the water by adding a chemical reagent.

Thus, the treatment station is a complex of buildings in which water is treated, acquiring a quality and properties required by the customer. Treatment facilities usually have so that water could be transferred from one facility to another by gravity.

The coagulation and sedimentation of water.

For consolidation of dispersed colloidal particles to increase their rate of deposition and ability to stay porous filter materials used coagulation.

Colloidal particles, having electric charge, mutually repel each other, preventing their enlargement. To overcome this obstacle in the treated water, usually containing negatively charged colloidal particles, injected coagulants, forming a positively charged colloids. The interaction between those and other colloidal particles leads to neutralization of their charges and the formation of larger particles in the form of flakes. As the coagulants most often used aluminum sulphate (sulphate of alumina), iron ferrous sulfate (iron sulfate), iron sulfate oxide, ferric chloride.

As a result of the hydrolysis of these salts form hydrates of oxides of aluminium or iron, which is a usually positively charged colloids. Formed by the hydrolysis of hydrogen ions present in touch water of bicarbonate ions. If contained in the water of bicarbonate ions is not sufficient, for binding released during the coagulation of hydrogen ions to the water adding lime, soda or caustic soda. The dose of coagulant depends on the turbidity and chromaticity of water and for natural waters is typically about 20-50 mg/l.

Reagent economy. Reagent equipment is used for preparation and dosing of reagent solutions and consists of one of the sealing tank, two feed and one dosing tank. The most widely used is the wet method of chemical dosing. In this method, the coagulant lumps of mortar is loaded into a tank of water, where after the dissolution of the coagulant enters the tanks, which is prepared solution of a certain concentration. This solution is routed to the dosing tank, and it is served in the treated water. Usually set two mortar tank operating alternately.

To accelerate the process of dissolution of the coagulant in the mortar tank serves compressed air fire pairs, or apply a mechanical stirrer.

To accelerate the coagulation process in water is injected flocculants — polyacrylamide or the active silicic acid.

Calculation of reagent equipment is to determine the sizes of tanks. Determined the daily consumption of coagulant in t/day:

$$m = \frac{q_{час} \cdot a \cdot T_{HCL}}{1000 \cdot 1000}, \tag{2.2}$$

where a is the dose of coagulant, which is determined depending on the turbidity of the water at source;

$q_{час}$ - hour performance of the pumping station first lift (m^3/h);

T_{HCI} - time of operation of the pump station of the first ascent = 24 hours.

The volume of the sealing of the tank is determined by the formula in m^3:

$$W_З = \frac{m \cdot 100}{b \cdot n \cdot \gamma}, \tag{2.3}$$

where b is the strength of coagulant solution, b = 1 – 15 %;

n – number of preparations of solution per day, n = 1 – 3;

γ - volumetric weight of the solution =1 t/m^3.

Tanks reagent facilities have a cylindrical shape:

$$\mathrm{D} = 1.24\sqrt{W_З}\ ;\ \ \mathrm{H} = \frac{2}{3}D_З. \tag{2.4}$$

The volume of the dosing tank shall be equal to 20 liters

Faucets. For uniform mixing of the coagulant with the entire mass of water are faucets. The most widely cloisonne, perforated and vortex faucets.

Cloisonne mixer is a tray with three vertical transverse baffles having alternating Central and lateral passages. Mixing of coagulant with water occurs as a result of the intense turbulence of the flow.

In the perforated mixer mixing is carried out under the influence of the turbulence formed by the passage of water through openings in the transverse partitions.

Vertical (vortex) mixer the mixing is due to turbulence vertical flow. The mixer can be square or circular cross-section in plan with a pyramidal or conical lower part.

Allowed to mix the chemicals with water in pipelines and pumps, supplying water to the treatment plant.

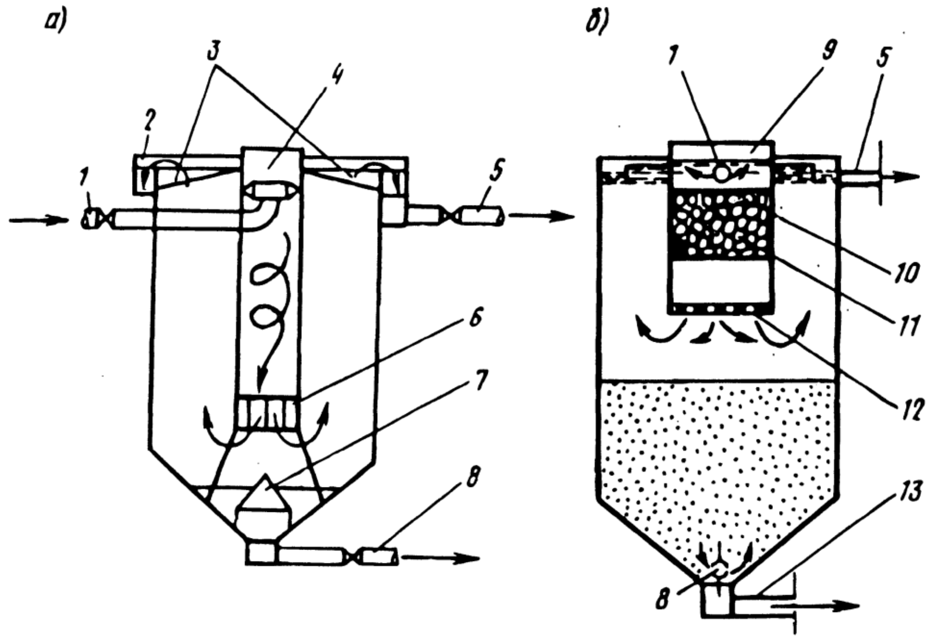
Of the flocculation chamber. In these cells the formation of flakes in the process of gradual mixing of treated water with a solution of coagulant. The water in the chamber within 10-40 min gradually moves from the inlet to the outlet. The velocity of the water in the chamber should be such that the flakes didn't fall out and is not broken down.

According to the principle of camera reaction classified on hydraulic and mechanical. From the chambers of the hydraulic type, preference is given to windmill crooked umbrella, vortex, cloisonne.

All cameras except the cloisonné is inserted in the septic tanks. The design of the reaction chamber should be selected based on the quality of the source water and the type of sump.

Windmill crooked umbrella reaction chamber is combined with a vertical sump and is located in the Central part. Water is distributed in the upper part of the chamber nozzle, located at a distance of 0.2 of the diameter of the camera from the wall, at a depth of 0.5 m from the surface of the water. Leaving the nozzle with a speed of 2 – 3 m/sec, the water acquires a rotary motion along its walls and moves down. At the outlet of the chamber the velocity of the water 4 – 5 m/sec. For damping the rotational motion of water during its transition into the sump at the bottom of the camera installed damper in the form of a lattice at a height of 0.8 m with cells of 0,5x0,5 m, the residence time of water in the chamber take 15 - 20 minutes, and its height is 3.5 – 4 m.

Figure 2.3 presents windmill crooked umbrella (a) and contact (b) of the flocculation chamber, combined with a vertical clarifier.



1,5 - feed and withdrawal of clear water; 2 - circular catchment tray; 3 - radial trays; 4,9 - windmill crooked umbrella and contact camera flocculation; 6 - damper; 7 - cone-reflector; 8 - discharge of sediment; 10,12 - upper and lower grille; 11 - expanded polystyrene; 13 - discharge of sediment.

Figure 2.3 - windmill crooked umbrella (a) and contact (b) of the camera flocculation, combined with vertical a sump

Cloisonne chamber is a reinforced concrete tank is divided by longitudinal partitions into corridors. Water passes through these corridors at a speed of 0.2-0.3 m/s and the Number of corridors can vary depending on turbidity of water.

Sedimentation – the deposition of suspended matter from the water, at rest.

Practically in the purification of the water used continuous sedimentation (uncomfortable periodically to fill and empty the septic tanks), in which water with low velocities continuously passes through the settling tanks where the slurry falls.

Practical application currently find three types of sedimentation sumps , which can be distinguished by the direction of movement of water in them: horizontal, vertical and radial, and clarifiers with suspended sediment.

The sumps. The process of sedimentation based on the fact that at small velocities of water movement in the suspended particles under the action of gravity settle to the bottom. The rate of deposition of particles depends on their size, shape, specific weight and water temperature.

Water supply sources are characterized by different content in water of suspended particles, i.e., have different turbidity. In this regard, the duration of sedimentation of water will be different.

Lighten the water can move in the sump in a horizontal, vertical or radial direction. Depending on the flow direction of distinguish sedimentation sumps horizontal, vertical and radial.

Horizontal settling tanks used in wastewater treatment plants with capacity more than 30,000 m^3/day.

In a horizontal sedimentation tank, which is a rectangular tank, the water flows from the end and moves along the long side of the tank.

Horizontal flow sedimentation tank (figure 2.4) is a pool rectangular section in plan. Water flows into one end of the sump and with a low speed moving in the sump. Suspended particles settle to the bottom and clarified water flows out of the tank on the other side. Relatively uniform movement of water across the cross section of the clarifier is achieved by the device perforated baffles, weirs, distribution and prefabricated gutters.

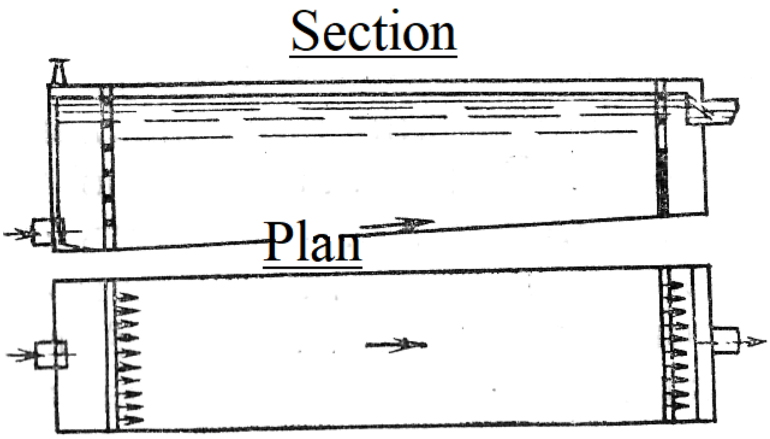


Figure 2.4 - Horizontal sedimentation sump

For uniform water removal from the sump at a distance of 1-2 m in front of the rear end wall set perforated septum. The lower part of the walls 0.3-0.5 m above the zone of accumulation and compaction of sediment making solid (no holes).

The depth of the zone of deposition is equal 2,5-3,5 m, and width of the section of the sump — not more than 6 m.

The bottom horizontal sedimentation tanks is sloped to a sump for sediment located at the beginning of the sump. Sediment accumulating in the sump, periodically remove mechanised or hydraulic way.

In case of horizontal settling tanks should include the flocculation chamber cloisonne or vertical type with suspended sludge layer.

In recent years, proliferating from the horizontal-sumps with a dispersed area of the collecting water through a flooded hole.

Vertical settling tanks, arranged in small wastewater treatment plants with capacity up to 3000 m^3/day, are round or square tank with a conical or pyramidal bottom with an angle of inclination of the walls of 50-70°. Water is supplied by pipeline to the Central pipe, is lowered into the lower part of the sump and then rises into its working parts and spills over the Weir into a circular tray. Sometimes instead of a Central tube having a camera flocculation windmill crooked umbrella type (figure 2.5). In this chamber the water passes through the nozzle, from which it enters tangentially, creating rotational motion in the chamber.

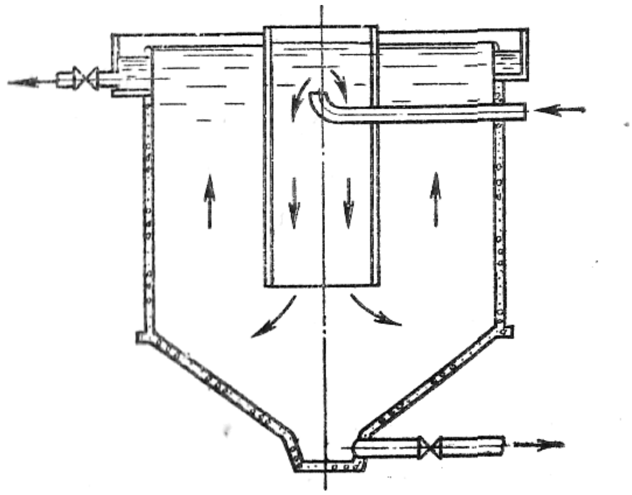


Figure 2.5 - Vertical sump

At the bottom of the camera set lattice of panels for damping rotational motion of the water.

Clarification is provided that the speed of upward flow of water is less than the deposition rate of suspended particles. Then these particles fall to the bottom. The sludge is periodically withdrawn sludge by gravity at the pipe without interruption of the sedimentation tank.

The rate of upward flow of water v is taken in the range of 0.5-0.75 mm/s. the Diameter of clarifier shall not exceed 10 m, and the ratio of the diameter of the vertical sump to the height of the zone of deposition should not be greater than 1.5. If the diameter of the sump is more than 4 m, except for pie pan arrange the radial gutters.

The number of clarifiers at the wastewater treatment plant shall not be less than two.

The cross-sectional area of the vertical sediment tank is composed of the area of the zone of deposition and the area of the flocculation chamber.

The area of the flocculation chamber is determined by calculating the water there for 15-20 min. height of the camera is assigned in the range of 3.5-4.5 m.

The movement of water in the chamber from top to bottom. In the cell reaction occurs for the formation of flakes. The response time TP = 15 ÷ 20 minutes the Water through the dampers enters the settling zone of the clarifier, there is a slow movement of water upward and through the gutter outlet. Sediment accumulates in the bottom of the sump and periodically removed. The particles precipitate during the upward movement of water in the sump. The velocity of the water must be less than the speed of particles (in still water). When coagulation of the particles become larger and consequently the rate of loss is increasing and therefore it is the rate of upward flow to take Vup = 0,4 ÷ 0,6 mm/s. Asking Vup identify the main dimensions of the sump

$$\omega = \frac{Q}{V_{восх}} \qquad (2.5)$$

$$H = V_{восх} \cdot T, \qquad (2.6)$$

where T is the residence time of water in the sump, T = 2 – 3 hours;
N = 4 ÷ 5 m, it is recommended to take the ratio <1,5.

The height of the flocculation chamber:

$$Hк.р. = (0,8 \div 0,9)\ H. \qquad (2.7)$$

The chamber volume of the reaction:

$$W_{к.р.} = \frac{Q \cdot t_p}{60}, \qquad (2.8)$$

where Q is the flow rate in m^3/h.

The cross-sectional area:

$$\omega_{к.р.} = \frac{W_{к.р.}}{h_{к.р.}}. \qquad (2.9)$$

The sedimentary part of the settling tanks should have a sloping wall at an angle of 70-80 degrees.

Vertical clarifiers are recommended for stations of small capacity – up to 5000 m^3/day.

Radial sedimentation tanks are used primarily in industrial water systems, sewage treatment stations of great performance at high content in water of suspended particles. In these lagoons the water is supplied to the center and then moves in the radial direction and merges into a peripheral collection trough, from which it is withdrawn via pipe. As with other types of clarifiers the clarification here is due to the small velocity at which suspended particles fall to the bottom.

Radial settling tanks have a diameter of 20 - 60 m, depth 3 - 5 m in the center and 1.5 - 3 m at the periphery.

The advantage of these ponds is that their design allows for constant removal of sediment in a mechanized way without stopping the operation of the tanks.

Figure 2.6 shows the radial clarifier with recirculation of sludge (a) and tank-building modules (b).

Waste water flows into the sump via the Central tube, and the clarified discharged through the annular tray. The residue rake to the center of the clarifier scrapers are suspended to the farm. In the middle of the tank is arranged a sump for collecting sediment. Sediment removal is carried out using pumps.

On this principle operate structures called clarifiers with suspended sediment (figure 2.7).

Brighteners when equal volumes have better performance than septic tanks and require less consumption of coagulant.

To remove air bubbles which can air striper suspended sediment in the clarifier, the water is pre-sent in the air-purge drum. Refining the sludge blanket reaction chamber of the vortex is in the middle of the clarifier.

The height of the sludge blanket should take 2 – 2.5 m, the height of the clarification zone (from suspended sediment to the water level) should take 2 – 2.5 m.

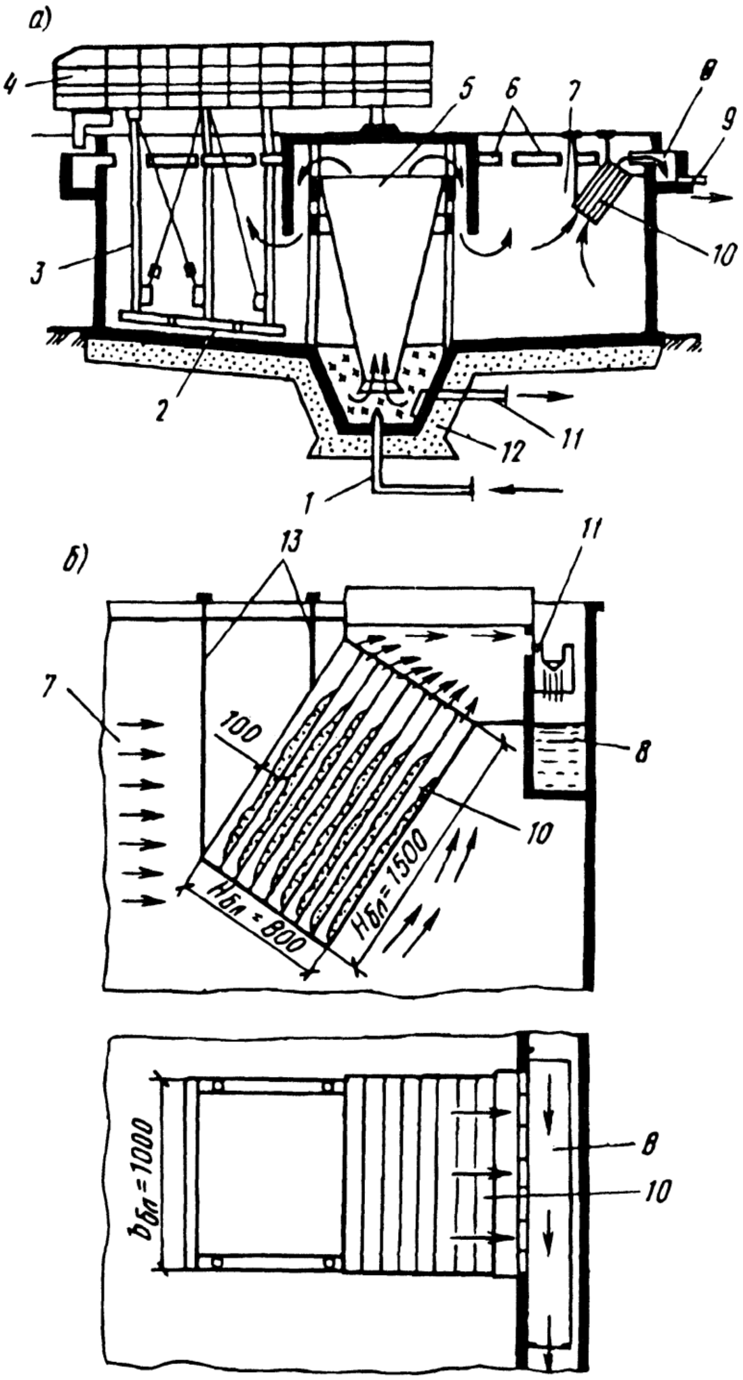
The area of the clarification zone is defined by formula (m^2):

$$F_{осв.} = \frac{K_{р.в.} \cdot q}{3{,}6 V_{осв.}}, \tag{2.10}$$

where Cu.in. – distribution coefficient of water between the zones of the clarification and separation of the precipitate, Cu.in. F = 0.6 ÷ 0.8 m;

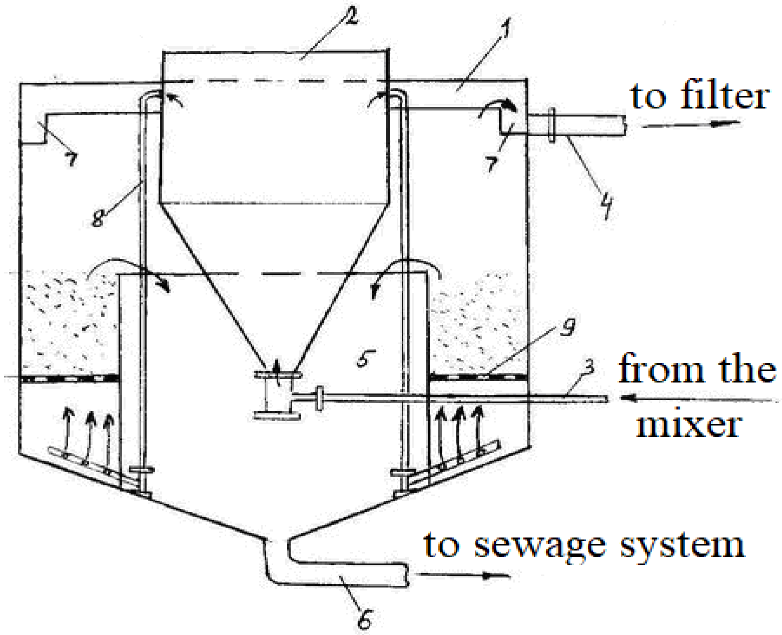
- the rate of upward flow of water in the clarifying zone, mm/sec; = 0,4 ÷ 1,2 mm/sec.

After the reaction chambers through special pipes (8) water is pumped to the bottom of the clarifier through perforated bottom (9), the water rises, passes through the sludge blanket. The water rises to a level where the rate of loss of suspension (settling), and water velocity are the same. Clarified water rises to special chute (7) from which pipe (4) enters the rapid filter. The process of deposition of suspended substances is ongoing prior to entering the chute.



1, 9 - feed and withdrawal of clear water; 2 - scraper; 3 - rotating farm; 5 - recirculator; 6 - drain window; 7 - clarification of water; 8 - circular catchment tray; 10 - thin-layer blocks; 11 - sediment removal; 12 - raincollector; 13 - mount blocks.

Figure 2.6 - Radial clarifier with recirculation of sludge (a) and Tank building modules (b)



1 – bleach; 2 – reaction chamber; 3 – the pipe supplying water into the reaction chamber; 4 – withdrawal of clarified water; 5 – area of accumulation of sediment; 6 – sediment removal; 7 – a gutter that collects the clarified water; 8 – pipe supplying water from the reaction chamber into the bottom of the clarifier; 9 – perforated bottom.

Figure 2.7 - water Clarification in the suspended sludge layer

The lighting in the suspended sludge layer is used when water turbidity is 200 ÷ 1500 mg/l and performance of the wastewater treatment plant more than 5000 m^3/day. Currently, the clarifiers with suspended sediment are used in addition to the clarification of water for softening and discoloration.

Usually after water clarification in sedimentation tanks or clarifiers it is filtered. For filtration, the water passes through a layer of chalk- filter material, check it contains small particles of suspended matter. As filter material used quartz sand, gravel, crushed anthracite and other materials.

Distinguish an ambulance, ultra-fast and slow filters. Fast filters are used in the coagulation of water, slow — water treatment without coagulation, ultra-fast can work with the coagulation of water and without it.

The filters are opened (non-pressurized) and pressurized (closed). Fast filters, most often, are opened, the bullet is always pressure, slow is always open. Water movement via gravity, or gravity filters filled to a certain level of filter loading, occurs under the pressure generated by the height difference of the water levels in the filter and the output from it. The movement of water through a layer of filter loading pressure filters occurs under the pressure generated by the pumps.

Fast filters. Rapid filter is a loaded filter medium tank, equipped with devices for supplying water, collecting the filtered water and wash.

Need to rinse the boot due to the fact that in operation, the filter gradually becomes clogged and its hydraulic resistance increases. Washing produce with clean water in the upward direction. Frequency of cleaning the filter depends on the quality of the raw water, and usually does not exceed 1-2 times a day.

By construction, the distinguished public fast filters with single-threaded movement of water only downwards, and two in-line — with simultaneous movement of water from the top down and bottom up. Single-threaded filters may be loading from a homogeneous filter material or of different materials or two - or multilayer filters.

The choice of a particular filter system is determined by technology-related and technical-economic indicators.

The thickness of the filter load depends on the size of its constituent grains of sand and taken in the range of 0.7-2 m. In this case the calculated filtration rate at normal mode 5.5-10 m/h.

In recent years, began to use double layer filters, Graeme top to a height of 400-500 mm crushed anthracite, and below to a height of 600-700 mm quartz sand. Such filters have greater contaminant holding capacity than filters loaded only with sand. Productivity of two-layer filter is nearly 2 times more productivity of a single layer.

Support gravel layer suit with a height of 650 mm of particle size from 2 to 40 mm. Download size increases from top to bottom. The gravel layer serves to prevent washout of the filter material.

The washing of the filters is carried out with a speed in 7-10 times greater filtration rates. A rinsing time of 5-8 min.

Coarse fast filters are used for the partial clarification of water used for technological purposes at industrial enterprises. These filters are pressure and opened. To download the filters most commonly used quartz sand with grain size 1-2,5 mm. the height of the layer loading of 1.5-3 m. the filtration Rate of 10-15 m/h. Washing coarse filter produce water and air in the following sequence: 1) wrigley filter media with water; 2) air water rinse; 3) wash water. The intensity of washing by water is 6-8 l/ (s • m^2), air — 15-25 l/ (s • m^2).

Ultrafast filters by design are vertical and horizontal. Support gravel layer in these filters is not satisfied. At the bottom of the filter, a pipe for flushing and purging it with air. The most widely vertical filters. Velocity of filtration in these is filters 25-100 m/h Use them for partial clarification of water. Filters, adjustment of the speed of filtration and washing of filters is automated. For wastewater treatment plants a big performance apply the horizontal filter having a large filtration area compared to vertical. Loss of pressure in the filters reaches 10 m.

Slow filters. Slow filters are used in treatment plants with low productivity. According to the method of regeneration download these filters are of two types: 1) removal of the polluted layer; 2) washing the contaminated layer directly in the filter by mechanical loosening of the layer of hydraulic and contaminant removal. The height of the bed load of sand particle size of 0.3-2 mm taken as equal to 850 mm and gravel size 2-40 mm — equal to 450 mm. During regeneration with the washing load directly in the filter width of the filter should be no more than 6 m in length and not more than 60 m water Layer above the surface of the load is equal to 1.5 m. the filtration Rate for slow filters is 0.1-0.2 m/h.

Contact clarifiers are a structure combined type. They combined processes of flocculation, sedimentation and filtration. This can significantly reduce the volume of construction. The principle of operation of the contact clarifier is that when filtering water through a layer of granular load on the surface of its constituent grains adsorbed, suspended and colloidal particles.

The movement of the water in contact clarifiers is bottom-up. The filtration rate of 4-5 m/h For loading of clarifiers used gravel and quartz sand. Gravel support layer has a grain size 2-32 mm and a height of 350-500 mm. height of the filtering layer of sand 2000-2300 mm in equivalent diameter of grains of 0.7-2 mm.

Download washed upward flow of water and air. For uniform distribution of air and water used tubular distribution system of high resistance with supporting gravel layer or not. Mode water-air washing is prescribed as follows: 1) purge 1-1,5 min; 2) joint rinsing water and air for 6-7 min with a water delivery rate of 2-3 l/ (s • m^2); 3) the subsequent flushing with water with the intensity of 6-7 l/ (s • m^2) for 4-6 min.

Contact clarifiers can work with a constant filtration rate in the period of the working cycle, and variable speed, decreasing by the end of the Cycle.

The disinfection of water.

The water of surface sources generally contains bacteria. In the result of the settling and filtration of the water is removed up to 95% bacteria. To destroy the remaining bacteria, water is sterilized. For this purpose, use liquid chlorine, sodium hypochlorite, solutions of hypochlorites, obtained by electrolysis, ozone, and chlorine dioxide germicidal irradiation. Water in drinking water supply systems fed from groundwater sources, is disinfected in case of possible contact with these sources of pathogenic bacteria.

Chlorination.

The most common method of disinfection is chlorination. For chlorination using bleach or chlorine gas.

Bleach is used for small discharges. With the introduction of water bleach breaks down into calcium hypochlorite and calcium chloride. Calcium hypochlorite reacts with carbon dioxide or bicarbonates of calcium, present in water, forming hypochlorous acid, which easily decomposes with formation of atomic oxygen, has a bactericidal effect. When introduced into water, chlorine gas formed hypochlorous and hydrochloric acid. Hypochlorous acid decomposes with the release of atomic oxygen. The desired effect of chlorination is achieved by good mixing and a 30-minute contact of chlorine with water. Such contact occurs in the contact tank or in the pipeline supplying water to consumers.

Water supplied to the consumers shall contain the I l 0.3-0.5 mg of chlorine (called chlorine residual), which indicates the adequacy of the administered dose of chlorine to complete the disinfection of water. To 1 liter of filtered water administered 2-3 mg of chlorine, and 1 l of unfiltered river water to 6 mg of chlorine.

Usually used double chlorination chlorine before sedimentation and after filtration.

For dosing of chlorine chlorinators are. The principle of operation they are divided into vacuum and pressure. Pressure heating systems have the disadvantage that they are chlorine gas is under pressure above atmospheric and therefore a possible gas leak, which is very poisonous. Vacuum chlorinators do not have this drawback.

Chlorine is delivered to the station in liquid form in cylinders. Of these cylinders of chlorine is poured into an intermediate tank where it goes into a gaseous state. The gas enters the chlorinator. Here it dissolves in tap water to form chlorine water is injected into the pipeline transporting water intended for disinfection.

When the dose of chlorine in the water is an unpleasant smell. This water must be certificated. To prevent the formation hlorhinaldola odor at stations in water serves gaseous ammonia.

For the preparation of sodium hypochlorite by electrolytic method directly in wastewater treatment plants serve the electrolyzied with a graphite plate or the charging of magnetite electrodes. The pots should be placed in an isolated room.

Ozonation.

The essence of the process of water disinfection by ozone is the oxidation of the bacteria by atomic oxygen formed during decomposition of ozone. Ozone reduces the color, smell and taste of water.

For disinfection of 1 l water from underground sources is required of 0.75-1 mg of ozone, while 1 liter of filtered water from surface sources 1-3 mg of ozone.

Ozone in the ozone-air mixture is produced in the electric ozone from oxygen in the air. The composition of the ozonation plant includes facilities for synthesis of ozone and mixing the ozone with water. Preparation of air for the synthesis consists in the arrest of suspended particles on the filter, drying air in the adsorbers of silica gel or alumogel. Conditioned air is sent to the ozone generators.

Mixing the obtained ozone-air mixture with water is bubbling in the columns, tanks. This is also used for the ejector-mixers and mechanical mixers.

Germicidal irradiation.

This method of water disinfection is performed using ultraviolet rays, has antibacterial properties. It is used for disinfection of small water underground sources and filtered water from surface sources. As radiation sources serve as mercury-quartz

The effect of decontamination depends on the duration and intensity of the radiation. Distinguish pressure germicidal installation is located on the pressure or suction pipes and non-pressure installed in horizontal pipelines or in special channels.

Disinfection with ultraviolet rays is not applied to waters of high turbidity.

The special treatment of the water.

Depending on the properties of water a water supply source or from the requirements of consumers to quality of water, may need special treatment — softening, iron removal, stabilization, desalination, cooling, etc.

Softening water intended for drinking purposes, usually do not produce. However, it is necessary for some technological processes in industrial enterprises. So, for individual industries of textile, chemical and food industries require water with a hardness not exceeding 1 mEq/l feed water for boilers medium and high pressure must have a stiffness no more than 0.3 mEq/L.

Distinguish methods of chemical and kationitic water softeners, and combined techniques.

Of the methods of chemical softening is the most common lime soda, which you add some lime to relieve the temporary (carbonate) hardness and soda ash to remove a permanent (non-carbonate) hardness. When introduced into water, these reagents are formed insoluble compounds, drop down into the sediment, or compounds that remain in water, but not having the properties of hardness salts.

After softening the water is clarified in settling tanks or clarifiers. Sometimes, to accelerate the clarification process produces coagulation of water, iron sulphate.

At lime-soda water softening is usually used the camera flocculation whirlpool type.

Method kationitov softening is based on the ability of the cation exchange resin to exchange sodium cations or hydrogen cations of hardness salts contained in the water. Umagaeshi ability called cation exchange resin exchange capacity or absorption capacity.

As a result of exchange reaction of the cations of hardness salts become part of cation, and in the water, moving the cations of sodium, forming the sodium salt. This softening is called Na-cation exchange. If N is the cation exchange in the exchange reaction with cations of magnesium and calcium enters the cation of hydrogen.

When the plant consumes cation cations Na or H and loses its ability to soften the water. In this regard, the necessary periodic regeneration of the filter kationitov. For recovery of cations of sodium through the filter is passed the salt solution, and recovery of cations and hydrogen — sulfuric acid solution. After N-cataniavation increases the acidity of the water, and after the cation exchange unit, the water becomes more alkaline. Applying H-Na cation exchange, softened water does not need to alkalize or acidify.

The deironing of water. The iron content in drinking water should not exceed 0.3 mg/L. At the enterprises of some branches of industry, e.g. the textile, the iron content of the water used for technological needs, should not exceed 0.1-0.2 mg/L.

Removal of water from surface sources is carried out by aeration, the introduction of oxidizing agents with or without aeration and by cataniavia. At the same time it is brightening and discoloration.

Installation of iron removal by aeration method consists of aeration device, contact tank and filter.

In the aeration device, water is saturated with oxygen, is partially removed carbon dioxide, ferrous iron is oxidized to trivalent. In the contact oxidation tank is completed, the two-valent iron and precipitate of ferric hydroxide. The filters serve to extract from the water of the hydrate of iron oxide. Water aeration can be done in the following ways: by forcing air through perforated pipes or porous plates; the flow of air into the pump suction of the pump; a water spray; the water pass through the contact or cooling towers. The most common contact cooling tower.

Installation for the reagent (with the help of coagulation and liming) deferrization of water consists of a device for dissolving and dispensing a reagent of the aerator-mixer, clarifier and filter.

Aerator-mixer is usually combined with clarifier and settles over him. It is a system of perforated bottoms, placed one above the other. Removal is by cation exchange to produce cationite filters loaded with coal. The filter is regenerated with salt solution.

Stabilization of water is to give it properties, in which it loses its ability to cause corrosion and to defer salt, prevent biological fouling.

Stabilization of water needed in industrial systems-the company commander of the supply, when, due to evaporation of water in cooling structures, it increases the concentration of salts. Stabilization of water in such systems prevents the formation of scale and corrosion in heat exchangers and cooling devices.

To stabilize water use acidification, recarbonization and phosphate. Acidification of water is adding to it hydrochloric or sulfuric acid. If recarbonization in the water injected carbon dioxide to stabilize the contained carbonates. This is usually used flue gases, which include carbon dioxide. When phosphate in the water include phosphates (sodium hexametaphosphate, trisodium phosphate and superphosphate). Phosphates prevent the formation of deposits in pipelines and, in addition, form on the surface of the metal film, which prevents corrosion.

To combat biological fouling of piping and equipment in water recycling systems periodically apply vitriol or chlorination of water.

Desalination of water is to remove dissolved salts from it. Full desalination is necessary, for example, in the preparation of feed water for high pressure boilers. Partial removal of dissolved salts is called desalination.

Desalination of waters with the salinity 2-3 g/l is carried out using ion exchange, water with a salt content of 3-15 g/l g-electrodialysis or hyperfiltration and waters with salinity more than 10 g/l by freezing, distillation or hyperfiltration.

Ion exchange is used for desalination or demineralization of water when the quantity of suspended particles is not more than 8 mg/l and chroma not more than 8 mg/L. Water desalination by ion exchange is usually carried out in a one-stage scheme by filtration through cation and weakly basic anion exchange resin. Provides for removal of carbon dioxide from the filtrate cationite filters. Also used two - and three-stage scheme.

Cooling of the water. In the systems of industrial water for cooling water use cooling ponds, pools and sprinkling cooling towers.

Cooling towers are drip and film.

The most common cooling tower drip tower. Heating the water is fed into the top of the tower and troughs bred over its entire area. The sprinkler is a system of wooden slats. Water from gutters falls on the outlet is sprayed and flows down. Cold air enters through the Windows in the lower part of the sprinkler and rises, cooling the water. The total height of 30-80 m. cooling towers cooling water going to the cooling tower. The area of the sprinkler needed to cool 1 m3 of water is 0.25 - 0.3 m^2. In film-type cooling towers the water flows in a thin film large area of the sprinkler. Also used the cooling tower with an artificial air supply fans. In this case, the exhaust tower is not arranged. Cooling towers are made of wood or reinforced concrete.

3 Use of wastewater

Sewage system designed for the removal of building contaminants generated in the process of sanitary and hygiene, household and industrial human activities, as well as for drainage of atmospheric and melt water. In the presence of water throwing floatable system of sewage contamination and remove water. No sewage in areas without water supply for residential buildings and hostels height one or two floors when occupancy is not more than 50 persons, summer camps, rural clubs, etc. allowed to do a local export sewers using luftslottet or raked.

Removes industrial Sewerage outside the building, the liquid used in industrial processes and waste, which cannot be applied in production. Internal gutters (rainwater drainage) is removed from the roof rainwater and meltwater. Solid waste (garbage) is removed by the refuse chutes, which can also be attributed to sanitation – sanitation solid waste.

The purpose of the Sewerage system are divided into domestic, industrial, and domestic drains.

Household drain removes dirty water from washing dishes, groceries, Laundry, sanitary and hygienic procedures.

In residential and public buildings is provided for household and stormwater (gutters) Sewerage. Cooling water from air conditioning units that do not contain solid and dissolved contaminants, refers to conventionally clean the drains and is discharged into the drains or household drains.

Scheme Sewerage residential buildings typically consist of the following main elements: receivers of waste water, hydraulic seals, inner and yard sewage networks. Internal Sewerage network collects and carries the waste water from the sinks in the yard drainage system.

Installation for pumping sewage are provided by the network in the case if the external network is located above yard sewage.

In industrial buildings are designed to separate domestic and industrial sewage, drains. To sewage of different composition, aggressiveness, temperature, or other indicators against which the mixing of these waters is unacceptable or impractical, provides several production systems, sewage, transporting this wastewater separately.

On the installations for wastewater treatment is pre-treatment of the most contaminated waste water and removes substances that may interfere with the normal operation of the outer sewage networks or sewage treatment plants.

The choice of Sewerage system for individual buildings, as well as its schema (number and mutual arrangement of the individual elements of the system) is determined by the purpose of the building, a view of the technological process, the installed equipment, the depth of the outside drainage network, the quality of wastewater.

To reduce construction and operating costs, it is desirable to joint the diversion of industrial and domestic wastewater combined sewer system. This may be the case that industrial waste water have a temperature of below 40^0C; contain less than 500 mg/l suspended and floating particles; do not have destructive effects on the pipe material and elements of the Sewerage; not contain substances that can clog the pipe, the sediment on the pipe wall, inhibit biological treatment to form explosive or toxic mixtures in networks and structures. In case of discrepancy between the specified effluent requirements for systems of production include sewage treatment plants, where wastewater is subjected to preliminary processing, which reduces the contaminants to acceptable limits.

Internal Sewerage network assembled from cast-iron, plastic, asbestos cement pipes. Steel pipe used for laying of short branch lines from washbasins, sinks, baths, etc.

Cast iron drainage pipes according to GOST is made with a diameter of 50, 100, 150 mm. To protect the pipes from the aggressive influence of sewage they are coated with a corrosion-resistant coating. Produce pipes of two classes A and B. class A is the pipe that can withstand the pressure of 0.1 MPa (1 kgf/cm2) before applying anticorrosive coating.

Sanitation of settlements and industrial enterprises. Tap water, which was used in the commercial, industrial and other purposes and have thus various impurities (pollution) that changed its chemical composition or physical properties, is called sewage. The category of waste includes atmospheric water, resulting from rainfall and snowmelt.

The wastewater composition is highly diverse. They contained organic contaminants can rot and serve as a favorable environment for microbial growth, including pathogenic (disease-causing). Present in the waste water chemicals, fats, oils, oil products, synthetic surface-active, poisonous and radioactive substances can cause great harm to the soil and water bodies. The accumulation of sewage on the surface and deep soil and in water bodies causes environmental pollution, prevents use of water bodies for economic purposes and can cause a variety of infectious diseases. All this constitutes a serious challenge to humanity and requires immediate removal of sewage outside the residential zones and their treatment.

Depending on the origin of the qualitative characteristics of the impurities of the waste water is divided into domestic, industrial and atmospheric.

To the household include water from kitchens, bathrooms, showers, baths, laundries, canteens, hospitals, etc. On the nature of the contaminants of household water can be sanitary, i.e., contaminated mainly physiological garbage, and utility, containing all kinds of household waste. Domestic wastewater is characterized mainly by the content of organic pollutants in different phase-dispersed state.

Industrial wastewater is produced as a result of contamination of tap water when it is used in the process. They are divided into polluted and conditionally pure. Compared to household composition and concentration of contaminants of industrial wastewater is more varied, as they depend on the nature of production, types of products and characteristics of technological processes which use tap water. Some industries can do several types of wastewater with varying composition and concentration of impurities. Conditionally pure water containing a very small quantity of contaminants discharged into the reservoir without treatment.

Atmospheric (rain) wastewater contains mainly mineral impurities. Distinctive features of the rainfall is its episodic nature and sharp inequality: in dry weather it is missing, and in times of showers of used costs of atmospheric water in 50-150 times higher than the costs of household water from the same area of the city or locality.

Under the Sewerage (wastewater) means a set of equipment, networks and structures designed to organize the reception and removal of pipelines for the settlements or industrial plants polluted wastewater, their cleaning and disposal prior to disposal or discharge into the reservoir.

There are two types of sewers: export and floatable. At the organization of export of liquid sewage contamination is collected in special receivers and periodically are taken by road to the field of sanitation for treatment or in a special place, agreed with sanitary authorities. Export the sewers satisfied only in small settlements, where the use of other types of sewage difficult.

Floatable sewage consists of the following main elements: domestic sewage devices of various intra-and street sewage networks, pumping stations and pressure pipelines, sewage treatment plants and devices for the release of treated wastewater into water bodies.

The outside street sewer network is a system of underground pipelines taking the waste water from the internal network and transporting them to the pumping stations, treatment plants and into the pond.

Sewerage network build mostly on gravity. All canalized the territory of the city or locality are divided into pools of sewage, respectively where the terrain lay gravity pipelines, street network and collectors. The sewage network must always be available for inspection, flushing and cleaning of debris, so it satisfied manholes. For receiving atmospheric waste waters include storm-water inlets, which is a circular or rectangular wells with a metal grate on top.

The use of wastewater for irrigation, warm water for agriculture and fish farming.

Currently, the total irrigated area with wastewater in Kazakhstan amount to 8-10 thousand hectares (30-35 ha). Some slow development of agricultural field irrigation (ZEP) is due to insufficient study of many technical, economic and environmental aspects of the problem, lack of experience in operating systems security software in various areas, the need to create winter storage, lack of coordinated interdepartmental SNaP, a small number of specialists familiar with the design, construction and operation of the systems.

The types of wastewater used for irrigation.

For irrigation of crops on ZEP can be used for household, industrial and mixed waste water, i.e. there are almost all kinds of liquid effluents. When deciding on the possible use of wastewater, especially industrial, should be considered: the composition of waste, climate data, topography, and hydrogeological conditions; soils and vegetation, hydrogeological and chemical characteristics of the receiving water; agricultural use of ZPO, the irrigation regime and a number of other factors. Household and municipal mixed water small towns and villages are considered to be suitable in composition for irrigation in different natural conditions.

It is believed that mixed waste water of major cities that have passed biological treatment suitable for submission for ZEP, because of the requirements of the MPC for water discharged to the receiving waters, is much higher than in irrigation water.

As recommended rules for water protection and the technical conditions for the design of sewer, private businesses or shops, where the formation of waste water, pollution threat to receiving waters or soil, must have local treatment facilities, and highly toxic wastes need to destroy or bury. Useful for fertilizing irrigation is recognized as industrial waste: canning, sugar, starch syrup, alcohol, brewing, yeast, dairy products.

The wastewater of sugar factories contain a lot of organic matter and fertilizer efficiency can be attributed to the middle category. They contain: nitrogen (N) - 40-50 mg/l; potassium (K) - 60-70 mg/l; phosphorus (R) - 3-6 mg/l.

The effluent of starch plants, characterized by high concentration of suspended and dissolved substances, and acid reaction: nitrogen (N), 85-105 mg/l; potassium (K) - 100-280 mg/l; phosphorus (P) - 10-50 mg/l. High concentration of these effluents requires a 2-3 - fold dilution, or the liming of soils.

The effluents of dairy plants is quite suitable for irrigation and do not require much of their training: nitrogen (N) - 35мг/l; potassium (K) - 25mg/l; phosphorus (P), 17 mg/l; calcium (Ca) – 150 mg/l.

The drains of meat plants have large fluctuations in concentration (N, P, К an average of 290:100:140), so they must be diluted previously to defend and subjected to biological treatment. To use these drains for ZEP recommended for growing herbs for the production of vitamin grass meal.

The effluents of distillery and yeast factories (N, P, К average 200:300:480) difficult biological treatment on structures and can be used for irrigation after 1.5-2 times dilution, subject to periodic liming soil in areas with sufficient and excessive moisture.

At least rich in fertilizing nutrients (N, P, K - 30:10:100) drains brewing, malt and canning (fruit and vegetable) plants.

The effluent of textile companies in their chemical composition suitable for irrigation. Since the content of phosphorus and nitrogen slightly, to use them effectively on ZEP for dilution of animal waste (liquid manure).

The treatment of wastewater for irrigation.

Before serving for irrigation, as well as before discharge into the receiving waters, all household and mixed urban runoff, according to the regulations must undergo a full preparation, and processing of sewage sludge.

Depending on the wastewater characteristics, physical -mechanical properties and chemical composition of the cleaning system may be missing individual items (e.g., fat catcher), but to include any additional structures or installations for the disposal of specific wastewater components, neutralization, dilution, elimination or cooling water.

On small objects the township sewer in areas with average annual temperature of above 0^{0}C is used biofilters, biological ponds (BP). For the more Northern areas of BP are used seasonally when the water temperature is above $+4^{0}$C. Distinguish the flow (speed) and contact BP, called BOXING (oxidation biological contact stabilization). Due to the successful interaction of the various hydrobiological factors provide a more efficient wastewater treatment. After the end of the cycle in a BOX ponds wastewater sanitary safe and epidemiologically harmless. The depth of sewage ponds 1-1. 5 m, the ratio of length and width in terms of 2:1 and 3:1. Design loads for BOD5 up to 250 - 300 kg/ha per day. They depend on climatic conditions and number of stages, typically taking 2 to 4.

Filling depth contact ponds of 0.5 - 0.8 m, the time of stay of wastewater 8 - 10 days., the load of BOD from 60 to 120 kg/ha. These ponds arrange sections, each of which is designed to accommodate one or two-day runoff.

The organization recycled water use for ZEP, of course, reduces sanitation requirements for pre-treatment of waste waters from pollutants of biogenic origin, but increases the demands on the chemical composition of runoff so that soil does not cause a accumulation of harmful components to toxic concentrations.

Schemes of agricultural fields of irrigation.

The choice of space for the device ZPO and layouts of their elements is determined by the following factors: weather conditions; economic use of the territory, modern state and prospects of development of agriculture, its performance, availability of labor and experience in irrigation, transport links and sources of energy conservation; characterization of waste waters; data on the integrated use of water resources in the basin of the inlet, the composition of water users and their development prospects, the volumes of water consumption and wastewater forecasts water quality, the presence of recreational water protection zones, number of water users in industry, agriculture, forestry and fisheries.

As a rule, to embed ZEP recommend using the square with a slope of 0.0005 and 0.01 (0.03) characterized by low fertility and high filtration properties of soils.

Existing ZPO are of three types:

1) capable of receiving and irrigation of wastewater during the whole year;

2) capable of receiving wastewater in the regulating reservoirs and the use of only during the growing season;

3) providing reception and irrigation only during the growing season.

The integrated value of ZEP is to increase soil fertility and crop yields, and combined with tertiary treatment of sewage. All this provides protection of natural waters against pollution.

The main task of designing the General scheme of ZPO is that in each case, when a certain combination of the previously discussed factors to select the most optimal variant of layout scheme that meets the requirements of rational use and protection of natural resources.

At a certain mode of irrigation wastewater, in addition to the water balance of soils and fertilizing ability of drains (N, P, K), they are usually checked by the MPC toxic and harmful substances emitted with wastewater in the soil. This is particularly true for slightly diluted sinks.

It should be noted that the calculations of the water balance should take into account not only the zone of aeration and the zone of groundwater. Irrigation norm during vegetation period are assigned as for a normal irrigation. They depend on the water holding capacity of soils, irrigation techniques, growing season, and range from 200 to 1000 m^3/ha. Irrigation norms for individual crops on ZEP is often prescribed for 20-50% higher than conventional irrigation.

The use of warm water for agriculture.

The intensive development of thermal and nuclear power is due to the expenditure of large amounts of water, much of which is discharged back into rivers, lakes and reservoirs, causing thermal pollution and disruption of water ecosystems. Therefore, maximum utilization of treated heat - current problem.

The water necessary for the operation of thermal and nuclear power plants, is mainly consumed for steam generation in boilers and condensation of exhaust steam. In addition, they spent on cooling of the steam, oil, gas, air, bearings, and solid fuel - hydraulic removing ash and sludge. As a rule, all waste water energy sites suitable for irrigation. When you collect them in bodies of water, the temperature of the upper water 8 - 15^{0}C above the temperature of the bottom layers. This difference depends on the parameters of the reservoir, climatic conditions, time of year, the volume and temperature of the incoming wastewater. Therefore, more appropriate water for irrigation take from the upper layers of water bodies and reservoirs.

Depending on the location of stations and parameters of the installed it equipment, the temperature of the waste water varies within the following limits: in the winter of 10-20^{0}C; in the spring of 20-25^{0}C; in the summer of 35-40^{0}C. The positive effect of warm water on germination of crops is most noticeable in spring and autumn, due to shortage of heat at this time of year. When watering with warm water not recommended to avoid significant temperature differences between the air, water and soil. It is a depressing effect on many plants.

The use of warm water for fish farming.

As shown by the experience of recent years, waste water, thermal and nuclear power plants can be used successfully for the needs of fisheries in inland waters. The most promising directions in the development of fish farming with the use of warm water must be considered: the creation of full-cycle fish farms of industrial type with swimming pools, mesh nets, workshops for the incubation of eggs and plants, ensuring the production of live food. These farms are continuously the technology of producing planting material and cultivation of fish throughout the year; the use of reservoirs - coolers as grow-out ponds for heat-loving fish (carp etc.); organization of nurseries for growing planting material for commercial farms; creation of high-production fish farms

3.1 Conditions of draining sewage into reservoirs

The conditions of descent of sewage into water bodies is determined by the "Rules of surface water protection from pollution by sewage" and "Rules of sanitary protection of coastal areas of the seas." In accordance with these rules distinguish water bodies of drinking and cultural-domestic water use and the water bodies used for fishery purposes.

Water reservoirs of drinking and cultural-domestic water use. Standards of water quality for used parts of these reservoirs two ways of water uses: the first is for the centralized and decentralized drinking water and water of food industry enterprises, one for bathing, sports and recreation. The second type of water use are also areas of the water bodies located within the boundaries of settlements.

Established the following standard indicators of water quality of the reservoir.

Dissolved oxygen. The amount dissolved in the water of the reservoir of oxygen after mixing it with sewage water in any period of the year in the sample, selected at 12 PM, shall not be less than 4 mg/L.

Biochemical oxygen demand. Value 20 for reservoirs of the first type of water use should not exceed 3 mg/l and for waters of the second type of water — 6 mg/L.

Suspended materials. The concentration of suspended solids in the water of the reservoir after the descent into it of sewage should not increase by more than 0,25 mg/l for reservoirs of the first type of water use, 0.75 mg/l for reservoirs of the second type of water use.

Active reaction of water. Active reaction of water (pH) after mixing it with sewage water should not be below 6.5 and above 8.5 is not.

Water reservoirs also set standard values for color, presence of toxic substances, floating impurities, pathogens, odors and flavors, mineral composition and temperature. Poisonous substances should not be contained at concentrations, which may have directly or indirectly harmful effects on the health of the population.

Fishery ponds. There are two types of use of such water reservoirs: one for the reproduction and conservation of valuable species of fish, the other for all other management purposes.

The water quality of fishery water bodies shall conform to the standards established for water bodies of drinking and cultural-domestic water use. At the same time, some indicators for water of fishery water bodies demand more. In winter, the amount of oxygen dissolved in the water of fishery water bodies of the first type of usage, should not be less than 6 mg/l, and dissolved in water bodies of the second type of use — 4 mg/l Biochemical oxygen demand BOD should not exceed 3 mg/L.

The content in water of any waters of radioactive substances in the release of contaminated wastewater must not exceed maximum allowable concentrations established by the Chief state sanitary Inspectorate.

The required degree of wastewater treatment is determined by if the amount contained therein suspended solids, consumption of RA-target oxygen with a mixture of sewage and waters of the reservoir, the permissible value of PBCD mixture of water reservoir and waste water, change the active reaction of water and other indicators taking into account self-purification ability of a water body.

Under the self-purification ability of water bodies to understand the decrease of contaminant concentration due to biochemical, chemical and physical processes occurring in the reservoir.

3.2 Methods of wastewater treatment

For wastewater treatment use of mechanical, physical-chemical and biological treatment. The cleaned waste liquid before descending into a body of water subjected to disinfection to destroy pathogenic bacteria.

In the wastewater treatment process of precipitation are formed that are subjected to neutralization, disinfection, dehydration, drying, possible subsequent disposal of sludge.

If the conditions of wastewater discharge into the reservoir, requires a higher degree of purification, after the constructions of full biological treatment of wastewater are satisfied with the construction of a deep cleaning. In accordance with the "Rules of surface water protection from pollution by sewage" waste water after cleaning before discharge into the reservoir is subjected to disinfection to destroy pathogens.

As a result of mechanical purification of sewage liquid is removed partially undissolved and colloidal fouling. Major contamination (rags, paper, remains of fruit and vegetables) are delayed grates and sieves. Contamination of mineral origin (sand, slag etc.) are trapped by the sand traps. The bulk of the insoluble organic impurities is retained in sedimentation tanks. While particles with a specific gravity greater than the specific weight of the sewage fall to the bottom, and particles with a lower specific gravity (specific contaminants: grease, oil, oil) emerge, depending on their nature used fat catcher, oil separator, oil and melolabial etc. With the help of these facilities provide for the treatment of industrial wastewater. Advocacy based on patterns of deposition of solid particles in the liquid. This may be: free deposition particles are prone to coagulation in the deposition process and changing its shape and size. Free deposition is observed at a particle concentration of 1% or 8 kg/m .

For the treatment of industrial wastewater is also used flotation by introducing contaminated liquid air and foaming agents (surfactants, alumina, animal glue, etc.). Emerging vials of air and particles of blowing agents absorb pollution and raise them to the surface of the liquid in the form of foam, which is removed continuously.

The mechanical treatment include septic tanks, two settling tanks and clarifiers septic sediment trap in which the liquid is clarified and processed precipitate.

Removal from industrial wastewater suspended solids with large specific gravity is used *hydrocyclones.*

When mechanical cleaning is not delayed more than 60% of precipitating suspended matter (typically 30 - 50%).

A higher effect is achieved by the application of various methods of intensification. Simple aeration improves the functioning of primary sedimentation tanks 5 - 8% (for detention of suspended solids and reduction of BOD). The effect of reducing pollution of suspended substances by biocomplete increases by about 30%, and BOD by 35%. The effectiveness of detention of suspended solids in the primary clarifiers pre-aerators increased to 65 - 70%. BPK 20 the clarified water is reduced by about 15%. The biocoagulator can successfully work not only in activated sludge aeration tanks, but also on the biofilm after the biofilters. In this biocoagulator with a regenerator is delayed 60 - 70% of suspended solids, and БПК20 reduced by 50 - 55%. Mechanical cleaning as an independent method is used in cases when freed from impurities the water reused in manufacturing or in local and sanitary conditions it can be reset in the reservoir.

Physical-chemical methods are used primarily for treatment of industrial wastewater and municipal wastewater treatment, taking into account technical and economic indicators, used very rarely.

Methods physical-chemical treatment of industrial wastewater include: chemical treatment, sorption, extraction, evaporate, degassing, ion exchange, ozonation, electroflotation, chlorination, electro dialysis etc.

Industrial waste water from technological processes very often contain alkali and acid. Most sour water containing soluble salts of heavy non-ferrous metals which must be extracted from wastewater.

To prevent the corrosion of materials of sewage treatment plants, disturbance of biochemical processes in water bodies, and deposition of wastewater salts of heavy metals, acidic and alkaline effluent is subjected to chemical cleaning.

Chemical cleaning can be used as an independent method before serving the production waste water in water recycling system and before lowering them into the water. Sometimes there is a problem of removal from wastewater nutrients — nitrogen and phosphorus, which get into the reservoir, contribute to the increased development of aquatic vegetation. Nitrogen is removed by physicochemical and biological methods, phosphorus is normally removed by chemical precipitation with salts of iron, aluminium or lime.

The use of chemical cleaning in some cases it is advisable to biological or physico-chemical treatment. The main methods of physicochemical treatment of industrial wastewater are the neutralization and oxidation.

Acidic and alkaline waste water before it is discharged into the industrial sewage system or water bodies must be neutralized to achieve a pH equal to 6.5 and 8.5. In the neutralization of wastewater allowed the mixing of acidic and alkaline waste to mutual neutralization.

Neutralization – a chemical reaction between the acid and base. Considered neutral waste water with pH=6,5-8,5. Neutralize exposed to wastewater with a pH< 6.5 and pH > 8,5.

More serious is the risk of acidic runoff, which is formed much more than alkaline. When chemical cleaning is used the following techniques of neutralization:

- mutual neutralization of acidic and alkaline waste water;
- neutralization reagents;
- filtration by neutralizing the materials.

The choice of the method of neutralization depends on many factors: type and concentration of acids, pollutants promstump, flow, and mode of receipt of waste water for neutralization, the presence of reagents, the local settings in which cleaning, etc.

Modes of discharge of wastewater containing acid and alkali, usually different. Sour water is usually discharged throughout the day evenly and have a constant concentration, alkaline water is discharged periodically as they accumulate. In this regard, alkaline waters often hold the regulating reservoir, the volume of which is determined by the daily intake of alkaline water. From the reservoir is alkaline water evenly produced in the reaction chamber, where there is a mutual neutralization.

Biological treatment is based on the oxidation of organic substances by microorganisms. Microorganisms have a number of special properties from which to select for cleaning purposes: the ability to consume as food sources a variety of organic (and some inorganic) compounds for energy and to ensure its existence. Distinguish biological treatment of sewage in artificially created conditions (biological filters and aeration tanks) and in conditions close to natural (field of filtration and biological ponds).

To reduce the concentration of organic pollutants in biologically treated wastewater can be applied to the sorption on activated carbon or chemical oxidation by ozone.

Deep wastewater treatment may be required if the waste water after completing biological treatment before discharging into the pond is necessary to reduce the concentration of suspended solids, value of indicators BOD, COD etc.

For disinfection of treated wastewater is most often used chlorination.

Currently, the requirements for the degree of sewage treatment on the rise, therefore they are subjected to post-treatment. To do this, use sand filters, contact clarifiers, microfilters, biological ponds.

With the deep cleaning of waste waters, mainly from suspended solids filters are of different designs. For deep purification from dissolved organic substances are used sorption, biosorption, ozone and other settings. Deep cleaning from nitrogen and phosphorus can be carried out physical - chemical and biological methods.

Sewage disinfection is the final stage of their processing prior to discharge into the pond. The purpose of disinfection - destruction of pathogenic microorganisms contained in the waste water. The most widely used method of disinfecting by introducing the water gas chlorine. Possible effluent disinfection with ozone using ultraviolet germicidal lamp.

The wastewater treatment technologies currently being developed in the direction of intensification of biological purification processes of conducting successively the processes of biological and physical-chemical treatment with the purpose of reuse is deeply treated wastewater in industrial enterprises.

Accumulated in wastewater treatment plants of large masses of sediment are treated not only in septic tanks, bunk sumps and clarifiers - septic sediment trap, but in the digesters. Septic tanks, double-tiered sumps and clarifiers septic sediment trap is intended for clarification of sewage and digestion of sludge. The digesters are only for the sludge digestion.

Treatment of precipitation waste water generated in the processes is cleaned, is to reduce their moisture content and volume reduction, the treatment process precipitation is disinfected.

Contamination held by the gratings, is transported from treatment plants, or crushed and processed together with the rainfall from ponds. The sand from the sand traps is dewatered on sand sites, and is removed or washed from impurities, dried and used in planning work.

The sludge from the primary clarifiers and compacted sludge from the secondary clarifiers (activated sludge, which has high humidity, ill give the water and threat to health) are sent to the digester – an airtight tank in which under the action of anaerobic microorganisms mineralized organic matter. Instead of anaerobic digesters used method of stabilization, the essence of which consists in purging the sludge for a long time the air in the buildings, arranged by type of aeration. Fermented in the digester residue well give the water less dangerous in respect to sanitary and contains significant quantities of nitrogen, phosphorus and potassium, i.e., it is a good fertilizer.

For dewatering it is used sludge drying beds, vacuum filters, centrifuges, filter presses. Often the sediment is dewatered on a vacuum filter, is subjected to thermal drying.

Some types of precipitation industrial wastewater containing harmful pollution, after a preliminary drying burn. The combustion is fully oxidized organic matter precipitation and formed a sterile residue of ash. Physical-chemical methods are used primarily for treatment of industrial wastewater and municipal wastewater treatment, taking into account technical and economic indicators, used very rarely.

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3.3 Facilities for mechanical wastewater treatment

Grates are designed to capture large contaminants. Place them in the receiving tanks of pumping stations pumping sewage treatment stations or on the channel, the inlet waste water to treatment facilities. It is better to install the lattice and in the receiving tank and channel.

Lattice are mobile and stationary. The latter are more common. There are also lattices with manual and mechanized cleaning of the waste. Mechanized cleaning of grids required when the amount of waste more than 0.2 m^3/day. If you waste more than 1 t/day in addition to working of crusher is installed backup. Crushed scum is discharged into the waste liquid in front of bars or pumped to the digesters.

In our country is used a fixed grid with a powered bathroom cleaning the following types:

the grates that are set at an angle 60^0 to the horizontal, and clears the moving rake over the flow of water;

lattice, which are also set at an angle of 60° to the horizon and cleared moving the rake from below with the flow of water;

the vertical grille, which is cleaned by the moving rake the bottom for water.

The width of the gap grids in sewage treatment plants taken to be equal to 16 mm. Cross-section of the rods of the grids may be rectangular (most common), oval or round. The number gaps in the grille and main door so that the speed of movement of sewage in influx at the maximum inflow was 0.8-1 m/s.

The number of removed waste from the grids is 8 liters/year per person. Moisture content of waste is 80%.

In the treatment plants allowed to install grilles in a separate building, where there are supply and exhaust ventilation.

Currently, in domestic practice are spreading bars-crusher, and delay the dregs, and crushed them under water. Advantage of grinder screens is that they do not need to arrange special rooms.

Sand traps are designed to catch impurities of the mine-General origin, mainly sand with particle size more than 0.2-0.25 mm. due To the retention of sand in the sand traps facilitates the operation of subsequent installations. Light particles of organic origin must be made out of sand traps. The principle of operation of grit chambers is based on the fact that the particles, which share more of the specific weight of water as it moves along with the water fall to the bottom of the catcher under gravity.

Horizontal sand traps represent elongated in plan structure with a rectangular cross section. Essential elements of the catcher are: input and output channels; a hopper for collecting sludge located in the beginning of the sand trap. In addition, the grit chamber includes a mechanism for moving sediment into the hopper and elevator for sand removal. Mechanisms are of two types: chain and wagon. Chain mechanisms are composed of two endless chains, arranged on the edges of sand traps, attached to them scrapers. The mechanisms of the trolley type consists of a trolley, movable over a sandtrap on rails forward and backward, which is suspended scraper. The velocity of the water at the maximum flow rate is taken equal to 0.3 m/s, while minimum consumption is not less than 0.15 m/s.

The grit chambers are horizontal and rotational motion of water (tangential and aerated).

Horizontal grit chamber consists of flow and sediment parts.

Length of flow area, m:

$$L = \upsilon \cdot t\,, \tag{3.1}$$

where — flow velocity of the fluid at the maximum flow rate;

t — the residence time of liquid in the grit chamber taken at least 30 p.

The area of the living section of the catcher, m^2:

$$w = q / \upsilon\,, \tag{3.2}$$

where q is the maximum wastewater flow rate, m^3/s.

When the working depth h and width b of each compartment, determine the necessary number of offices p. working depth h is assigned multiple greater than the depth of flow in the inlet channel by not more than 1 m. the Width b is normally 0.5-2 m.

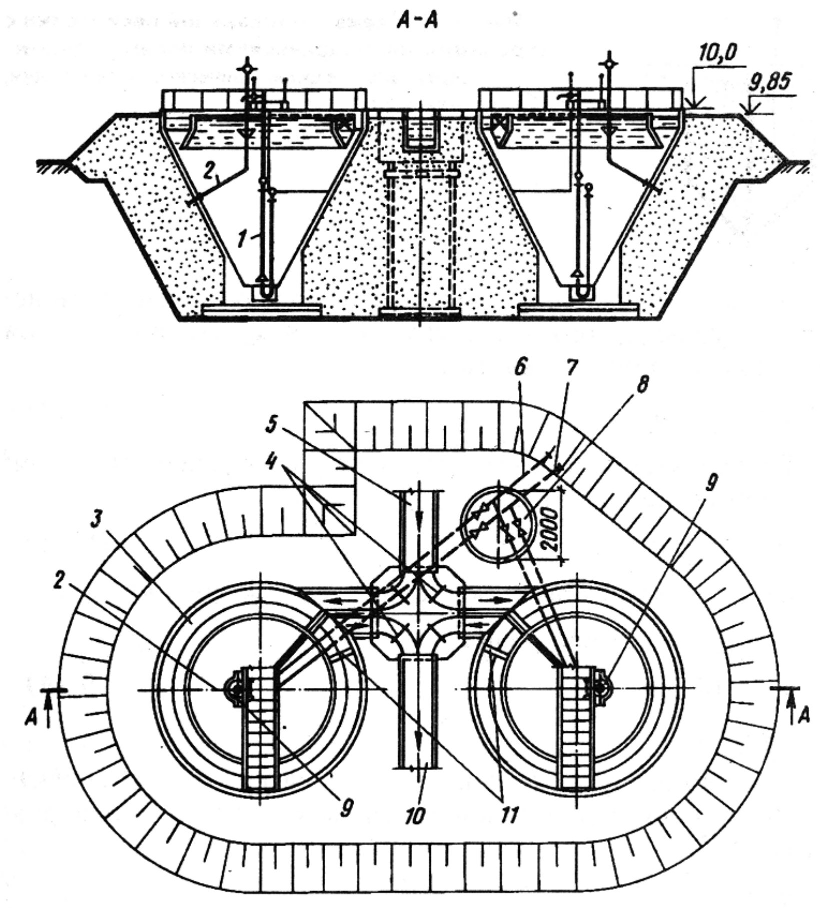
The volume of the sedimentary part of the horizontal sand-catcher is defined m terms of savings in her two-day the amount of lost sand.

Horizontal sand traps are used at a cost of effluent more than 10,000 m^3/day, and horizontal sand traps with circular motion of up to 70 000 m^3/day.

In Czechoslovakia and the NDP for the removal of sand from sand traps used centrifugal gravel pumps and a hydraulic Elevator mounted on the trolley, moving on rails along the sand traps. The sand pulp is taken from the bottom of the sand trap pump and fed into a hydrocyclone, where the sand is separated and sent to the sand bunker. There is carried out simultaneously with the washing of organic substances.

Horizontal sand catchers with circular water movement is shown in figure 3.1.

The annular tray, which is the waste liquid, works like a normal horizontal grit chamber. Drop down the sand accumulates in the conical part of the sand trap where it is removed by the Elevator located in the center of the sand trap.



1 - Elevator; 2 - pipe to drain pop-up impurities; 3 – chute; 4 - valves; 5 - the supply tray; 6 - slurry pipeline; 7 - pipe for the working fluid; 8 - switch; 9 - device for collecting pop-up impurities; 10 - collecting tray; 11 - semi-submersible shields.

Figure 3.1 - Horizontal grit chamber with a circular movement of water

Tangential grit chambers have a circular shape in plan; a water inlet are located on a tangent (tangentially). Water supply tangentially and movement in the construction of a circle produces a rotational flow. With simultaneous translational and rotational motion creates a helical movement. The rotational motion has a positive effect on the work of the sand traps because it promotes washing sand from organic substances, avoiding precipitation. Because of this, the sediment in the tangential grit chambers contains less organic contaminants than in the horizontal.

Aerated sand traps differ from the horizontal and tangential that they dropped in the sand, almost does not contain organic impurities.

The aerated sand trap project in the form of tanks, divided into sections. Along one of the walls of each section at a distance of 20 - 80 cm from the bottom along the entire length of the sand trap install aerators.

Duration of stay of waste water in grit chambers at a maximum inflow of about 30 seconds.

The experience of the operation, at a speed of water of 0.6-0.8 m/s the removal efficiency of the sand is 90%, the humidity 20% and the ash content of 94%.

In the tangential grit chambers shall be equal to the depth of half its diameter. The estimated particle diameter of trapped sand 0.2-0.5 mm, the density of the sand 1,5 t/m^3. Caught the sand is sent to sand or sand bunker. Emptying of the bunker sand shall be not less than 1 times a day.

Gravel pad and bunker. Sand, a sand trap, is usually removed from the hydraulic Elevator and the sand pulp is served on a specially arranged platform sand — land, divided into card enclosing bolsters height of 1-2 m. Filtered collect water drainage system and directed into the tank, where it is pumped into the channel before the sand trap.

The sand is dewatered on sand sites contains many organic substances that can rot and therefore its continued use for any purpose, such as for planning, it is difficult for sanitary reasons.

In order to remove sand from organic impurities and dehydration used sand hopper, hydrocyclones, hydraulic and mechanical sand washer. After this treatment, the sand can be used for filling and grading of the area or as a builder material.

The clarifiers.

Sedimentation basins are used for detention undissolved organic contaminants in waste water. These contaminants fall to the bottom of lagoons or float to the surface of the liquid in them due to the low speed of its flow.

Depending on the flow direction of distinguish horizontal, vertical and radial clarifiers. A variety of clarifiers are settling tanks-septic sediment trap, which is clarification of sewage and at the same time the decayt precipitated sludge. These include bunk sumps and clarifiers septic sediment trap.

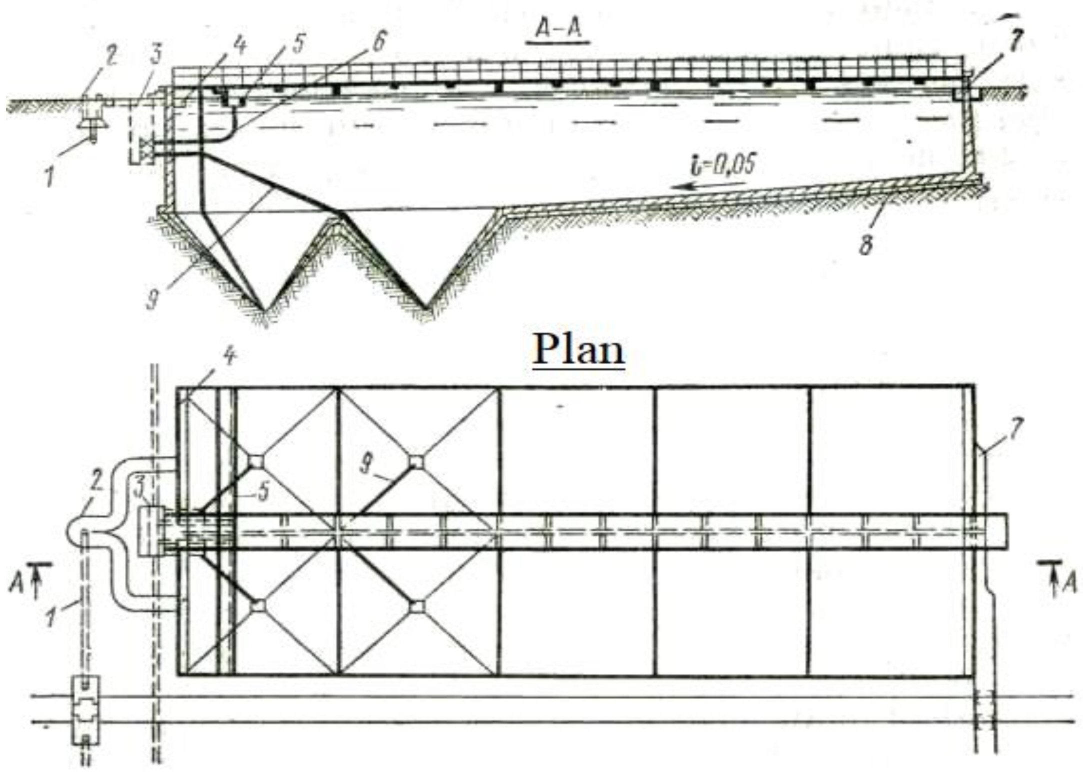
Sumps used as the construction of wastewater pre-treatment before biological treatment facilities. In this case they are called primary. If sanitation is sufficient only mechanical treatment of wastewater, clarified in the sump water after disinfection dumped into the pond.

During the treatment of domestic wastewater shall not be less than two lame nicknames, each of them are workers.

Key inputs in the calculation and design of settling tanks serve the duration of settling and the maximum rate of flow of the sewage. These values for ponds of different types and applications are given in SNaP RK 4.01-02-2001 G.

Horizontal flow sedimentation tank (figure 3.2) is a rectangular tank divided into several compartments. Wastewater flows into the sump with the mechanical side, with low speed passes through it, and then gets bleached in the outlet channel.

Horizontal settling tanks are usually used for treatment Stan-conferences capacity of more than 15 000 m 3/day. However, in the presence of weak soils with high groundwater level can be applied at a lower productivity of the station.



1 — siphon; 2 —chamber distribution; 3 — silt the well; 4 — feed tray: 5 — the fat tray; 6 — fatty pipe; 7 — collecting tray; 8 — bottom; 9 — sludge pipe.

Figure 3.2 - Horizontal sump

Calculation of horizontal sedimentation tanks is to determine the dimensions of the flow (slop) and sedimentary units.

The estimated depth of the settling zone N take in the range of 1.5-4 m depending on the performance of the treatment plant and the necessary efficiency of deposition of suspended substances (the smaller N, the higher the efficiency of deposition of suspended substances).

The efficiency of deposition of suspended substances in the obtained rates of deposition of suspended matter is determined according to SNiP RK 4.01-02-2001.

The number of outliers in the primary clarifiers sludge is 0.8 l/day per capita. Humidity paged sludge is 95% under gravity removal, and 93% removing piston pumps.

At the beginning of the sump is arranged a sump for collecting sediment with an angle of inclination of the walls of 45°. For raking sludge scrapers should be used. From the sump, the precipitate is removed under the action of hydrostatic water pressure equal to 1.5 m, is pumped or plunger pumps.

The amount of sedimentation part of the sedimentation tanks is taken to equal the volume of sediment that falls for a period not exceeding 2 days at remove sludge under hydrostatic pressure or over 8 hours if power to remove it.

Between flow and sedimentary parts have to be created neutral layer height of 0.3 m, measured from the bottom of the sump out of it. The neutral layer is required for protection of fallen sediment from washing out by water flow.

The vertical settling tank is a circular, square or rectangular tank with a conical or pyramidal bottom. Vertical sedimentation tanks are usually used for treatment of Stan-range capacity of up to 20 000 m3/day, located on dense soils with a low groundwater level. The diameter of the vertical sucks-nicknames to accept from 4 to 9 m, the height of the settling portion is between 2.7 to 3.8 m. the Length of the Central tube should be equal to the estimated height of the settling part. The slope of the walls of the sedimentary part shall be not less than 50°.

The amount of sedimentation of counting on a two-day storage volume of the sediment. The precipitate was removed periodically at least 1-2 times per day gravity through the sludge pipe with a diameter of 200 mm under a hydrostatic pressure equal to 1.5 m.

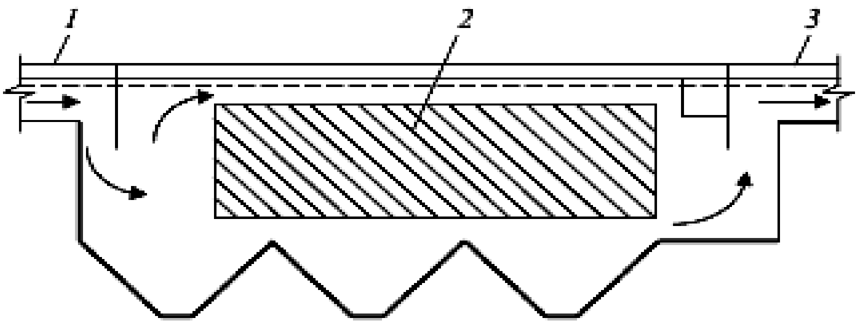
Radial settling tank is a round tank of the shallow depth where the flow is moving from the center to the periphery. Waste water flows into the sump via the Central tube, and the clarified discharged through the annular tray. The residue rake to the center of the clarifier scrapers are suspended to the farm. In the middle of the tank is arranged a sump for collecting sediment. Sediment removal is carried out using pumps. Radial sedimentation tanks are used for wastewater treatment plants with the capacity of 20 000 m^3/day. The length of settling depends on the method of biological treatment and is accepted the same as for the horizontal settling tanks.

In recent years, design and build a radial settling tanks with peripheral flow of wastewater. A water distribution trough located at the periphery of the tank has a constant width and variable depth. Since the bottom of the gutter inlet placed at different distances from each other, provided a constant translational speed of motion of water in the gutter and so the residue in the gutter does not fall. The flow is then directed to the lower area of the sump, and then in the Central zone and up to the annular drainage trough. This flow creates favorable conditions for deposition of suspended substances. The sludge is removed outside of the tank of the sludge pipe.

Currently increasingly common to find readymade or thin-layer sedimentation tanks. They have water, sludge, and sediment catchment area (figure 3.3).

The settling zone divided by the height of the shelves with a distance between them of up to 15 cm Sediment slides into the sludge pit from where it is periodically removed. Pop-up the substances are collected in the sinus between the sections and removed the tray. The number of known structures of thin-layer sediment tanks.

Biloculare is a method of intensification of the process of sedimentation, which consists of adding to the sewage water active sludge (biofilm) and aeration of the mixture. The effectiveness of bleaching increases to 60-80% and reduce BOD by 40-50%. Biloculare is carried out in such structures as preparatory and bilocular.



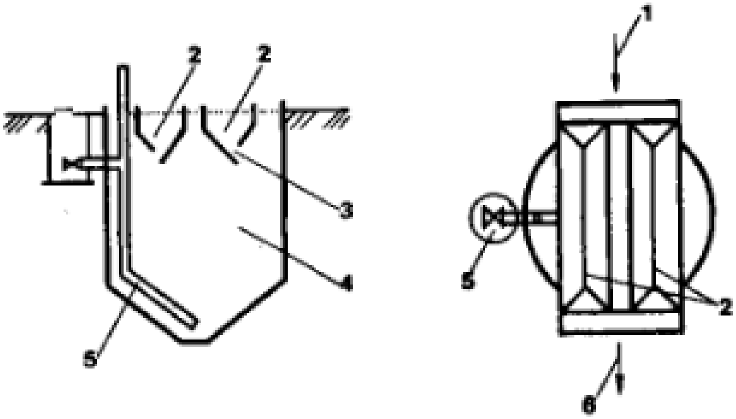
1 – feed water; 2 – thin; 3 – removal of clear water.

Figure 3.3 - Horizontal sump with thin-layer blocks

Preparatory performed in a separate, embedded or attached to the primary clarifiers structures. Pre-aeration increases the effect of bleaching by 10-15%.

Biofactory are based on horizontal, vertical and radial clarifiers. For this purpose they are equipped with aerators, so that the settling zone is formed a weighted layer to lighten filtered through it sewer water.

Two-level sedimentation tanks are cylindrical or rectangular in shape with a conical or pyramidal bottom (figure 3.4).



1 – submission of waste water; 2 – sedimentary troughs; 3 – longitudinal cracks; 4 – septic; 5 – silt pipe; 6 – output of clear water.

Figure 3.4 - Two - level sump

In septic tanks the wastewater enters after the grids and sand trap, the clarifying zone in a two-stage ponds located in the troughs located in the upper part of the building and represents the horizontal settling tanks. Precipitated suspended solids through the longitudinal slit fall into the septic part of the sump, where there is a consolidation and digestion of sludge. The bottom of the grooves overlap each other at 0.15 m, which prevents contamination of clear water by the products of decay, released during the fermentation of sludge. The depth of trench of 1.2-1.5 m. The calculation of the bunk sump is in determining the size of sedimentary troughs and the sludge chamber.

Sedimentary trough is calculated as a horizontal flow sedimentation tank. The duration of stay of water in the trough is taken 1.5 hours.

The total volume of the grooves is determined by the formula:

$$W_{жс} = q \cdot t\,, \tag{3.3}$$

where q - design flow, m3/h;

t - duration of stay of water in the gutter, sec.

The effectiveness of detention of suspended solids in chutes is 40-50%. The velocity of the water in them, prescribe, 4-7 mm/h.

The length of the grooves L,m, shall be determined in accordance with the selected diameter.

Usually bunk sumps satisfied with two troughs. A single gutter is used for small diameter sumps (up to 5 - 6 m).

The capacity of the sludge chamber two ponds per one person take depending on the average temperature of wastewater in winter (table 3.1).

Table 3.1 - Capacity of the sludge chamber bunk clarifiers

Middle winter temperature of wastewater	6	7	8,5	10	12	15	20
The volume of the sludge chamber Wpic l, for one person	110	95	80	65	50	30	15
The duration of fermentation, days.	210	180	150	120	90	60	30

In the subsequent water supply to the fields of filtration, the capacity of the sludge chamber two settling ponds can be reduced, but not more than 20%.

The total volume of the sludge chamber:

$$W_{общ} = W_{ил} \cdot N_{пр}\,, \tag{3.4}$$

where N_{np} is the number of residents.

In the presence of industrial sewage of similar composition, the additional volume of the sludge chamber can be determined by the equivalent number of inhabitants and the ratio:

$$N_{э} = M_{сух} / 65 , \qquad (3.5)$$

where S_{uch} - the daily amount of dry matter in the sludge production of waste water,g;

65 - the amount of sediment, grams dry matter per person per day.

The lower part of the sludge for better sliding of the silt doing in the form of a cone with an angle forming equal to 30°.

The Central layer between the sludge chamber and the slit of the trough taken as equal to 0.5 m, the elevation of the side of the bunk sump above the water surface 0.5 m .

The most common monolithic and precast concrete double-deck sedimentation tanks, which are built on standard projects (table 3.2).

Table 3.2 - Main dimensions of the model two-level sedimentation tanks of reinforced and precast concrete

The main parameters for the design of structures	Constructive way of making building й						
	Monolithic				Precast		
Diameter, m	6	6	9	9	9	12	12
Overall height, m	7,6	8,8	8,5	9,7	8,5	8,2	9,4
Throughput power, m3/hour during the period of settling 1.5 hours	13,7	13,7	37,5	37,5	31	67	67

The disadvantages include a large volume of sludge part, which increases the cost of construction, and a large sump depth makes it unprofitable to their use at high groundwater level.

The sludge from the two settling tanks is removed via the sludge pipe with a diameter not less than 150 mm under a hydrostatic pressure not less than 1.6 m.

If the average air temperature of up to $3{,}5^{0}$C settling tanks of capacity up to 500 m3/day. In a heated room, and with a 3.5 – 6^{0}C in not heated.

The cleaning effect on BoD. on bunk ponds reaches 25% and 60% of suspended solids of 45 - 70%.

Avarager

The averager is a facility designed to equalize the amount of wastewater and concentration of pollutants, to clean it. Distinguish avarage costs and average concentration of the incoming wastewater. As a rule, is made by averaging of substances in waste water in colloidal or dissolved form.

The use of the averaging method allows to optimize the performance of all wastewater treatment facilities to reduce the number of reagents at physical-chemical treatment methods, reduce energy costs, i.e. to improve the economic effect and also to achieve optimum operation of the biological treatment facilities.

At low flows, and periodic discharge of water used contact average. However, as a rule, apply averager flow type, which are performed in multichannel tanks or tanks with stirring devices.

The following types of flow balancing reservoirs:

- multi-line – rectangular (design Wanakena D. M.) and round (design Shpilev D. A.) in the plan, with the uneven distribution of water flow through the channels;

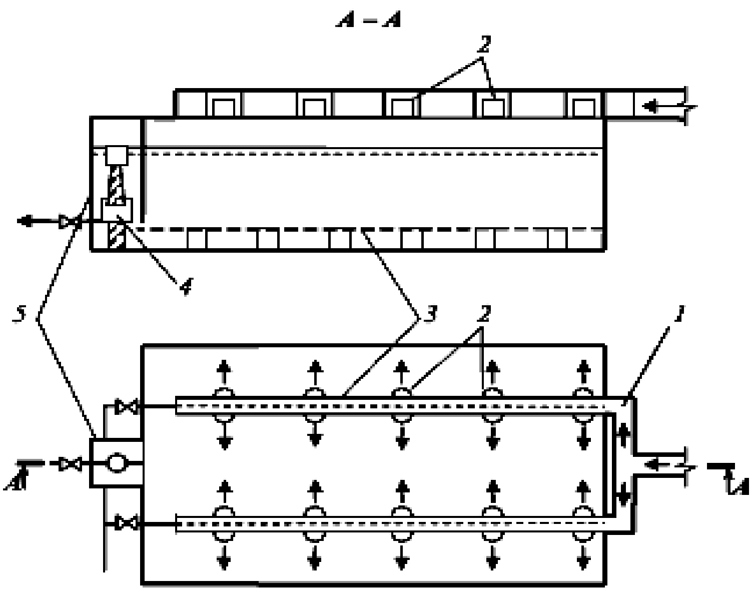
- average mixers (average with mixing devices) bubble type and with mechanical stirring.

The type of equalization selected according to the nature and quantity of the undissolved components (e.g., suspended solids), and the dynamics of income of waste water.

Multi-channel average used for leveling of volley discharges of sewage with suspended solids hydraulic size up to 5 mm/s at a concentration up to 500 mg/L.

Averaging in such devices occurs by the flow of water, which is divided into several streams, flowing through the corridors of the moving average. Corridors are of different length (or width), so in the collecting tray mixed water streams with different concentrations of pollutants received by the averager at different times.

Averager-bubbler-type mixer (figure 3.5) used for averaging the composition



1 – feed tray; 2 – inlet; 3 – bubbler; 4 – outlet device; 5 – exhaust chamber.

Figure 3.5 - Averager with bubbling water

of wastewater with suspended solids up to 500 mg/l hydraulic size up to 10 mm/s in any mode of their receipt.

Averaging in this case is achieved by intensive mixing provided by sparing waste water air.

One of the important conditions of effective averaging is the most uniform distribution of wastewater on the area of the moving average type bubble. For this purpose, a system feeds trays with bottom drainage or triangular weirs.

3.4 Construction of physical-chemical wastewater treatment

Sewage treatment by flotation.

Wastewater treatment methods, which are based on the processes described by the laws of physical chemistry, called physical-chemical.

In the practice of wastewater often there are situations when the biological sewage treatment plant can not operate effectively, for example, due to prolonged interruptions in the flow of waste water, instability of supply, and also the presence of wastewater compounds that are toxic to ecological communities, and several others. The peculiarity of the construction of physical-chemical wastewater treatment — fast mode of operation, which is important solving problems of life support, including in emergencies.

In the diagrams of the wastewater treatment plants of settlements at different stages of water treatment can be applied methods such as flotation, coagulation and sorption. The feasibility of inclusion in the treatment facilities must be justified by technical and economic calculations.

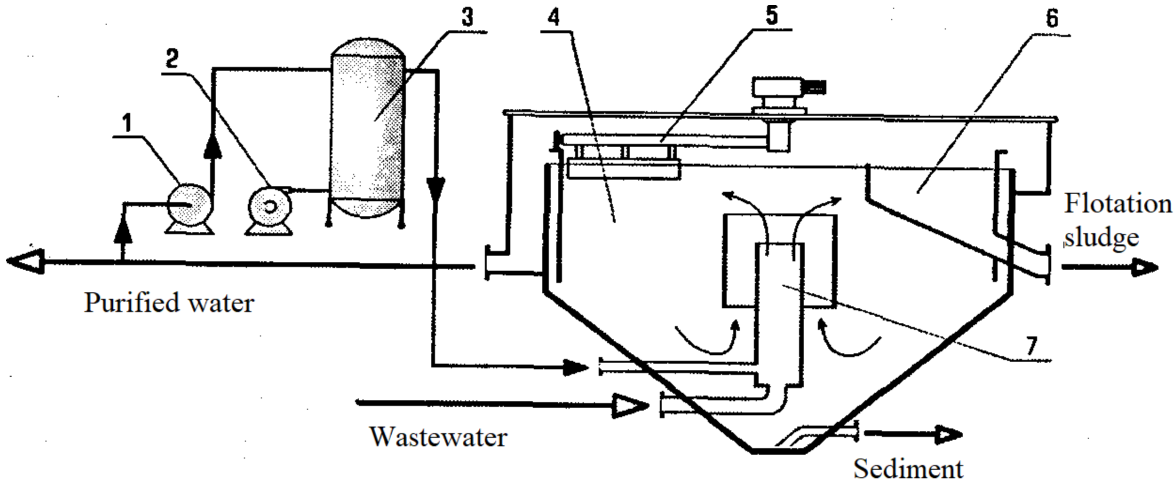
Flotation is one of many types of adsorptive-bubble separation based on the formation of pop-up agglomerates of dirt from the dispersed gas phase (fotoconnection) and their subsequent separation in the form of a concentrated foam product (flotsam).

In accordance with the classification of pollution of urban waste water flotation allows for the extraction of coarse fresh impurities, characterized by the indicator "suspended matter", the presence of floating materials (oil, fats and similar substances) and surfactants.

In accordance with the classification of pollution of urban waste water flotation allows for removing coarse impurities, characterized by the indicator "suspended matter", the presence of floating materials (oil, fat-like substances) and surfactants.

In technological processes of sewage treatment plants of settlements the greatest application is the flotation of a compression obtaining a dispersed gas phase. The gas phase, obtained by this method has a large specific surface and adhesion activity. Photocouplers formed on its basis, have high rate of coming up, reaching 20 mm/s. This significantly reduces the period of separation of the contaminants compared to defending.

The flotation consists of the camera flotation and auxiliary equipment (figure 3.6).



1 - circulation pump; 2 - compressor; 3 — pressure vessel;
4 — chamber flotation; 5 - scraper mechanism; 6 - a collection of flotsam;
7 — water distribution system and the air / water mixture.

Figure 3.6 - Scheme of flotation facility

Functionally flotation structures can make the task a preliminary clarification of incoming wastewater, tertiary treatment of waste water of suspended substances and surfactants, as well as functions root delay at different stages of sludge treatment.

The shape of the flotation chamber is rectangular or circular in plan with a depth of not more than 3 m Inside the chamber is placed the device of the distribution of incoming water and water-air mixture, the baffles, the device to maintain a constant position of the water level in the construction, collection and removal of precipitation and flotsam. In the auxiliary devices to saturate the water with air at a gauge pressure of 0.3 - 0.6 MPa.

Part of the flow of purified water under pressure is fed into pressure vessel (saturator). There compressor serving the air. It is also possible to supply of air through the air / water ejector, mounted on the bypass line of the pump. The quantity of supplied air depends on the initial concentration of pollutants and can change from 40 to 15 dm^3 per 1 kg of extracted substances during their initial concentration, respectively, of 0.2-I g/l Saturated air the water from the saturator is fed in the flotation cell, where there is a sharp decrease in pressure. Eye-catching air bubbles form on dirt photocouplers that float on the exposed surface of the flotation cell. Pop-up mass is removed continuously or raking the foam in panoramic.

The flotation structures after full biological treatment of municipal wastewater can significantly improve many water quality parameters. In table 3.3 the data for the flotation of biologically treated wastewater.

Table 3.3 - Results of flotation of municipal wastewater after biological treatment facilities complete

Indicator	Waste water		Average effect cleaning, %
	coming	cleaned	
Suspended solids, mg/l	8-25	4-12	50
BOD_5, mg O_2/l	10-25	4,5-11	55
COD O_2/l	40-110	24-39	45
Surfactants, mg/l	1,5-6,5	0,5-4,2	67

In addition, it was noted the removal of nitrogen compounds at 15-20%, of iron ions of 23-26%, chromium ions by 11-18%, firesplace substances by 25-28%.

Among the other buildings of the gravitational separation of impurities, the machines are more efficient, smaller, technological flexibility, and manageability. The disadvantages are the dependence on electricity and more electricity consumption.

Wastewater treatment by coagulation.

Wastewater settlements contain 50-60% of contaminants

relevant physical-chemical properties for colloidal

Dispersed colloid particles do not settle and do not stay conventional filters. Their size is conditionally interval in 1-100 nm. They form a sustainable system, external symptoms similar to true solutions.

To improve the efficiency of sewage treatment on the number

False pollution use of reagents, called coagulental. Mineral coagulants is gidrolized.

Metal salts.

As coagulants are often used aluminum sulfate $A1_2(S0_4)_3 \cdot 18H_20$, sodium aluminate $NaAlO_2$, hydroxochloride aluminum $A1_2(OH)_5C1$, at least — tetraoxalate of aluminium - potassium and aluminium - ammonium. Widespread aluminum sulfate. When coagulation aluminum sulfate interacts with the bicarbonates present in the water, or specifically adding alkaline reagents, forming a slightly soluble base. In recent times successfully used hydroxochloride aluminum, which requires less alkaline water.

Iron-containing coagulants is primarily sulfates two - and trivalent iron $Fe_2(S04)_3 \cdot 2H20$, $Fe(S0)_4 \cdot 3H20$ and $FeS04 \cdot 7H_20$ and ferric chloride $FeC1_3$. Because iron has a transitive valence, the listed reagents mogut be used not only for coagulation but also for the Prov-the discussion of oxidation reactions-recovery follow-up the Cedi is the documentation.

For intensification of processes of separating dirt used a reagent called flocculants. Flocculants can be both inorganic and organic substances. Recently, for wastewater treatment widely used high-molecular compounds (Navy). Molecule of the Navy in the water may be electrically neutral or carry a charge. In the latter case, the substance will be called a polyelectrolyte. Sometimes polyelectrolytes fully perform the functions of the coagulant and flocculant.

Technological complex for coagulation of wastewater includes the basic facilities for mixing of treated water with a solution of coagulant, the formation of large flocal settling, clarification of water, as well as auxiliary facilities and equipment for storage, preparation and dosing of reagents.

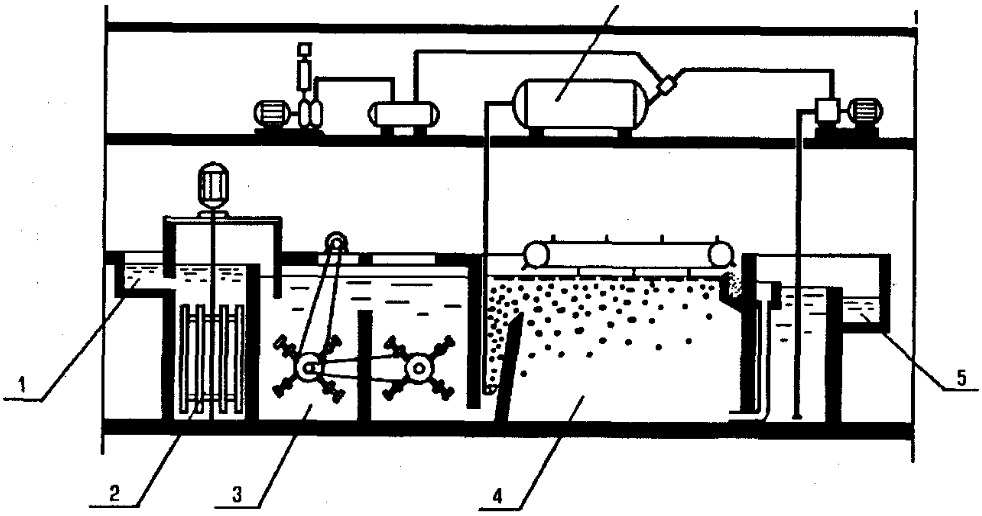
For effective carrying out of coagulation, you need to provide the most favorable conditions for the occurrence of reactions of the hydrolysis of coagulants and their interaction with impurities and the formation of solid flakes of sediment. Therefore, the mixing of coagulant with water must occur so that once formed a large number of small units, which later become the centers of crystallization of slightly soluble compounds.

The coagulants are mixed with treated waste water in the faucets. On the constructive characteristics of the mixers are cloisonne, perforated, shaybovuyu and vertical. The process of forming flokul carried out in the flocculation chambers. Referring to the flow of the flocculation chamber can be windmill crooked umbrella, cloisonne, whirlpool and with mechanical stirring.

The separation of the formed colloidal dispersion of the hydrolyzed coagulant and of the contaminants occurs, typically in ponds vertical, horizontal or radial type. Perhaps the use for these purposes, flotation and clarifiers.

In the technology of coagulation of municipal wastewater using different schemes that provides the best cleaning results in specific conditions. The main difference between these schemes lies in the choice of the points of input of reagents in the processing chain structures and modes of their presentation. For the treatment of municipal wastewater is the most appropriate two-stage scheme of the settling sewage. At the I stage is settling in the primary sedimentation tank without coagulant, level II — wastewater treatment with coagulants and flocculants with the following clarification in a settling tank or flotation cell. Figure 3.7 shows an example of the technological complex of coagulation of wastewater is made in a monoblock construction.

Truly dissolved and colloidal organic pollution urban waste water are characterized by a variety of components. The study of the composition of dissolved organic contaminants have shown that 62-66% of the compounds belong to the group of organic acids, 8,2-9,6% exhibit the properties of bases and 28.4-34,0% neutral. Taking into account the adsorption of pollutants on hydroxides of coagulation removes 30-40% of the total mass of organic substances in solution. The greatest efficiency of water treatment achieved by organic bases (70%), the smallest organic acid (20%).



1 — inlet channel of wastewater; 2 — mechanical mixer; 3 - flocculation; 4 — flotation unit; 5 — discharge channel of the treated water; 6 — the system of preparation of water-air mixture.

Figure 3.7 - Combined structure physico-chemical wastewater treatment

Phosphorus compounds that are dissolved in the process of coagulation to form slightly soluble phosphates of aluminium, iron or calcium to precipitate. Complex and insoluble forms of phosphorus are removed by sorption on the flakes of hydroxides. Removal of heavy metals occurs as a result of sorption and deposition of their hydroxides, the completeness of which depends on the wastewater pH and the properties of the metals. Thus, in the process of coagulation and subsequent separation of rain and waste water can be sufficiently removed not only suspended solids but also organic number lainnya pollution, some dissolved contaminants, including possessing surface-active properties, phosphorus compounds, salts of heavy metals, etc.

The application of flotation for the separation coagulated pollution along with the increase in the speed of extraction of contaminants increases the efficiency of water treatment for suspended solids, surfactants, COD.

In table 3.4 the results of coagulation of municipal wastewater receiving full biological treatment followed by flotation.

As a coagulant used is ferric chloride in an amount of 0.5-1.0 mg-EQ/l Duration of treatment in the compression protein skimmer — 20 min of Coagulation followed by settling virtually ineffective in relation to the removal of ammonia nitrogen. Other disadvantages of the method are the need of the use of reagents and increased precipitation detachable.

Adsorption to wastewater treatment.

Sorption is a dynamic equilibrium process of absorption of a substance from the environment as solid, liquid or gas. Absorbing a substance called a sorbent, and

Table 3.4 - Results of tertiary treatment of sewage by coagulation with following flotation

Figure	Wastewater		Average effect cleaning, %
	coming	cleaned	
Suspended solids, mg/l	18-40	6-10	71
BOD_5 mg 02/l	20-35	4,5-11	73
COD, mg 02/l	90-170	35-70	60
Surfactants, mg/l	4-20	1,3-6	70

absorb the sorbate. Sorption of substances in surface layer of solid adsorbent is called adsorption.

Adsorption to wastewater treatment.

Sorption is a dynamic equilibrium process of absorption of a substance from the environment as solid, liquid or gas. Absorbing a substance called a sorbent, and absorb the sorbate. Sorption of substances in surface layer of solid adsorbent is called adsorption.

Sorption methods are the most effective for deep cleaning of waste water from dissolved organic substances. Sorption treatment can be used alone or in conjunction with other methods of preliminary and advanced wastewater treatment.

As sorbents in municipal wastewater treatment plants use natural materials, the waste of some industries and active coals. Natural porous materials such as peat, active clay and industrial waste — ash, coke breeze, silicagel, alumogel etc., have low sorption capacity and high filtration resistance. Sorption capacity is the weight of absorbed contaminants per unit volume or mass of the sorbent (kg/m^3, kg/kg).

Sorbents used for wastewater treatment can be unregulated and regenerated. In the latter case they are subjected to recovery using regenerative technology, when the extracted substance is utilized, or destructive, in which the extracted substances are destroyed.

For regeneration of active carbons using thermal, chemical-chemical or biological methods. Volatile organic substances are removed by high temperature desorption air (120-140°C), steam (200-300°C) or flue gases (300-500°C). During chemical regeneration of the organic compounds are removed by washing with solutions of acids or alkalis. Biological regeneration consists of the biochemical oxidation of organic matter within 10-20 h, depending on the purpose of sorption purification are various methods of sorbent regeneration or destruction.

Efficient sorbents to be used in the technology of urban wastewater treatment are granulated active coals of various grades. The greatest distribution adsorption received in the final stages of wastewater treatment. This is due to the fact that the composition of the incoming wastewater can contain persistent organic compounds, the discharge of pollutants in wastewater is limited.

The adsorption process is carried out by filtering the wastewater through a layer of densely Packed sorbent. After the biological purification is used gravity filters. The filtration rate depends on the concentration dissolved in wastewater organic matter and varies from 1 to 12 m/h with a grain size of the sorbent 0,8-5 mm. the Most efficient way of filtering — from the bottom up, as in this case, there is uniform filling of all section of the filter and relatively easily displaced air bubbles and gases within the sorbent layer together with the waste water.

In the adsorption purification process, the water removed from bio-chemically resistant organic matter, trace amounts of heavy metal ions, radioactive isotopes, mercury, residual chlorine, ammonia nitrogen, bacterial and other contaminants. Roughly assume that 1 kg of coal takes about 0.5 kg of pollution, as measured by COD. The results of adsorption tertiary treatment of sewage is given in table 3.5.

In the process of a continuous operation adsorption filters on the surface of the bean boot is formed biofilm, which disrupts their normal operation, increases the pressure loss. However, the growing biofilm provides more deep purification of water for military and nitrogen content. This phenomenon was the basis for the development of facilities for waste water treatment — biocorner.

Table 3.5 - the Results of adsorption filters after complete biological treatment of municipal wastewater

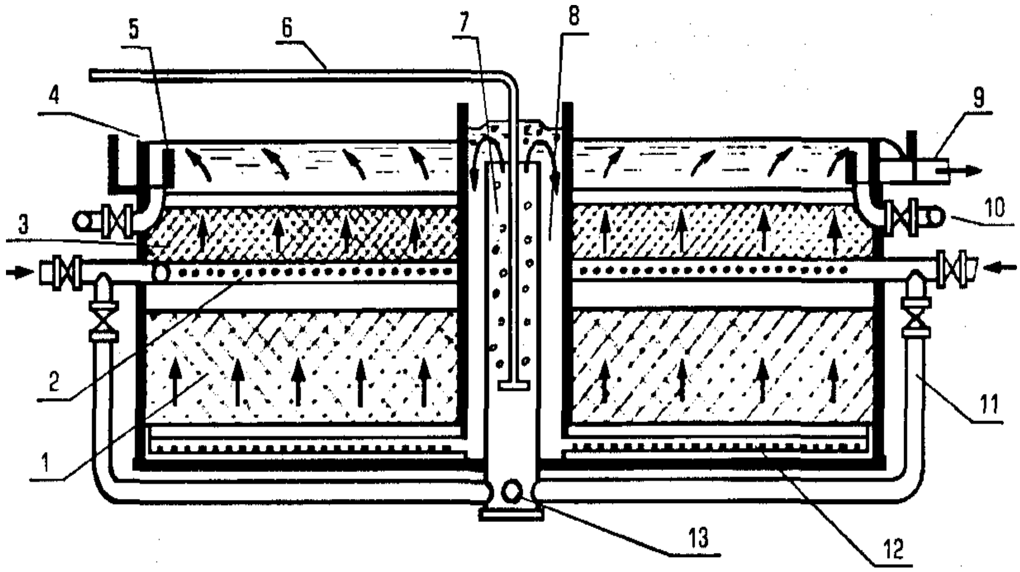
Figure	Wastewater		Average effect cleaning, %
	coming	cleaned	
Suspended solids, mg/l	10	1	90
H_{cobs}., mg 0_2/l	47	9,5	80
Filtrate COD, mg 0_2/l	31	7	77
Total organic carbon, mg/l	13	2,5	81

In biocarburan combined biochemical and physico-chemical processes occurring in suspended and dense layers of active carbon. Diagram of the setup is given in figure 3.8.

The tank is filled with two layers of sorption: the lower layer of the fluidized bed, the upper - tight. The direction of water movement from the bottom up. The water velocity in the lower layer 9 m/h, in the upper 3-5 m/h. Oxidative capacity of biosorbed on the MIC in 1.6-1.8 times, and COD 4-6 times higher oxidative capacity of the aeration tank. In biosorbent activated charcoal does not require a separate regeneration.

Based on the objectives of wastewater treatment of settlements constructions physical-chemical treatment can be the basis of the technological process or its part in combination with other structures, for example, mechanical or biological treatment.

The most simple scheme of the station physical-chemical treatment of wastewater include coagulation and separation coagulant contaminants from water in the process of settling or flotation. This scheme can be implemented in the short term on the basis of both new and old structures mechanical cleaning.



1 — suspended layer of active carbon; 2 — drainage system; 3 — thick layer of active carbon; 4 and 5 weirs and purified water wash; 6 — duct; 7 — the air pump; 8 — chamber degassing; 9 and 10 — removal of treated and wash water; 11 — circulating pipe; 12 distribution system water inlet; 13 — flow of wastewater.

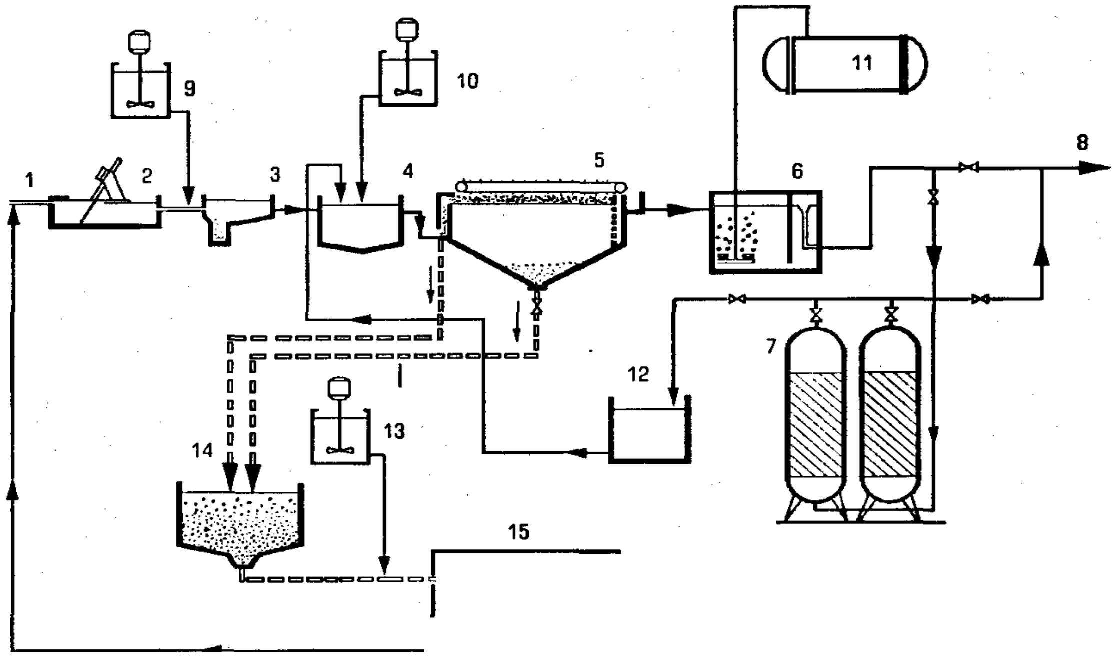
Figure 3.8 - Biosorbed design FSUE WAtergeo

Concept of this wastewater treatment is shown in figure 3.9.

A significant increase in efficiency of sewage treatment plants is also provided by a combination of chemical treatment wastewater adsorption purification stage — filtration through a layer of active carbon. So, if you want to achieve advanced wastewater treatment in wastewater treatment plants with a limited area can be applied technological process scheme: coagulation flotation, sorption. Replacement sumps on machines with a zone of deposition of heavy impurities, several times reduces the duration of the stage of separation of the coarse impurities sewage.

Treatment facilities are built under this scheme, ensure the efficiency of wastewater treatment of the village on indicators of COD — 85%, BOD5 — 96, suspended solids — 90 phosphates — 95, saw 95, total nitrogen — 57%. The efficiency of reducing ammonia nitrogen greatly depends on the material loading of the adsorption filter.

If necessary, deep extraction from wastewater nitrogen compounds of the technological scheme is supplemented by the step of clearing is based on one physical-chemical techniques, with a selective action, or on the biological process of nitrification — denitrification.



1,8 — flow of wastewater and abstraction of the treated water; 2 — lattice; 3 — grit chamber; 4 — chamber flocculation; 5 — sump-protein skimmer, 6 - pin camera; 7 — adsorption filter; 9 — flow of the coagulant; 10, 13 — submission of flocculant; 11 ozone; 12 — tank dirty wash water; 14 — seal draught; 15 — filter press.

Figure 3.9 - Scheme of the station with a three-stage physical-chemical wastewater treatment

The wastewater treatment plant, constructed according to more complex schemes are of high intensity and a depth of removal of contaminants in all major indicators. In some cases this allows to use of treated waste water in the circulating systems of industrial enterprises and agriculture. Schemes such plants usually combine methods of mechanical, physical, chemical and biological water purification. Moreover, processing sequence and their combination can be different.

Because physical-chemical wastewater treatment methods are based on the additional energy from external sources, the cost of implementation is higher compared to methods that use your own energy system (mechanical and partly biological).

3.5 Biological purification of sewage

Biological filters.

Biological filters are biological purification of sewage in artificially created conditions.

The performance of the biofilter is divided *into drip and high-loaded.*

According to the method of air supply distinguish biofilters with natural and artificial ventilation. For trickling biofilters use natural ventilation, high-rate, both natural and artificial ventilation. In the latter case, biofilters call aerofilters.

Biotrickling filters. Biotrickling filters consist of the following main elements: waterproof foundation, drainage, walls (airtight or breathable), filter loading and distribution devices. In terms of biotrickling filters can be rectangular or circular shape.

The nature of the processes occurring in the biofilter, is as follows. On the surface of the grains of the filter are absorbed by insoluble and colloidal impurities, forming a biological film, inhabited by microorganisms. Getting on this film, the dissolved pollution in the waste water are oxidized by microorganisms. Dead film is washed is the waste liquid and is taken out from the body of the biofilter.

Clarified in the primary clarifiers, wastewater periodically through a special device is evenly distributed over the area of the biofilter. Passing through a layer of load and drainage, the liquid is collected by a system of troughs and play for them in the secondary clarifier. The purpose of the secondary clarifier is the detention of a dead biological film taken from the biofilter.

The calculation of the trickling biofilter is to determine the loading volume, square in plan, the number of partitions, sizes of distribution devices and trays for collecting the purified liquid.

The working height of the biofilter is equal to 1.5-2 m.

High-rate biofilters. These filters differ from drip peculiarities of design and operational character. The constructive features include increasing grain size boot, alteration bottoms and drainage, increasing the height of the load. Features performance character consists of the reduction of interruptions in the flow of a fluid and increasing the hydraulic load on 1 m^2 of filter area that helps to wash away dead biological film.

Biotrickling filters used for wastewater flow rate 1000 m^3/day.

According to the principle distinguishes high-rate biofilters operating on complete and incomplete cleaning.

On the mode of operation of high-rate biofilters are divided into operating with recirculation and without recirculation. Reducing BOD entering the biological filters of sewage, recycling ensures steady operation of the filters.

The purification method of high-rate biofilters can be single-stage and two-stage. In the first stage, carries out a partial purification of water, and the second full.

According to the methods of air supply distinguish high-rate biofilters with natural and artificial ventilation.

The height of high-rate filters are divided into low (up to 2 m) and high (2 m and above).

Mind download of high-rate filters can be bulk load (gravel, crushed stone, expanded clay, etc.) and in-plane loading (ring or debris from the ceramic or plastic of the charging elements, rigid loading in the form of grids or blocks of flat or corrugated sheets, etc.).

Design features of the biofilters. As feed material filters use gravel and pebbles of hard rocks, and expanded clay and plastic. The particle size of the feed material for high-rate filters shall be equal to 40-60 mm across the height of the load. The particle size of the material of the lower support layer with a height of 0.2 m is 60-100 mm. Size of feed material for trickling biofilters shall be taken equal to 30-50 mm with a gradual increase in depth.

The distribution of the sewage over the surface of the biofilters are carried out with a stationary or movable sprinklers jet sprinklers. The greatest distribution of stationary sprinklers got sprinklers. Sprinkler system consists of a dosing tank, distribution pipes and sprinklers. Sprinkler heads-nozzles mounted on vertical processes, connected with distribution pipes laid in the body of the biofilter.

For normal operation of the biofilter is necessary to supply air in sufficient quantity. In biotrickling filters usually are used natural ventilation generated by temperature difference between outdoor air and the body of the biofilter. In high-rate biofilters air is supplied by fans into the space between the drain and the bottom.

In recent years, domestic and foreign practice are spreading biofilters with plastic download. They have high performance, provide good cleaning. The height of such biofilters take is 3-4 m. us the feed material is possible to use blocks of polyvinyl chloride, polystyrene and other rigid plastics.

The aeration tanks.

The aeration tanks are biological purification of sewage in artificially created conditions. Usually they are made in the form of long concrete tanks (corridors) depth 3 - 6 m and a width of 6 - 10 m is supplied to the aeration tank, the clarified liquid is mixed with active sludge. Activated sludge is the accumulation of microorganisms, capable of sorbing on its surface of organic pollutants and oxidize them in the presence of oxygen. A mixture of clarified sewage and activated sludge throughout the length of the aeration tank is blown with air.

As a result of growth of microorganisms and sorption of organic contaminants, the mass of sludge in the aeration tank is continuously increasing. With the increase of its concentration in the aeration tanks increasing the removal of active sludge from secondary settling tanks is reduced and the quality of treated water. To prevent this, part of the activated sludge (surplus sludge) is not returned to the aeration tanks, and is sent to sludge thickener.

The process of decomposition of organic matter in the aeration tank takes place in three phases. In the first phase is responsible for sorption of organic contaminants on the flakes of activated sludge and oxidation easy oxidized organic substances. While the military-industrial complex waste water is sharply reduced. In the second phase hard oxidize organic matter and regeneration of activated sludge, i.e. the restoration of its sorption ability. The third phase is the nitrification of ammonium salts.

The aeration tanks can be used for partial or full sewage treatment. Partial clearing is used, if local conditions allow the use of self-purification capacity of the reservoir.

To ensure stable operation of the aeration tanks arrange the regenerators — structures in which serviruya restored the ability of activated sludge. The sludge in the regenerator is aerated constantly. Under the regenerators typically allocate part of the corridors of the aeration tanks. There are a number of schemes airtanks. In addition to the single-stage aeration tanks with regeneration or not, working full or a partial clean up, also used aeration-mixers, two stage aeration tanks and aeration tanks with step aeration.

Aerotank-mixer usually are used for treatment of industrial wastewaters with high organic concentrations. In order to improve the use of oxygen in the waste liquid is supplied to the aeration basin mixer tap dispersed along its length.

The estimated volume of the aeration tank depends on flow rate of waste liquid, its pollution with organic substances, the quantity of delivered air and the concentration of activated sludge.

The estimated area of the aeration tank is divided into sections, each of which consists of several corridors (two to four). Part of Sidorov (one — two) is allocated under the regenerators. Effluent liquid passes sequentially from one corridor to another. The length of the aeration tanks is usually administered in the range of 50-130 m. the ratio of the width of the corridor to the working depth of the aeration tank should be taken from 1 : 1 to 1 : 2.

Distinguish the aeration tanks with purge of sewage between compressed air and aeration with mechanical aeration. The air in the aeration tanks is fed by the blower for the duct system. Air distribution in the aeration tank is carried through the porous ceramic materials (Filtrona plate, ceramic pipe, synthetic fabrics). Normally air enters the perforated pipe or channel, on top of which are placed filtrona plate of the risers that extend from the main duct, located in the longitudinal wall of the aeration tank.

The distance between the risers is taken in the range of 20-40 m. the Perforated pipe is placed on one side of the corridor of the aeration basin along its length to circulate flow in the cross section. Holes in them with a diameter of 2-2,5 mm located at a distance of 10-15 cm from each other. Filtrona plates are arranged in one to three series from one side of the corridor of the aeration basin along its length.

The aeration tanks-clarifiers designed specifically for treatment of small wastewater quantity. In the aeration tanks flows multiple processes - aeration, sedimentation and circulation of activated sludge.

The big advantage of aeration tanks-clarifiers are their compact size, the possibility of prefabrication and the ability to compose in blocks with other treatment facilities.

The currently developed model projects of treatment facilities, equipped with aeration tanks-sedimentation tanks with capacity from 12 to 700 m^3/day. In Estonia developed the aeration tanks-clarifiers of a type of BIO-25,50,100 m^3/day. In AOO NII KVOV developed the compact aeration tanks-clarifiers type KU bandwidth 200; 400 and 700 m^3/day.

4 Protection of water bodies and the fight against harmful effects of water

4.1 pressures on water resources

Annually renewable river runoff resources in the country amount to an average of 100.5. In table 4.1 comparative table of water use (million m^3).

Table 4.1: Comparative table of water use (million m^3)

	Indicators	1996	1998	2002	2007	2011
1	Intake underground sea	40700 33464 2596 1816	36102 31552 2724	28807 25597 2013	19830 18040 1169	26434 24495 1174 765
2	Used water including the needs of:	31031	28460	22239	14058	20218
	drinking and production	1800	1414	1241	623	620
	производственные	5089	4835	4089	2803	4337
	irrigation regular	21382	16705	12115	7628	8638
	irrigation estuary	-	4031	3679	2486	510
	the agricultural water supply	483	479	355	179	516
	watering of pastures	-	515	327	130	94
	pond fisheries	-	369	319	123	52
	other needs	1052	62	72	82	3189
	hay watering	-	-	-	-	2258
3	Wastewater including	9033	9001	7069	4055	6904
-	in surface water bodies в of them are contaminated	7470 339	7313 289	5780 229	3404 212	4178 210
4	Оборотное водопотребление	-	12177	7906	4845	8120
5	Повторное водоснабжение	707	707	565	622	4122
6	Потери при транспортировке	6600	5217	5521	-	4657
7	The discharge of pollutants (thousand tons)					
	organic (BOD)	84,88	3,71	3,6	3,19	2,34
	oil products	0,1	0,19	0,33	0,43	0,22
	suspended solids	8,9	15,24	12,2	11,0	50,8
	sulfates	70,81	66,43	189,48	253,53	50047,71
	chlorides	16,85	35,18	399,48	263,07	4696,15

The management system of water quality and water resources.

Further development of industrial production requires a number of urgent measures: first, the reduction of pollution per unit of production; second, reduced discharge of waste water into water bodies until the complete cessation.

The package of measures in this area should include measures to improve production technology, creation of re-circulating and closed water systems, extending the use of water circulation systems.

The second direction should be possible to use purified wastewater from municipal and industrial facilities in places of their formation, their education to the needs of industrial production prepared by the municipal, industrial and animal waste on agricultural fields of irrigation.

The decline of salinity in the water of the rivers due to the complex water conservation measures in irrigated agriculture. To completely eliminate discharge into the river of collector-drainage water is impossible, because of complexity of technical solutions.

In order to improve the quality of river water is necessary to use drainage water in the places of their formation, reconstruction and construction of collector networks and channels to drain these drains to a safe area.

To improve river water quality require from the farms to regulate and normalize the use of mineral fertilizers and pesticides in agricultural production.

Providing in a number of activities that reduce salinity of the river water, should be a part of desalination of collector-drainage runoff. Biological treatment of drainage water is the most promising.

The use of large volumes of collector-drainage waters in places of their formation must be accompanied by their preparation. For these purposes, the most promising is the method of electrochemical activation of water. When using it is demineralisation water up to 24-32%, with the removal of magnesium ion up to 100% sulfate 29%, chloride to 26%.

To prevent contamination of surface waters by pesticides is necessary to stop the agricultural use of products containing mercury and arsenic, DDT, etc. to develop work on the implementation of biological methods of plant protection.

Main activities and recommendations on reduction of pollution of water resources:

- define and clarify the roles and responsibilities organs of government, water management organisations and other stakeholders in the field of quality of water resources;
- determination of needs and minimum requirements for environmental discharges on the basins and lower reaches of rivers;
- improvement of existing systems of water management based on integrated river basin management;
- development of river basin action plans in the field of IWRM, including water quality;
- the improvement and harmonization of water legislation with the neighboring countries in transboundary river basins;
- development issues associated with economic evaluation of water and charges for water use;
- determine the extent of damage to water bodies and the amount of compensation for pollution and exhaustion of water objects;

- implementation of international requirements for water quality control, and ensuring minimum sanitary and environmental flow;

- reduction of water losses through the rehabilitation of irrigation systems, improving irrigation techniques, use of technologies of reuse of drainage water;

- establishment of water protection zones along rivers and other water bodies;

- support the principles of integrated water resources management (IWRM) from the public, informing the population, creation of special educational programs.

The quality management system of waters and water resources should provide:

- an objective assessment of water management in the river basin;

- analysis of alternative courses of basin environmental and economic policy and necessary changes in the structure of production and consumption to ensure reliable support for the economy and the population with quality drinking water;

- the functioning of the integrated monitoring system of waters;

- formation of target programs of improvement and preservation of water quality, both at the regional and river basin, the effectiveness of their implementation;

- effective use of the mechanisms of regulation of water use, including economic and administrative;

- education and informing of wide layers of the population in order great understanding of the importance of water and the motivation of the population on actions for conservation and restoration of water quality.

The basic principles of quality management of waters and water resources are recognized:

- the sustainability principle – water management should be aimed at meeting the needs of the present generation without compromising future generations;

- the principle of ecosystem approach;

- the principle of the continuity of the waters of one river basin in space and time: a basin-wide integration and territorial coordination;

- the principle of relativity;

- economic justification;

technical adequacy;

- precautionary principle – should ensure the least possible impact of economic activities on water status;

- the precautionary principle – measures to prevent possible harmful impact of economic activities on the state of waters should not be delayed on the grounds that studies have not established fully the causal relationships between these effects on the one hand and the influence of these effects on the status of waters on the other side;

- the principle of "water user pays";

- the prevention principle is to prevent the harmful impact of economic activities on water status it is easier, than then to struggle with consequences of this action.

Reduction of water consumption.

The largest volume of water is used for irrigation. The amount of the second water consumption is industrial-energy complex. For water saving in industrial and energy sector it is necessary to implement low-water technologies and water recycling. In the implementation of these measures the water demand of industrial and energy complex can be reduced by half.

The weighted average of specific costs water gross per hectare of irrigated area at the present stage is 14,87, net 9.5 thousand m3 per hectare. The weighted average efficiency of irrigation systems is 0.68 with fluctuations from 0.55 to 0.80.

In the implementation of the technical solutions of the weighted average efficiency of the system can be increased to 0.75. For these purposes, the existing earthen channels necessary to carry out the construction of concrete and reinforced concrete linings, coatings with the use of groundwater and polymer screens. On-farm network in earthen channels replaced with trays and pipelines. The major event that provides water savings in irrigation is the improvement of irrigation technique. This requires maximum use of mechanization and automation of irrigation and others. The most important area to water saving is the rational use of collector-drainage flow, the value of which in the Aral sea basin is estimated about 30-35 km3 per year. Disposal of drainage effluent should be conducted in areas to create cascading systems of irrigation, using it in places of formation.

4.2 Protection of water objects

Water objects are protected from natural and man-made contamination with harmful hazardous chemical and toxic substances and their compounds, thermal, bacterial, radiation and other pollution; clogging of a solid, insoluble objects, wastes of industrial, domestic and other origin; exhaustion.

Water bodies are protected to prevent violation of ecological sustainability of natural systems; harm to the life and health of the population; reduction of fish stocks and other aquatic animals; deterioration in water supply conditions; reduction in the capacity of water objects to natural reproduction and purification; worsening of the hydrological and hydrogeological regime of water objects; other adverse events that negatively affect the physical, chemical and biological properties of water objects.

Protection of water objects is effected as follows: the presentation of the General requirements for the protection of water bodies to all water users engaged in any use of them; the presentation of special requirements for certain types of economic activity; improving and applying water protective measures with the introduction of new equipment and environmentally, epidemiologically safe technology; establishment of water protection zones, protective strips of water bodies, sanitary protection zones of drinking water sources; the state and other forms of control over the use and protection of water objects; application of measures of responsibility for non-compliance for the protection of water objects.

Central and local Executive bodies of oblasts (cities of Republican status, capital) in accordance with the legislation of the Republic of Kazakhstan take compatible with the principle of sustainable development measures on preservation of water objects, prevention of their pollution, clogging and depletion, and also on liquidation of consequences of the specified phenomena.

Individuals and legal entities that affect the state of water objects are obliged to observe the ecological requirements of the ecological legislation of the Republic of Kazakhstan, and carry out organizational, technological, forest reclamation, agrotechnical, hydrotechnical, sanitary-epidemiological and other activities to ensure the protection of water bodies from pollution, blockage and depletion.

Pollution of water bodies is recognized reset or receipt of a different way into water objects of subjects or contaminants, deteriorating the quality of the state and complicating use of water objects.

In order to protect water objects from pollution, it is prohibited:

- the use of pesticides, fertilizers in water area of water objects. Disinfection, pest and deratization measures spillway area and zone of sanitary protection of water objects are conducted in coordination with the authorized body in the sphere of sanitary-epidemiological welfare of population;

- discharge and disposal of radioactive and toxic substances into water bodies;

- discharge in water objects of sewage, industrial, food objects that have no treatment and do not provide in accordance with the standards of effective cleaning;

- the carrying out, water blasting, which use nuclear and other types of technologies, accompanied by the release of radioactive and toxic substances;

Protection of water bodies from clogging.

Clogging of water bodies admits the ingress of solid, industrial, household and other waste, and suspended particles, resulting in deteriorating the hydrological condition of water object and water becomes difficult.

Discharge into water bodies and dumping them solid, industrial, household and other wastes is prohibited.

Not allowed clogging of the spillway areas of water bodies, the ice cover of water objects, glaciers solid, industrial, household and other waste, the erosion of which will entail deterioration of surface and underground facilities.

Protection of water objects from exhaustion.

The depletion of water bodies is recognized the decrease of the minimum level of flow of surface water supplies and reducing groundwater.

In order to prevent the depletion of water bodies, natural and legal persons using water bodies, are obliged: to prevent excessive irrevocable water withdrawals from water bodies; to prevent on-site water protection zones and strips of plowing, bathing and sanitary processing of livestock, construction and maintenance of other types of economic activity, leading to depletion of water bodies; to carry out water protection measures.

Water protection measures to prevent water bodies from depletion, carried out by individuals and legal entities, previously agreed with the authorized body in the field of use and protection of water Fund, authorized state body in the field of environmental protection and the authorized body for study and utilization of mineral resources.

Water protection zones and strips of water objects and water management facilities.

To maintain water bodies and water management facilities in a state corresponding to sanitary-hygienic and environmental requirements, to prevent pollution, contamination and depletion of surface water and conservation of fauna and flora establishes the water protection zones and strips with special conditions of use.

Water protection zones, stripes and a mode of their economic use are set by local executive bodies of districts in coordination with the authorized body in the field of use and protection of water fund on the basis of approved design documentation, agreed with the authorized body in the field of environmental protection, the Central authorized body for land management, and in mudflow areas additionally with the Central Executive body of the Republic of Kazakhstan for emergency situations.

In the forests located in water protection zones and coastal protective strips, the implementation of the final felling is prohibited. Suitable for intermediate fellings and other forestry activities, ensuring the protection of water bodies.

The leased forests of water protection zones is carried out in coordination with the authorized body in the field of use and protection of water resources in accordance with forest and water legislation of the Republic of Kazakhstan. The rules for establishing water protection zones and strips shall be approved by the Government of the Republic of Kazakhstan.

Zones of sanitary protection.

In order to protect waters used for drinking water supply, medical, resort and other health needs of the population, local Executive bodies of oblasts (city of Republican status, capital) areas shall be established sanitary protection.

The order of establishing sanitary protection zones and sanitary protective zones, determined by the authorized body in the sphere of sanitary-epidemiological welfare of the population.

Water bodies, which as a result of economic activities or natural processes result in changes that threaten the health of the population, flora and fauna, the state of the environment, can be declared as zones of environmental emergency situation or environmental disaster. Environmental emergencies on water bodies or river basins and groundwater deposits is declared by the Government of the Republic of Kazakhstan.

Land plots in water protection zones and strips of water objects and water management facilities can be provided for temporary use to natural and legal persons in the procedure established by legislative act of the Republic of Kazakhstan on land, on condition of compliance to the regime of economic activities. State control over observance of requirements to economic activity regime in water protection zones and strips is carried out by the authorized body in the field of use and protection of water Fund, authorized state body in the field of environmental protection, the Central authorized body for land management within their jurisdiction.

Features of protection of underground water objects.

Individuals and legal entities, industrial activity which may have a detrimental impact on the status of groundwater are required to monitor groundwater and to take timely measures for the prevention of pollution and depletion of water resources and the harmful effects of water.

In catchment areas of underground water that are used or can be used for drinking and economic-household water supply, it is prohibited to place storage of radioactive and chemical wastes, dumps, cemeteries, cattle burial grounds and other objects, affecting condition of underground waters. It is prohibited to land irrigation of wastewater, if it affects or may affect the status of groundwater.

Small water bodies and their protection. Small water bodies are natural water bodies having the following dimensions: for closed water bodies with surface area up to ten acres; on the rivers - watercourses with a length up to two hundred kilometers.

The use of water resources of small water bodies, as a rule, is carried out in a General water use. The use of water resources of small water objects in the order of special water use may after examination by the authorized body in the field of use and protection of water Fund impacts of such water use on their condition and if a positive conclusion of the state ecological expertise. In order to prevent depletion, pollution and degradation of small wetlands in the basin programs for the integrated use and protection of water objects and in the regional programs of local Executive bodies of areas set aside for the actions for their protection and recovery.

4.3 Water resource management and their influence on the environment

Overall assessment of consequences of hydro technical construction.

Among the various types of anthropogenic activities establishment of water management systems leads, as a rule, to the most notable changes in natural conditions. These changes are due to the scale of the implemented activities, physical-geographical conditions of the region and the totality of circumstances, among which of great importance are social factors.

Intensive development of water engineering, found expression in the creation of large hydropower systems, multi-purpose and associated large reservoirs, in the construction of channels of considerable length with water flow rates up to several hundred cubic meters per second, for irrigation and drainage of arrays, an area of hundreds of thousands of hectares. Increase the volumes of redistribution of the river flow and is training Kazakhstan interregional redistribution of water resources.

A number of significant large water measures resulted in noticeable changes in the environment, and in some cases caused irreversible negative processes in natural ecosystems.

Consequences of hydraulic engineering construction and can be both positive and negative. The positive influence is usually determined by the economic value built

system, especially its role in improving the living conditions of the population and the economic development of the area.

All changes in the environment caused by water management activities, we must first distinguish between territorial basis. It is possible to distinguish three characteristic zones: weaning or artificial storage of water; the transit of water; delivery and distribution of water.

The consequences of water engineering can occur directly and indirectly. The former include changes in the water balance, coastal flooding and river bottoms, while the creation of reservoirs, changes in hydrological, hydrochemical and hydrobiological regime of rivers, lakes, reservoirs, etc. Indirect effects occur over a longer period of time since the beginning of operation of the water system lies in the change of vegetation, wildlife, drying of swamps, small ponds and streams, reduce or increase groundwater levels. The negative consequences of water policies are reversible and irreversible. Under the first of these are implied, eradication and containment where possible by using known measures during the relevant financial costs. Permanent effects are characterized by the emergence of rapidly developing processes, accompanied by the destruction of the community's existing natural ecosystems.

The influence of reservoirs on natural conditions.

The creation of water reservoirs allows to provide storage of runoff and its regulation in time for the needs of various water users. At present in Kazakhstan there are more than 180 reservoirs with a volume over 1 million m^3 each. However, their total volume exceeds 90 km^3. As a rule, all major artificial bodies of water designed for many years of use.

Reservoir have multivariate relationships with the environment, which in turn has an influence on their regime. The nature of changes in natural conditions due to physical and geographical features of the area, parameters of the reservoir and mode of operation.

The most noticeable influence on the environment have a large reservoirs with a full volume greater than 1 km3 and a surface area of over 100 km^2 are Bukhtarma, Kapshagay, Sochi.

Flooding and flooding of territories.

The most notable effect is the flooding of large areas, most of which was occupied by agricultural or forest land. Compensation is quite often tied to difficulties, resulting in agricultural production caused the corresponding damage. Concern there are areas of permanent and temporary flooding, and area flooding. Area of permanent flooding remains forever excluded from economic use, but at the same time the land under the water, begins to act in a new way. It creates wealth in the form of electricity generated by the hydropower plants, fishery products grown in the reservoir, additional agricultural products produced by irrigation, etc.

Area of temporary flooding includes areas within the flooded condition for a short time. Usually this land is located above the FSL that you can use under hay and pasture or for other purposes.

The formation of zones of flooding associated with the rise of groundwater level after the flooding of the reservoir. This process is very slow and due to the filtration properties of soils, mode of reservoir levels and groundwater inflow from the outside. The width of the flooding zone in some cases may be significant. The increase in groundwater level is accompanied by water longing of lands, flooding of a number of facilities, deterioration of sanitary conditions of the area. Simultaneously, there is a change of plant Association and change of the animal world.

Channel processes.

Frequent fluctuations in reservoir levels and associated over moistened of the mass of soil cause erosion and collapse of banks; these processes are enhanced and the dynamic effects of waves. The most characteristic of these phenomena for the initial period of operation, especially during storms when bombarded by large amounts of soil. In the future, these processes gradually fade.

Increases the level of underground waters in case of flooding are caused landslides, especially in the loess soil.

Deposition of sediment upstream of the structure significantly reduces their annual flow below the dam. In addition, the termination of receipt of the smallest sediment to downstream reduces the fertility of floodplain land, which necessitates the introduction of artificial fertilizers.

The hydrological regime.

The creation of reservoirs provides the alignment of the fluctuations of the average annual flow that is positive. Sufficient regulatory capacity allow you to reduce costs in the flood period, resulting in reduced flooding downstream, and during the low-flow period, additional releases from the reservoir provide several elevated compared to natural conditions, the levels and flow of water. At the same time this can happen scour downstream, the intensity of which is due to the pressure, cost and rate of flow, and the type of soil composing the bed of the river, to the detriment of agriculture and fishery.

Reservoir formation reduces amplitude levels, within seasons and throughout the year. This applies to most of the waterworks in lowland rivers. The consequence of the creation of reservoirs is generally slow water exchange in the river system, leading to serious changes in the hydrochemical and hydrobiological regimes.

Significantly the temperature regime is changing of regulated streamflow. Spring into the downstream enters colder water, and during autumn and winter is warmer. Significant changes occur in ice mode. Lengthens the period of fast ice, increasing the ice thickness by 10-20% compared with natural conditions. Compared to the initial conditions significantly increase evaporation losses. Also significant seepage losses in the bowl of the reservoir.

Climate change.

The study of the influence of reservoirs on the climate is still in the initial stage, therefore, the results of the individual observations cannot claim to be exhaustive. The degree of this influence depends on the geographical location of the reservoir, its volume, average depth, area of the mirror. Water bodies in the southern latitudes contribute to the partial transformation of the existing landscape. The largest of them cause a slight decrease in average annual temperatures and especially the average during the growing season. Sometimes there is a slight increase in rainfall is favorable for agriculture. More significant changes made reservoir created in the Northern latitudes: the increase in the total moisture and the decrease in the continentality of the local climate. The creation of large reservoirs in the North sometimes causes shortening of the vegetation period in the areas adjacent to them, which leads to unfavorable growth conditions of crops.

The quality of the water.

In contrast to the reservoirs, channels, and diversion are more complex combination of sources of contamination. These tracks usually have a greater length, within which is a relatively little sewage treatment plants and water quality control. All along the channel it can slip away impurities from the surface of the surrounding land and go unaccounted industrial and household waste. Taking into account the circumstances of the self-purification capacity of the channel will gradually begin to deteriorate. Therefore, the maintenance of proper quality of water on the route diversion of the river flow is a complex task.

The influence of irrigation on the natural conditions.

Are the positive effects of irrigation development well known. Among them one should mention the expansion of the boundaries of cultural cultivation with the aim of obtaining high guaranteed yields, and the satisfaction of related parties reclamation complexes, in particular water, aquaculture and recreation. Significant and social consequences of the reclamation and construction, manifested in increased material and spiritual living standards of the people. However, the rapid growth of irrigated areas is beginning to have an increasing impact on the natural environment. One of the types of negative influence of irrigation on the environment is an increase in return water. These waters contain various salts leached from soils and fertilizers, pesticides and animal waste.

Spending cuts of rivers due to irrigation development and associated water users, combined with the increasing salinity of return waters and the effects of other anthropogenic factors significantly contributed to the overall decline in the quality of natural waters. Example irrigation can be rivers – the Syr - Darya, the Amu Darya, the Talas, the Shu, etc.

5 Economic justification of water protection measures. Assessment of water protection measures

Monetary valuation of natural resources is an important component in the theory of optimal functioning of the economy. It is known that water resources are state property. However, this does not mean that they should not have monetary value. Free use of the natural resources in the future may not be admitted.

Definition of economic efficiency of use of water resources and the conduct of water protection measures is to compare the cost these events obtained from them results. Choose this option by determining the comparative economic efficiency, which can be found either at the given capitalized costs:

$$З = К + ИТ_n, \tag{5.1}$$

where К, И – capital investments, annual expenses, respectively;

T_n - normative payback period of additional capital investments (T_n=8.3 years)

Or normalized to one year costs:

$$З_н = И + E_nК, \tag{5.2}$$

where Y_{ong} – normative coefficient of efficiency ($E_n=T_n^{-1}$), currently E_n=0,12.

A technical option that has the minimum value of a given cost Z_n or Z_{as} the best.

In determining the overall economic efficiency using the indicator return period of capital investments:

$$\Omega = К/П \leq \Omega_н. \tag{5.3}$$

Coefficient or overall economic efficiency (profitability):

$$r = 1/\Omega = П/К \geq r_н, \tag{5.4}$$

where n is the index denoting the normalized value.

For existing facilities total economic efficiency is defined as the ratio of annual profit to average annual funds (the basic and turnaround). A measure of total economic efficiency for proposed consider the benefit / cost ratio.

Regulatory rate of return is not set, but for some industries it is taken from 0.10 to 0.16, depending on the specialization of farms.

Comparative economic efficiency of water protection measures.

Comparative economic efficiency is defined in the planning and design of water management facilities subject to environmental protection with the purpose of choosing optimal variant.

A prerequisite for determining the comparative economic efficiency is the reduction compare the options for comparative view of the material effect, ie the volume of production, its composition and quality; function compare variants of the constructions; on the effect of protective measures; the volume and extent of water treatment, etc.

The main method of determining the comparative economic efficiency of capital investments is the calculation of the amount of reduced expenditures, consisting of one-time capital investment and annual costs, as a criterion of effectiveness is the minimum of the estimated costs. Estimated cost Z can be normative payback period of additional capital investments of T_n or in one year. In the first case, summarize the capital investments To annual costs And regulatory payback period T_n and the second annual costs and capital expenditures, multiplied by a factor of comparative economic efficiency $E_n=T_n^{-1}$.

The source data in determining the relative cost-effectiveness are the only capital expenditures and production costs for all the comparative options. Unlike the original data, required for determining the overall economic efficiency, comparative effectiveness no need for data on the cost of products or work performed, as it must be the same in all comparative options.

Estimated cost З determined by the formula:

$$З = К + Т_н И, \tag{5.5}$$

$$З = И + Е_н К. \tag{5.6}$$

At present, for determining the comparative economic efficiency of the application of a normative eight-year payback period and the coefficient of comparative economic efficiency, respectively, and 0.12.

In determining the economic efficiency of capital investments, especially on large water objects, for which it takes a long time, it is necessary to consider the time factor, i.e. the timing of capital investments, on the one hand and the term of operation of a facility design rate of receipt of the products and profits on the other.

Designating by Kt capital investment in year t, taking the number of years the construction of a water object is equal to tc and assigning the year of the τ can be calculated given the capital investment Kτ by the formula:

$$К_\tau = \sum_{1}^{tc} K_t (1 + E_B)^{\tau - 1}, \tag{5.7}$$

where E_V – regulatory factor that takes into account the losses in production due to the immobilization of capital investments.

The value of E_V is still in the feasibility calculations are not normalized. Proven only that she needs to be with the normative value of the coefficient of comparative effectiveness. A number of experts believe that $E_B = E_F$, but there are proponents of another viewpoint believe that $E_B < E_F$. It is recommended to take $E_V=0{,}8\ E_N$.

In the first year of operation of water facilities and operation water protection measures annually costs change by ΔИt. Suppose that the ratio EB can be used to bring the values δ Иt.

If denoting the year of the beginning of operation through tэ, and year of output of the object at the project level t*, the formula of bringing annual costs Иτ will be:

$$\bar{И}_{\tau} = \sum_{t_э}^{t_*} \Delta И_t (1+E_в)^{\tau-1}. \tag{5.8}$$

Monetary assessment of the use and protection of water resources.

To ensure more appropriate and efficient use of water resources play a big role economic evaluation.

In terms of cost-accounting relations, the most important event to encourage economical and efficient use of water resources are the introduction of water charges.

Water charges should result in an increase of efficiency of production economic activity of an enterprise taking into account the factors of environmental protection. Insufficiently developed system of charges for wastewater discharge to the sewer system, depending on the degree of contamination of water resources.

The tariff for wastewater treatment in cooperative or regional wastewater treatment plants TS proposes to determine by the formula:

$$Ц = И + Р\ (I + е_1) + е_2 КФ \pm Л, \tag{5.9}$$

where And are the material costs for wastewater treatment;

R – pay;

E1 – norm of net income proportional to earnings;

E2 – norm of net income, proportional to the main and circulating production funds;

K – coefficient taking into account the performance of the funds;

F – production funds;

L – rate surcharge or benefits for the improvement of economic parameters of work of treatment facilities.

The cost of water supply, This is given by:

$$Зв = Звс + Эо, \tag{5.10}$$

where Dr – the cost of water supply, treatment and disposal of sewage;

EO – economic valuation of water in the pool.

In areas where water resources are limited, economic evaluation of water may be determined by the cost of closing events or on the assessment of water as a natural resource.

Then $E_0=E_z$, where ez is the cost of closing events for the replenishment of the water resource. It is necessary, to transfer of water resources from other water systems or swimming pools the costs of closing events is determined by the formula:

$$З_з = З_р + З_п, \quad (5.11)$$

where Z_r is the cost of flow regulation in the river, where is the transfer;

Z_P - expenses for the transfer of water resources.

Research focuses on the development of the following types of payment cleaning and sewage:

- for the wastewater treatment in cooperative or regional wastewater treatment facilities;

for the discharge of insufficiently treated sewage into rivers and ponds are shallow, densely populated industrial areas, where measures are taken to increase water resources;

for the discharge of insufficiently treated wastewater into rivers, water reservoirs with use of self-clearing ability.

6 Rational use and protection of water resources as an integral part of a comprehensive program of use of natural resources and environmental conservation

The basis for the development of human society is the rational use and protection of natural resources, among which a special place is occupied by surface water and groundwater of the land. The rapid growth of production and population is associated with an increase in water consumption, thus necessitating the implementation of a range of measures for the rational distribution, and prevent the depletion of water resources and the protection of them from contamination.

A comprehensive program of use of natural resources in recent years began to develop from the tendency of active use of economic methods of management and use of natural resources. We are talking primarily about the introduction of fees for use of natural resources.

Similar mechanisms exist in the international practice of environmental management (USA, Japan, Poland) and confirmed its effectiveness.

Under this principle, summed up the corresponding legal and methodical base, and also addressed issues of management and control. The formation of the economic mechanism of nature management in the conditions of market economy will occur in the following areas:

1) accounting and socio-economic assessment of natural resource potential and economic condition of the territory, planning of environmental protection and rational use of natural resources, financial and credit mechanism of nature management;

2) economic incentives (tax, credit and other benefits to companies and organizations), the payment for natural resources, the economic influence on violators of environmental legislation;

3) improvement of organizational and economic methods of environmental management.

The role of water in human activities as factor of increase efficiency of social production.

Water resources until recently, considered inexhaustible and

available, quickly moved into the category of resources, the lack of which will seriously hamper sustainable economic development, and in some parts of the world to be the main cause of conflict between the individual States.

The share of fresh water in the total volume of global water is about 2.5% or 31 to 35 million km^3. But this water is trapped in glaciers in the form of atmospheric and soil moisture, not available for development and the amount exceeds 99,7%.

Thus, humanity has conditionally 0.3% or 97 thousand km^3 of fresh water that could be used for economical purposes. However, this volume of freshwater, belonging to so-called renewable water resources, also unavailable, in many parts of the world formed in the form of monsoon rains, causing catastrophic floods with widespread destruction of settlements, infrastructure.

Scientists have found that water stress occurs when available water resources less than 1.7 thousand km^3 per person, and a shortage occurs when the index less than 1.0 thousand km^3 per year. Today, more than 230 million people live in countries which are considered to be countries with a deficit of water. In 11 countries in the Middle East and North Africa per capita accounts for only 500 m^3 of water resources annually, and they are related to the category of countries with "absolute water scarcity".

According to the forecast, in connection with population growth, the number of such countries will grow rapidly. Every year, global population growth is 90 to 94 million people, respectively, should increase the consumption of water for drinking purposes, food production, industrial products, etc. So, if in 1950 this value is averaged 33.0 thousand m^3, then in 1993 he dropped to 8.5 thousand m3 per person per year (almost 4 times). This figure in 2000 by region compared to 1950 declined in Africa from 20.6 to 5.1; Asia, from 9.6 to 3.3; Europe, from 5.9 to 4.7; North America from 37.2 to 17.5; Latin America 105,0 to 28.3 thousand m3 per person per year. Almost 40% of the world's population, most of them live in developing countries, already facing serious problems caused by lack of water. By the middle of this century, 65% of the world population will come into contact with the water problem, if you do not take effective measures. The flow of rivers and groundwater is in an average year about 41100 km, or 8% of the total volume of water making the cycle on earth. In relation to the amount of precipitation falling on the land, the runoff equal to 36.4%. This ratio is called the coefficient of runoff, the size varies depending on physical and geographical conditions of an area.

The General equation of the water balance within the entire globe may be represented in the form of the following equation:

$$U_o+U_c=O_o+O_c, \tag{6.1}$$

where U_o, U_c, — evaporation from the surface of the ocean and the land;
O_o, O_c, — precipitation at the ocean surface and land surface.

The distribution of the natural waters on the territory of the Republic of Kazakhstan. The reserves of fresh water in Kazakhstan has a great diversity of climatic conditions. The main part of its territory is located in arid zone and has very limited water resources. Most developed hydrological network in the North and East. In the Central part of Kazakhstan is occupied by desert areas, the main water arteries are not abounding in water sources. To the South, in the foothill and mountain areas, river network density increases and reaches its greatest development on the southern and South-Eastern suburbs. The rivers flow of the southern and Eastern zones of the Republic are formed by the melting of ice, snow. The same flow of rivers in the Northern, Western and Central Kazakhstan, in most cases, due to winter precipitation. The main phase of water regime of rivers in Kazakhstan, with the exception of the southern and South-Eastern regions, is spring flooding, which accounts for most or all of the annual runoff. Water resources of river waters of the Republic in an average water year are estimated at 100.5 billion m3, of which 56,5 billion m^3 formed on the territory of Kazakhstan and 44.0 billion m3 coming from neighboring territories (China, Uzbekistan, Kyrgyzstan and the Russian Federation). Specific water availability is equal to 36,4 thousand m^3/km^2 and 6,0 thousand m^3 per person per year.

Surface water resources in the territory are unevenly distributed and vary by year and within each year, and cause uneven water supply to the regions of the Republic. Most water supply East-Kazakhstan oblast - 290 thousand m^3/km^3, the least Atyrau, Kyzylorda region and in particular Mangystau region - 0,36 m^3/km^3.

On the territory of the Republic there are 3700 lakes with surface area over 1 km^2 and 17 lakes with an area exceeding 100 km^3, the total volume of water in lakes reaches 190 mrad. m^3, of which the share of freshwater lakes makes up about 10%. In order to accumulate winter and spring river runoff in Kazakhstan has built 180 reservoirs with a total capacity of about 90 mrad. m3.

According to hydrogeological bodies of the Republic of Kazakhstan approved groundwater reserves equal to 17.3 mrad.m3, of which categories A+b=11,9 mrad. m3. currently, the amount of them used groundwater is about 2.0 mrad. m^3.

Given the extent of modern improvement perspective use, and excluding hydraulically connected part of them with river flows, it is possible to use, you can take up to 7 mrad. m^3 per year.

Assessment of the economic necessity of development, however, a need to determine the numerical criteria, the simplest of which is the criterion of economic efficiency (formula 6.2):

$$k_э = Э_п/З_и, \qquad (6.2)$$

where EP is the estimated economic effect of the introduction;
Z — the cost of research.

The larger the value of k, the more effective theme and above its economic efficiency. However, the k criterion does not take into account the amount of the introduced products, implementation period, so the more the lensing criterion is calculated according to formula 6.3:

$$k_э = C_г\sqrt{T}/З_о, \qquad (6.3)$$

where SG — the cost of production for the year after the development of research and implementation into production;
T — the duration of the production implementation in years;
3O — the total cost of performance of scientific research, experimental and industrial development of products and annual production costs for new technologies.

7 River basins of the Republic of Kazakhstan

The Balkhash-Alakol river basin.

1) General characteristics of the Balkhash-Alakol basin (BAB): the territory of 400 km^2; coordinates 73-830 VD, 43-480 school; it has a population of 2.8 million people; the demographics — urban population of 1.7 million people in 35 cities and towns, rural 1.1 million people - 1050 of the rural settlements; major cities: Almaty, Taldykorgan, Balkhash; the area of farmland — 31,0 million hectares; administrative division: Almaty region, part of the Karaganda, Zhambyl and East Kazakhstan regions.

2) the Water resources of the Balkhash-Alakol basin.

Surface water resources: more than 50 thousand rivers and small streams, 95% of the rivers are concentrated on 450 rivers; about 24 thousand lakes and artificial reservoirs, the main water artery of the basin — river Or main lake — inlet: lake Balkhash, Alakol.

Transboundary water resources — 50% of the total volume of China (PRC).

Tobol-Torgay river basin.

In the service area of Tobol - Torgai BVU part of Kostanai region and Irgiz regional area of Aktobe region, within the basins of the rivers Tobol, Torgai and Irgiz. The total area of the serviced territory is 283 thousand km^2. The population in the service area 1050,0 thousand people, with 3.7 persons/km^2. In the service area, there were (as of 01.01.2006) 19 districts, 4 cities and 297 rural local authorities..

Main water arteries are TBWW rivers Tobol, Torgai and Irgiz with their tributaries. Has a length of from 10 to 50 km – 290 watercourses; river length 100 km – 21; up to 200 km – 13; 300 km 4 500 km – 2 (Ubagan, UY); up to 1000 km – 2 (Torgai, Irgiz) and more than 1000 km – 1 (Tobol).

The nature of the surface divided into four regions: the TRANS-Ural plateau, in the plain, the Turgay table country Western outskirts of the Kazakh folded country. Within TBWW is more than 5000 lakes, the total area of which is about 3% of the total land area of STB. 80% of the lakes have a surface area less than 1 km^2, about 20% of lakes in the Northern part and 60% in the southern part belong to the salt ponds. The largest reservoirs and lakes – 3 (Upper Tobol reservoir with a capacity of 816 million m3, Cartomancie reservoir with a capacity of 586 million m3 and lake Kushmurun with capacity above 500 million m^3 and area of the mirror (460 km^2), with a capacity of lakes and 500 million m3 to 7 lakes and up to 100 million m3 – 8 lakes, other small.

Irtysh river basin.

In the Irtysh basin live to 2.5 million people. Here are located the major industrial centers of Ust-Kamenogorsk, Semipalatinsk, Pavlodar, not to mention the numerous small towns and villages.

The Irtysh river — like water body is a transboundary river and has a status of special national importance. In the Irtysh basin has 788 rivers, 13 rivers with length of over 200 km and 775 of the rivers (with length less than 200 km) that are related to the category of small rivers with a total length of 17.7 thousand km the largest tributary of the Irtysh river in Kazakhstan is the Bukhtarma river, its length is 405 km, mean annual runoff 243 m^3/sec, catchment area 15485 km^2, in her pool accounted for 124 river with a total length of 2919 km^3.

The second water tributary of the Irtysh — river UBA, with a length of 286 km. the average annual flow of the river 170 MZ/h, with a catchment area of 9952 KMZ. In a river basin of UBA accounted for 92 of the total river length km 1998 To the middle river includes the river Kurchum, R. Ulba.

Rivers of southern Altai is less humid than the river right Bank. The largest rivers — Kaba, Alibek. Even smaller water content at the left — Bank tributaries of the Irtysh- Char, Kenderlyk, UGENE, Kandysu, Big, Bukon, Kokpekty, Kyzylsu. Mean annual water level of the river basin is 33.8 km^3 per year.

In East Kazakhstan there are 1967 lakes with a total area of 896 km^2, with a volume of about 6.8 km^3 (without the lake. Alakol, Sasykkol). Of the total number of lakes in the region — 91 has an area of over 1 km^2.

A special place of all the lakes of Eastern Kazakhstan is lake Markakol. On the territory of Pavlodar region there are 398 lakes area of 11 km2, of which 74 are fresh, the others salty.

The largest natural reservoirs with a surface area of over 50 km^2 are salt lake Kanyzak, two birds caught on Zhalauly, AGI Bulat, Maraldy, Charector and others.

From freshwater lakes the largest are lakes Sabyndykol, Zhasybai, Tuberty, Humicool, Karasukinac, Tensor.

The maximum content of the Bukhtarma reservoir were observed in the second decade of July, 1994 and the volume was made up 47,51 km^3. The minimum amount 18,81 km^3 (dead storage).

Ust-Kamenogorsk reservoir is 1 km upstream from the confluence of the river Irtysh river left tributary, Ablaketka. Reservoir channel , flow regulation unseparated. The purpose of the reservoir is complex. It is taken into commercial operation in 1961. The volume of the reservoir at FSL is equal to 655 million m^3. Maksimalno fluctuation of water level is 1 m.

Surface area is 38 km2, a coastline of 180 km. the facilities of the dam include: concrete dam, the building of the dam type with 4 units with a capacity of 332 MW and one hole for the idle reset, the lock chamber of the mine type.

The volume of discharge in 2005 was 17,22 km^3. Shulbinsky reservoir is 3 km above the village Bazhenovo. Reservoir channel, lead seasonal regulation of lateral inflow in the area between the Bukhtarma and Shulbinskaya HPP. The purpose of the reservoir complex. The facilities of the dam include channel building with 6 units with a capacity of 702 MW, combined with 12 of the bottom spillway, earthen dam and run of river shipping lock. The hydroelectric station Shulbinskaya hydroelectric power station built in 1987.

The Aral-Syrdarya river basin.

The Aral-Syrdarya basin water authority, being a territorial subdivision of the Committee on water resources, Ministry of agriculture, carries out its activities in public administration, to regulate the use and protection of water resources on the territory of 250 thousand km^2 of the Syrdarya river basin, a total area of 444 km^2 (the rest of the territory belongs to the Republics of Kyrgyzstan, Tajikistan and Uzbekistan). The Aral-Syrdarya water basin covers the territory of Kyzylorda and South Kazakhstan regions which are almost entirely located in the basin of Syr Darya river and enter the four water industry districts: the middle current - Hungry steppe of Kazakhstan with an area of 2.0 km^2, Chirchik - Angren -Keles (Cakir) - with an area of 12 thousand km2, Arys-Turkestan (Arthur) - with an area of 28 km^2 and downstream - with an area of 208 thousand km^2, which belongs to the desert zone, the climatic features of which is a sharp continental climate, high summer temperatures, a very small amount of precipitation, wind North-East and the North. In the area of the Aral-Syrdarya series of electric plants, the STB has 120 small rivers and reservoirs 18. On the territory of South Kazakhstan region takes 2 tributary rivers Keles, Arys and collector-drainage water from rice and cotton fields. Below the confluence, R. Keles, R. Syrdarya is regulated by the Shardara reservoir, which was implemented as all reservoirs of the Naryn-Syrdarya series of electric plants of the cascade with the priority goal of water supply for agriculture.

Shu-Talas river basin.

Shu-Talas hydrographic basin is located mainly on the territory of Zhambyl region and partially Sozak district of South Kazakhstan region. The main rivers are Shu, Talas are transboundary, the drain of which is mainly formed in the territory of the Kyrgyz Republic (KR). River Shu - basin area of 67.5 km^2, including the territory of Kazakhstan – 40,9 thousand km^2; the length of the river is 1186 km, including the territory of Kazakhstan – 850 km; annual runoff – 6.64 km3, of which is formed of RK – of 1.64 km^3. Talas river - basin area – 52.7 K km^2, including the territory of the Republic of Kazakhstan – 41,27 thousand km^2; the length of the river is 661 km, including on the territory of the Republic of Kazakhstan – 444-km; annual runoff – 1616 million m^3; of those formed in the Republic of Kazakhstan - 92 million m^3.

Ural-Caspian river basin.

Ural-Caspian hydrographic basin is located in the Western part of Kazakhstan covering the territory of four regions: Atyrau, Aktobe, West Kazakhstan and Mangistau, the area of which amounts to 733 km^2. The region is home to more than 2 million population. The main direction of economy is the development and production of oil and gas fields, agriculture and fisheries.

In the Ural-Caspian basin includes more than 20 large and medium rivers, over 40 reservoirs with a volume of more than one million m3 each, hundreds of small rivers longer than 10 km, thousands of rivers length of 10 km, as well as the Kazakhstan part of the Caspian sea. The coastline on the Kazakh coast is 1600 km, or 23% of the total length of the coastline of the Caspian sea. The main rivers of the basin – Ural, Kigach (sleeve Delta of the Volga river), Bolshoi and Malyi Uzen, Or', Ilek, Chagan, etc. If water resources of the Ural-Caspian basin is 28 km^3, not including water from neighboring Russia comes of 21.3 km^3 or 76% of the total water Fund. The peculiarity of the Ural-Caspian basin is the fact that half of the surface runoff water is concentrated in the river Kigach, which flows through the territory of Kazakhstan only in their mouth parts, therefore significantly limits the use of this flow.

Nura-Sarysu river basin.

Nura river originates in the Central part of the Kazakh uplands in the mountains of Kyzyltas at altitude 1100-1250 m above sea level and flows into a closed lake Tengiz (Teniz) at a concentration of about 304 m. the Total length of the river is 978 km, the catchment area of 60.8 km^2. The river flows through Korgalzhyn lakes and flows into lake Tengiz. In this area in 1958 was created Korgalzhyn State nature reserve with a total area of 243,2 thousand ha. From 01.01.2004 year reserve Korgalzhyn related to protected areas of IUCN category 1A - strictly protected nature reserve. The river Sarysu - the total length of the river is 761 km, with a catchment area of 82 km^2.

All the river basins of the rivers Nura and Sarysu rivers are mostly snow supply. Therefore, almost the entire annual flow of the streams held in the spring – 100% almost all small and medium-sized tributaries to 85% on major rivers.

Water resources.

Water resources consist of surface runoff of rivers, the Irtysh revenues water reserves in lakes and groundwater.

The flow of rivers. Average long-term runoff of the river Nura from S. Romanowski (shot with the highest water level of the river) is 0.68 billion m^3. In wet years, security of 1% (1 in 100 years) estimated annual flow of the river exceeds 3 billion m^3. In dry years security 95% of the runoff is reduced to 0.12 billion m^3. In the basin of the Sarisu greatest natural runoff was observed at gauging post R. Sarysu - tract Karazhar – 237 million m^3/year.

The waste water. Directly to Nuru in 2004 received 33.2 million m^3, 1.6 million m3 Sherubainura in the inflow Sherubainura R. Sokar – 66.5 million m3 of wastewater. In the river Karakengir and Zhezdy dropped 24.7 million m^3 with treatment facilities in the city of Zhezkazgan and Satpaev. Only in the basins of Nura and Sarysu rivers has received 126 million m^3 of wastewater.

Ishim river basin.

Ishim basin water management covers a territory from Central Kazakhstan, Akmola and North Kazakhstan regions with total area of 245 km^2, where covers 85% of the total area of the basin. The population 1750,9 thousand people, including urban – 1720 thousand. Mean annual annual flow of 2.6 km^3. The disposable water resources of the basin is 5.3 km^3. Only 7515 lakes is 2.3 km^3 and the reservoir is 1.4 km^3 of annual water intake is 230 million m^3, of which groundwater is 40 million m^3.

The Ishim river takes the head of the mountains "Niyaz" osakarov district of Karaganda region. The total length of the river is 2460 km, in Kazakhstan is 1940 km, is a transboundary river which is a tributary of the Irtysh. River on the territory of Kazakhstan is regulated by four reservoirs, Ishimskiy capacity of 8.6 million m^3, Vyacheslav volume of 411 million m^3, Sergeevskaya - 693 million m^3 and Petropavlovsk water reservoir – 19.4 million m3. The annual flow of the Irtysh river on the border of Russia post Dolmatova 1995 and 2005 ranged from 400 million to 4100 million m^3 of water. From the top, the main channel of Ishim, a tributary of the Aktasty, Moiyldy and Meagher mainly fills Vyacheslav reservoir. The influx Koluton, Zhabay, Tersakan, Accubook, Minbulak and other tributaries mostly filled with Sergeevskoye reservoir.

7.1 Problems of the river basins of the Republic of Kazakhstan. The Caspian sea basin

Surface runoff of the Ural in an average year is 10.6 km^3, respectively, to 5.9 and 2.3 km^3 in the years 75 and 95% probability. From underground sources in the basin of the Urals is taken about 0.7 km^3. The flow of the Kura in the water balance is equal to 26.9 km^3 and drain 75 and 95% security is respectively 23.5 and 19.5 km^3. The use of groundwater in the basin is about 2 km^3. Surface runoff of the Terek river is for the average year 11 km^3, a drain 75 and 95% probability respectively of 10.1 and 7.8 km^3. The use of groundwater in the basin is estimated at 0.3 km^3. The runoff of the Sulak is 5.6 km^3 in an average year and 5.0 and 4.3 km^3, respectively, 75 and 95% probability (tables 7.1 and 7.2).

Wellhead part of the Ural river is a unique natural complex is exposed to fluctuations in the background level of the Caspian sea and anthropogenic changes in the river basin. The Ural river belongs to the type of rivers with a predominantly spring tides. The bulk of the runoff (70%) is received during spring (April - June).

Mouth of R Ural and Kigach the duct and Sharonovka.

Hydrological regime of the mouth area influenced by the river and the sea, the mouth area of the downstream reduced the impact of increasing river and sea.

Table 7.1 - Irrevocable withdrawal of flow in the basins of the main rivers flowing into the Caspian sea, km^3/year

River	Water and fish farming	Irrigation (75%)	Moving to other areas	Evaporation from surface water reservoirs
Volga	8,2	13,0	7,1	8,1
Terek	1,8	4,3	0,4	-
Sulak	0,1	1,0	-	0,0
Kura	2,2	15,0	2,2	1,3
Ural	1,1	1,6	-	0,2
Total	13,4	34,9	9,7	9,6

Table 7.2 - Water resources the main rivers flowing into the Caspian sea, km^3/year

River	Groundwater use	Surface runoff	Total water resources
Volga	5,70	253,0	258,70
Terek	0,30	11,00	11,30
Sulak	0,01	5,60	5,61
Kura	1,97	26,90	28,87
Ural	0,70	10,60	11,30
Total	8,68	307,10	315,78

Maximum discharges are observed in the period of spring floods, most often in the second half of may. The lowest discharges are observed in winter, as a rule, before or at the end of the ice period. Maximum annual flow 1% exceedance for the period 1958-1993 is equal to 2420 m^3/s, the lowest for the year consumption of the same security 113 m^3/s in natural regime, 1936-1967. these values were respectively equal to 7370 and 87.3 m^3/s. Average water consumption natural period coming in the top of the mouth area of the Ural river (S. Topol – Makhambet village), equal to 278 m^3/s with broken mode, its value was 253 m^3/s. For the period from 1980 to 1992 the average annual flow is 275 m^3/s About 85% of the total runoff in the Caspian sea enters the Northern part of its basin, within which are the largest rivers Volga and Ural. Flows into the sea about 160 rivers, but the bulk of runoff bring in the sea are the Volga (80%), Ural (about 5%), the Terek, Sulak and Samur (total up to 5%), chicken (about 6%). The rivers of the Iranian coast of the small rivers of the Caucasus and the other is 4-5%.

Lake Balkhash.

The basin of the Balkhash lake is 353 km^2 and is located on the territory of Almaty (Taldykorgan), partly in the East Kazakhstan (Semipalatinsk), Karaganda (Zhezkazgan) and Zhambyl regions. The pool is concentrated 35% of all water resources of Kazakhstan and submitted to surface and groundwater. Mean annual surface water resources of the basin of lake Balkhash are 24.3 km^3, including – R Or – 18.1 km^3, rivers of the Eastern Balkhash and 6.2 km^3. Forecasted operational resources of fresh underground water make – 308 m^3/s or 9.7 km^3, including GKZ approved and TKZ – 4.8 km^3.

Lake Balkhash has achieved over the average period before regulation of the river's flow Or just 15.1 km^3 (or 62%). The rest of the flow is spent: on the water requirements of a national economy – 16%; losses in zone of dispersion – 10%; evaporation in the river deltas of 12%. In the whole basin of water abstraction for irrigation in 1987 7.0 km^3 and the total volume of irrevocable water consumption in the modern conditions of 5.6 km^3. Therefore, the evaluation is roughly: on the border with China is 12.5 km^3; in Kazakhstan was 5.7 km^3; total is 18.2 km^3.

In its natural state (relatively to 1965) water balance of lake Balkhash was supported by the rivers discharge in the amount of 23.8 km^3/year, most of which is 17.4 km^3/year is runoff Or R. and the rest of 6.4 km^3/year accounts for the flow of the Eastern rivers Karatal, Aksu, Lepsy and Ayaguz flowing except for the last, from the slopes of the Jungar Alatau. This amount of water only 14.9 km^3/year reached the Balkhash lake, which is completely spent for evaporation.

7.2 Hydrological forecasting and its role in the water sector

The increasing value prediction in particular elements of water balance: surface runoff, precipitation and evaporation, will be available in the future due to the increasing value the more rational and economic use of water. The existing forecasting system provides a long-term and short-term forecasts. Long-term forecasts, predicted for the next few months, allow you to plan the most optimal allocation of water resources, particularly in areas with stressed water balance. Short-term forecasts contain information about the alleged condition of water resources for the days ahead.

The most important forecasts are: forecasts of monthly, quarterly and seasonal water inflows to all major reservoirs and energy complex assignments; forecasts of river flow in areas of irrigated agriculture during the growing season and more short-term; long-term predictions of maximum river levels during the spring and summer-autumn floods; short-term forecasts of expenditure levels of the rivers during floods; the forecasts of the beginning of freeze-up and opening of waterways and reservoirs.

In order to compare the existing water resources with the needs of different sectors of the economy and natural complex, constitute the water balance (figure 7.1).

In order to simplify the diagram, consider all the components with respect to the right-Bank part of the territory. The corresponding arrows tentatively identified the following value:

$$W_5 = W_1 – W_3 + W_4; \quad (7.1)$$

W_1 is total consumption of water consumption of various sectors of the economy;

W_2 - the total return flow of water that flows back into the river (after use);

W_3 is part of the return flow of water that can be reused in the range of 1 area; this flow can be represented by $W_3 = W_2$, where "a" is some coefficient equal to 0.1 - 0.5;

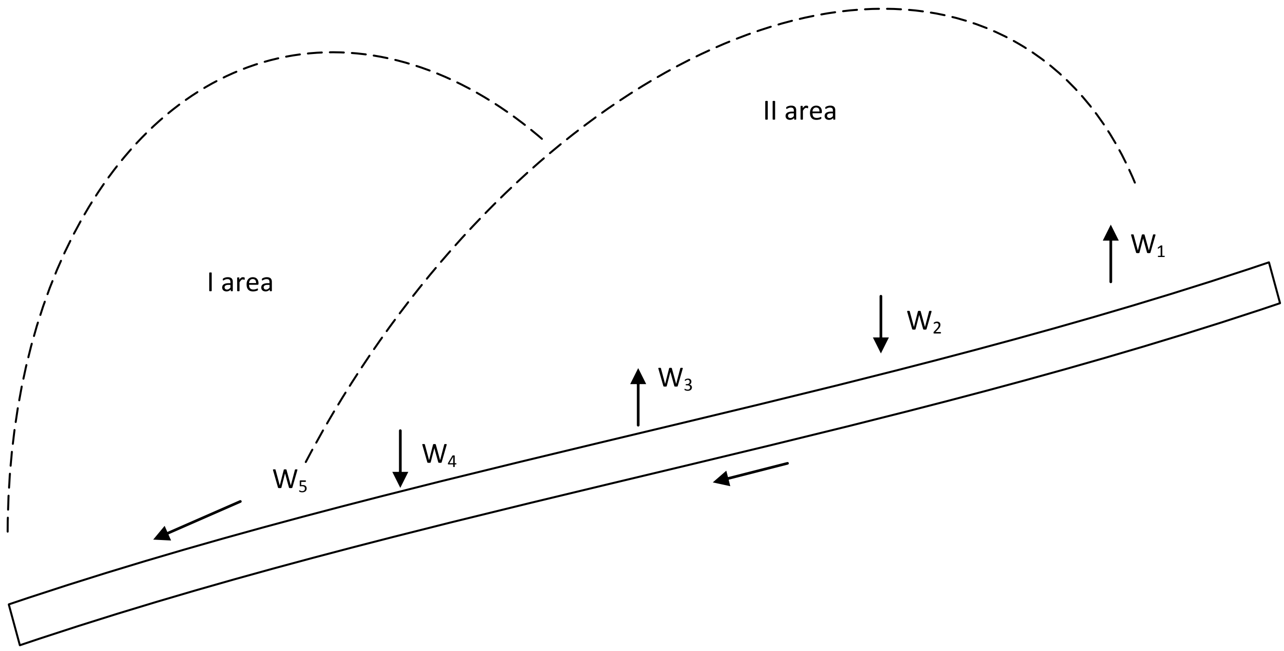


Figure 7.1 – Components of the water balance

I, II - numbers of areas for which water balances are being developed.

W_4 - the minimum acceptable flow in the river is established based on the requirements of sanitation, navigation, recreation, and for dilution of waste water;

W_5 - required minimum water flow in the river section under study, which should be maintained in a dry year with security 95%;

W_6 - the total loss of water for the settlement area within the I district:

$$W_6 = W_1 - W_2. \quad (7.2)$$

The flow of water in this area can be represented as:

$$V_1 = V_1' + V_1'' + V_1''' + V_1'''', \quad (7.3)$$

where V_1' is a natural inflow of surface and groundwaters;

V_1'' - the flow of return water from upstream areas;

V_1''' - surface and subsurface runoff generated within the boundaries of its own watershed;

V_1'''' - water transfer from neighboring river basins.

The total volume of water that can be obtained through the use of reservoirs located within the boundaries of the area under consideration, we denote by V2 (formula 7.4):

$$V_2 = V_2' – V_2'' + V_2''', \tag{7.4}$$

where: V_2' - drawdown of reservoirs;

V_2' - filling the reservoirs;

V_2'' - the loss of water through seepage and evaporation.

Thus, the total volume of regulated flow:

$$V_3 = V_1 – W_3. \tag{7.5}$$

Water flow in the river, which will flow into district II:

$$V_4 = V_3 – W_6. \tag{7.6}$$

The excess available flow in excess of the lowest acceptable flow in the river:

$$V_5 = V_4 - W_4. \tag{7.7}$$

It is becoming increasingly important predictions of water quality especially for river basins with intensive water use.

8 Major water problems of the Republic of Kazakhstan

According to some estimates, in 30 years, about one third of the world's population will experience a constant shortage of water.

The reasons are obvious: the growth needs as the intensive increase in population; the deteriorating quality of existing water reserves due to pollution; increase in water demand of rapidly developing industries and agriculture.

Global freshwater consumption is growing annually by 2-3%.

Therefore, in response to growing in number and increasing diversity of its use, the need to protect water resources and management more important than ever.

In the world, more than 1 billion people do not have the opportunity to enjoy healthy water, and 1.7 billion people live in unacceptable sanitary conditions. Polluted and contaminated water annually cause the deaths of millions (3 million) people. Since water pollution is a serious and ubiquitous problem, her cleaning is of paramount importance.

The identified trends show that currently in some regions of the brewing water crisis. His approach most noticeably in the middle East and North Africa, where annual water consumption per capita is 1247 m^3, when compared 18742 m^3 in North America and 23103 m^3 in Latin America, Kazakhstan 2500-2700 m^3.

In many countries water scarcity due to its wasteful use of water resources. Water losses due to leakage, filtering, and improper accounting range from 40 to 60 %.

Economic, political, environmental and social aspects of the problem.

In the coming Millennium, realizing the sustainable development agenda, we have to develop a new approach to the problem of water resources in order to overcome these errors, to eradicate poverty and save the environment.

This new approach needs to provide a holistic solution to the quantitative and qualitative aspects of integrated water resources management; to combine into a single unit agriculture and sustainable consumption of water; recognize water as an economic good and promote activities for its rational use; promote the implementation of new developments and approaches involving all stakeholders; to pay particular attention to activities aimed at improving living conditions and environmental quality.

Water resources management: water resources management are very diverse. The volume of water from rivers and reservoirs are made to meet the needs of water supply, fish culture, irrigation, irrigation and energy.

Dams are the more common type of flow control. The construction of the dams present an opportunity to accumulate large volumes of water used by many participants in the water management sector.

Regulation of water resources by reservoirs.

Due to large fluctuations of river flow in time-dependent meteorological conditions and the need to accommodate the interests of different sectors of the economy, we have to create the reservoir.

In the design, creation and operation of reservoirs the following types of flow control: daily; weekly; seasonal or annual; perennial; special.

When the daily regulation, a reallocation of a relatively uniform flow of water throughout the day to meet the changing needs of participants in the water sector.

Weekly regulation aims to provide uneven water consumption during the week. Accordingly produced the accumulation of flowing volumes and spending them in the most strenuous days. Seasonal or yearly regulation is made for redistribution of flow from wet seasons to dry. Long-term regulation allows to align the drain for a number of years. When this occurs, the accumulation of water in wet years and spending it in dry years.

The special regulation can take a variety of forms. It is primarily in those cases when the graph of water consumption by some participants of water sector is certain.

9 The Influence of economic activity on land resources

The lithosphere is the solid shell of the Earth (to a depth of about 200 km), which are the mantle and core. The age of the Earth is about 4.5 billion years. The surface of our planet is 510 million km . While most of it is 361 million km is covered by water. The total land area of about 148 million km , about 15 million km falls on glaciers, the remainder space, it is about one third forest, and the same are agricultural lands. The territory of the CIS is 22.3 million km , the territory of Kazakhstan is 2.72 million km . The proportion of agricultural land in total area is for the countries in the CIS

– 27% USA -53, France – 63, Canada – 7, Argentina – 65, FRG – 50, Brazil – 28, India – 60, Japan – 6, China – 40 [2].

The soil is a special natural formation, has a number of properties inherent in animate and inanimate nature, formed as a result of a long transformation of the surface layers of the lithosphere under the joint interdependent effects of the hydrosphere, atmosphere, and organisms. The main objective of the soil is the preservation of the integrity of the soil cover, maintenance of fertility to provide the growing population with food. For the characterization of land resources as means of production are important regional and territorial aspects. The highest percentage use of land for agriculture in Europe, in the CIS, Kazakhstan is the lowest, although the area is large, but the soil less fertile.

The soil cover of Kazakhstan. Kazakhstan takes 9th place in the world in terms of territory (272,5 million hectares), including forest-steppe, steppe, semidesert and desert zones. Diversity of soils of Kazakhstan due to latitudinal zonation, increased climate aridity from West to East, geological and geomorphological features of different parts of the territory. Land recourses of Kazakhstan, their rational use and improvement capable to produce various agricultural products in quantities that meet domestic and export needs.

The role and development of forest resources. A special role in the formation of soil play plants in General and forests in particular. The world of plants has more than 500 thousand species. Of all the types of Land cover and natural resources of our planet the most common and most valuable are the forest. Forests, occupying a significant portion of the earth's surface, are giant biological factory of the world, which constantly induces the production of oxygen, which allows you to exist all of humanity and all life on Earth. 1 hectare of forest yields from 3 to 5 t oxygen, recycles approximately 6 tons of carbon dioxide, precipitates of 30 – 60 tons of dust per year. The amount of precipitation over the forests for 10 – 30% more than other places (due to condensation of moisture on them). Any forest increases the amount of water in the soil (due to snow cover) in 1,5 – 2 times, reduces surface runoff up to 10 times, filters the water (increases transparency, improves the color, smell). The forest is the source of wood raw material for the chemical, food, medical industry.

The total area of forests in the world, according to the estimates of the Forest Department, FAO of the UN, is 4061 million hectares, and forest – 3620 million hectares of Kazakhstan is characterized by weak lesisty (3,7%), whereas only for the protection of arable land

forest Fund should be 2 - 4%. The average percentage of forest land is 27%, the stock of wood in forests – 337 billion cubic meters, of which 127 billion cubic meters accounts for softwood. Over the last 10 thousand years, the forested area on the Earth decreased by 1/3, giving way to crops, pastures and cities.

The main waste types and their brief description, principles of waste classification.

Waste, N. F. Reimers, understand in the General case, unsuitable for the production of the raw materials, , residues, substances and energy. The wastes in mining may be domestic (MSW), industrial (Tpro).

Industrial waste (or waste) – the remnants of raw materials, semi-finished products formed during production or performance of works and lost fully or partially to customer request. -

the cue properties. To can be attributed to consumer waste products and machines that have lost their consumer properties due to physical or mental deterioration.

Household waste – solid, non-recyclable in the home resulting from depreciation of everyday objects and life itself. Recently the solid waste include the solid component of communal waste waters, their sediment.

On phase as they are divided into liquid, solid or mixture of solid, liquid and gas phases (gases emitted to the atmosphere through the pipes is considered the issue of production, not waste).

Depending on the volume of waste are divided into large-and small-scale. For example, the sludge after use in the apparatus for biological water treatment at a refinery is a large-tonnage waste.

The impact on the environment distinguish between harmful and harmless waste. The progressive development of industry and scientific and technical progress result in both the quantitative and qualitative increase of consumption of mineral resources. The modern world from the Earth every year remove up to 100 billion tons of ore, building materials, fuel (4 billion tons of oil and gas, 2 billion tons of coal) dissipates up to 92 million tons of fertilizers and 2 million tons of toxic chemicals.

Waste products are residues of raw materials and semi-finished products produced in the production process, lost the original consumer properties, and substances captured during cleaning of waste process gases and waste water.

The main suppliers of solid waste are: energy (ashes and slag of burning solid fuel), ferrous and nonferrous metallurgy (slags, forming the earth, the remains of the coke); coal mining (dumps); woodworking industry (sawdust, shavings); chemical industry (chemicals in a wide range, including phosphogypsum, etc.).

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