МИНИСТЕРСТВО ОБРАЗОВАНИЯ РЕСПУБЛИКИ БЕЛАРУСЬ

УЧРЕЖДЕНИЕ ОБРАЗОВАНИЯ
<<БРЕСТСКИЙ ГОСУДАРСТВЕННЫЙ ТЕХНИЧЕСКИЙ УНИВЕРСИТЕТ>>

КАФЕДРА ИНОСТРАННЫХ ЯЗЫКОВ ПО ТЕХНИЧЕСКИМ СПЕЦИАЛЬНОСТЯМ

УЧЕБНО-МЕТОДИЧЕСКОЕ ПОСОБИЕ

ДЛЯ САМОСТОЯТЕЛЬНОЙ АУДИТОРНОЙ И ВНЕАУДИТОРНОЙ РАБОТЫ ПО ИЗУЧАЮЩЕМУ ЧТЕНИЮ НА АНГЛИЙСКОМ ЯЗЫКЕ

для студентов специальности

1-70 04 03 «Водоснабжение, водоотведение и охрана водных ресурсов»

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Данное учебно-методическое пособие составлено в соответствии с требованиями Программы по иностранным языкам.

Цель пособия – подготовить студентов к чтению и пониманию аутентичной литературы по изучаемой специальности, совершенствовать навыки перевода профессионально-ориентированных текстов, развить коммуникативные способности студентов, расширить их активный и пассивный лексический запас.

Пособие составлено из статей и текстов оригинальной английской и американской технической литературы, содержащих описание технологий и сооружений для очистки природных и сточных вод.

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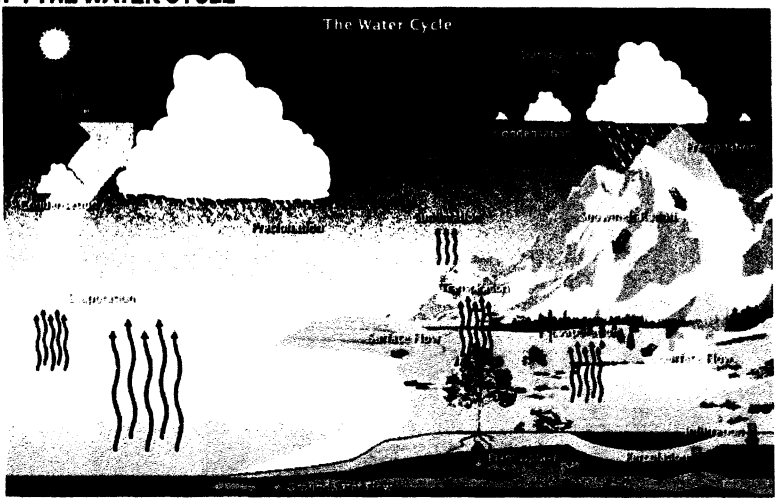
UNIT 1 THE WATER CYCLE



1. <u>Before reading the text learn the terms used in the text:</u>

water cycle – круговорот воды, влагооборот
hydrogen – водород
oxygen – кислород
gaseous – газовый; газообразный
liquid – жидкость; жидкий, текучий
solid – твёрдый
to mediate – быть посредником; служить связующим звеном
to replenish – снова наполняться, пополняться
to purify – очищать (от чего-л.)
moisture – влага; влажность
evaporation – испарение
vapor/vapour – пар , испарения
transpiration – транспирация
sublimation – сублимация, возгонка
to account for – объяснять; давать отчет; нести ответственность; отвечать
air current – воздушный поток, воздушное течение
precipitation – выпадение осадков
hail – град
to seep – просачиваться; проникать, протекать
to intercept – перехватывать
to irrigate – орошать
runoff – (поверхностный) сток
floe – плавучая льдина
glacier – ледник

2. **Read and translate the text.**

THE WATER CYCLE

Water is the basic element of nature. It is a substance composed of the chemical elements hydrogen and oxygen. It exists in gaseous, liquid, and solid states. Water is one of the most plentiful and essential compounds on Earth. It covers 70% of the Earth's surface. It provides life, mediates many vitally important processes, drains harmful substances, and eases out heat. Water needs to be replenished, purified and circulated again and again so that it can perform its functions.

The water, or hydrologic, cycle describes the pilgrimage of water from the Earth's surface to the atmosphere and back again, in some cases to below the surface. This gigantic system, powered by energy from the Sun, is a continuous exchange of moisture between the oceans, the atmosphere, and the land.

The water cycle starts with **evaporation.** It is the process by which water changes from a liquid to a gas or vapor. Studies have revealed that evaporation (from oceans, seas, and other bodies of water) provides nearly 90% of the moisture in our atmosphere. Most of the remaining 10% found in the atmosphere is released by plants through **transpiration.** Plants take in water through their roots, and then release it through small pores on the underside of their leaves. In addition, a very small portion of water vapor enters the atmosphere through **sublimation**, the process by which water changes directly from a solid (ice or snow) to a gas. The gradual shrinking of snow banks in cases when the temperature remains below freezing results from sublimation.

Together, evaporation, transpiration, and sublimation, plus volcanic emissions account for almost all the water vapor in the atmosphere that isn't inserted through human activities. While evaporation from the oceans is the primary vehicle for driving the surface-to-atmosphere portion of the hydrologic cycle, transpiration is also significant. For example, a cornfield 1 acre in size can transpire as much as 4,000 gallons (15140 litres) of water every day.

After the water enters the lower atmosphere, rising air currents carry it upward, often high into the atmosphere, where the air is cooler. In the cool air, water vapor is more likely to condense from a gas to a liquid to form cloud droplets. Cloud droplets can grow and produce **precipitation** (including rain, snow, and hail), which is the primary mechanism for transporting water from the atmosphere back to the Earth's surface.

When precipitation falls over the land surface, it follows various routes in its subsequent paths. Some of it evaporates, returning to the atmosphere; some seeps into the ground as soil moisture or groundwater; and some runs off into rivers and streams. Almost all of the water eventually flows into the oceans or other bodies of water, where the cycle continues. At different stages of the cycle, some of the water is intercepted by humans or other life forms for drinking, washing, irrigating, and a large variety of other uses.

Water continually evaporates, condenses, and precipitates. There are many paths that a water molecule might follow. Water at the bottom of Lake Baikal may eventually rise into the atmosphere and fall as rain in Massachusetts. Runoff from the Massachusetts rain may drain into the Atlantic Ocean and circulate northeastward toward Iceland, destined to become part of a floe of sea ice, or, after evaporation to the atmosphere and precipitation as snow, part of a glacier.

Water molecules can take an immense variety of routes and branching trails that lead them again and again through the three phases of ice, liquid water, and water vapor. For instance, the water molecules that once fell 100 years ago as rain on your great- grandparents' house might now be falling as snow on your driveway.

3. Match these terms with their definitions:

1. water cycle	a) the process by which water is converted from its liquid form to its vapor form and thus transferred from land and water masses to the atmosphere
2. evaporation	b) the conversion between the solid and the gaseous phases of matter, with no intermediate liquid stage
3. transpiration	c) describes the continuous circulation of the Earth's water in the air, on land, and in the ground
4. sublimation	d) water released from clouds in the form of rain, freezing rain, sleet, snow, or hail
5. precipitation	e) the process by which moisture is carried through plants from roots to small pores on the underside of leaves, where it changes to vapor and is released to the atmosphere

4. Find in the text English equivalents to the following word-combinations.

круговорот воды
вещество, состоящее из химических элементов водорода и кислорода
существовать в газообразной форме
покрывать 70% земной поверхности
обеспечивать жизнь
являться промежуточным звеном в жизненно важных процессах
выполнять функции
непрерывный обмен влаги между океанами, атмосферой и сушей
превращаться из жидкости в пар
поставлять около 90% влаги в атмосферу
выделяться посредством транспирации
деятельность человека
основной механизм для приведения в движение
восходящий воздушный поток
образовывать облачные капельки
образовывать осадки
перемещать влагу из атмосферы обратно на поверхность земли
просачиваться в почву
стекать в реки
постоянно испаряться, конденсироваться и выпадать в виде осадков

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to seep	to exist	to describe	to provide	to account for
to provide	to change	to cover	to release	to condense

1. Water ... in gaseous, liquid, and solid states.
2. Water ... 70% of the Earth's surface.
3. Water ... life.
4. The water cycle ... the pilgrimage of water from the Earth's surface to the atmosphere and back again.
5. Evaporation is the process by which water ... from a liquid to a gas or vapor.

6. Evaporation ... nearly 90% of the moisture in our atmosphere.
7. Water ... into the air by plants by a process known as transpiration.
8. Together, evaporation, transpiration, and sublimation, plus volcanic emissions ... almost all the water vapor in the atmosphere.
9. In the cool air, water vapor ... from a gas to a liquid to form cloud droplets.
10. Precipitation ... into the ground as soil moisture or groundwater.

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Water is a substance composed of the chemical elements hydrogen and oxygen.
2. The hydrologic cycle is a continuous exchange of moisture between the oceans, the atmosphere, and the land.
3. The water cycle starts with precipitation.
4. Water is released into the air by plants by a process known as sublimation.
5. Sublimation is the process by which water changes directly from a solid (ice or snow) to a gas.
6. Evaporation from the Earth's surface is the primary vehicle for driving the surface-to-atmosphere portion of the hydrologic cycle.
7. Precipitation is the primary mechanism for transporting water from the atmosphere back to the Earth's surface.
8. Water continually evaporates, condenses, and precipitates.

7. Answer the following questions.

1. What is water?
2. What states of water can you name?
3. Can you enumerate the functions of water?
4. What does the water cycle describe?
5. What is evaporation/transpiration/ sublimation/ precipitation?
6. Why is transpiration also significant alongside with evaporation?
7. What happens to water when it enters the atmosphere?
8. What happens to water when it falls over the land surface in the form of precipitation?
9. Can water molecules take an immense variety of routes that lead them again and again through the three phases of ice, liquid water, and water vapor?

8. Discuss the statements:

1. Every drop counts - water is vital to people and the environment.
2. We'll never know the value of water till the well is dry.

UNIT 2 WATER CONSUMPTION

1. Before reading the text learn the terms used in the text:

withdrawal – водозабор (изъятие воды из источника)
to triple – утраиваться
to increase – возрастать, увеличиваться; расти; усиливаться
to account for – составлять, насчитывать
to consume – расходовать, тратить (материалы в процессе потребления, использования)
to launder – стирать и гладить (бельё)

to average – в среднем равняться, составлять
to vary –изменять, менять
efficient – действенный, результативный, эффективный

2. Match the phrases below with the appropriate Russian equivalents.

1. water consumption	a.коммунальные потребности
2. freshwater withdrawal	b.инженер по охране окружающей среды
3. domestic demand	c.среднее потребление(воды)
4. average consumption	d.потребление воды
5. consumption per capita	e.максимальное потребление
6. public needs	f.жилой район
7. peak demand	g.забор пресной воды
8. residential area	h.система водоснабжения
9. environmental engineer	i.бытовая деятельность
10. water distribution system	j.потребление (воды) на душу населения
11. household activities	k. бытовое потребление

3. Read and translate the text.

WATER CONSUMPTION

Freshwater withdrawals have tripled over the last 50 years. Demand for freshwater is increasing by 64 billion cubic meters a year (1 cubic meter = 1,000 liters).

Water consumption in a community is characterized by several types of demand, including domestic, public, commercial, and industrial uses. Worldwide, agriculture accounts for 70% of all water consumption, compared to 20% for industry and 10% for domestic use. In industrialized nations, however, industries consume more than half of the water available for human use. Belgium, for example, uses 80% of the water available for industry.

Domestic demand includes water for drinking, cooking, washing, laundering, and other household functions. Public demand includes water for fire protection, street cleaning, and use in schools and other public buildings. Commercial and industrial demands include water for stores, offices, hotels, laundries, restaurants, and most manufacturing plants. There is usually a wide variation in total water demand among different communities. This variation depends on population, geographic location, climate, the extent of local commercial and industrial activity, and the cost of water.

Water use or demand is expressed numerically by average daily consumption per capita (per person). In the United States the average is approximately 100 gallons (380 liters) per capita per day for domestic and public needs. Overall the average total demand is about 180 gallons (680 liters) per capita per day, when commercial and industrial water uses are included. In the Republic of Belarus the average daily consumption is about 180 liters per capita. This is substantially higher than in most European countries (120-150 liters with 24-hour service). Water consumption in some developing countries may average as little as 4 gallons (15 liters) per capita per day. The world average is estimated to be approximately 16 gallons (60 liters) per person per day.

In any community, water demand varies on a seasonal, daily, and hourly basis. On a hot summer day, for example, it is not unusual for total water consumption to be as much as 200 percent of the average demand. The peak demands in residential areas usually occur in the

morning and early evening hours (just before and after the normal workday). Water demands in commercial and industrial districts, though, are usually uniform during the working day. Minimum water demands typically occur in the very early or predawn morning hours. Civil and environmental engineers must carefully study each community's water use patterns in order to design efficient pumping and distribution systems.

HOW MUCH WATER DO YOU USE?

The table below gives an indication of how much water is used in general household activities:

ACTIVITY	AMOUNT OF WATER (LITRES)
Per shower	40-250
Per bath	50-150
Per toilet flush	12
Per dishwasher load	20-50
Per washing machine load	40-265
Tap running while brushing teeth	5
Drinking, cooking, cleaning per day	8
Hand basin per use	5
Car washing with hose (12 minutes)	200
Hosing driveway (5 minutes)	75
Dripping tap per day (1 drip per second)	30

4. Match these terms with their definitions:

1. fresh water	a) water used for household purposes, such as drinking, food preparation, bathing, washing clothes, dishes, and dogs, flushing toilets, and watering lawns and gardens
2. withdrawal	b) the volume of freshwater used and then incorporated into a product
3. water consumption	c) water used for such purposes as firefighting, street washing, and municipal parks and swimming pools.
4. domestic water use	d) low salt content water containing less than 1 mg/l of dissolved solids of any type.
5. public water use	e) water used for industrial purposes in such industries as steel, chemical, paper, petroleum refining, and etc.
6. industrial water use	f) water removed from a ground- or surface-water source for use.
7. per capita use	g) water that is used for a specific purpose, such as for domestic use, irrigation, or industrial processing.
8. water use	h) the average amount of water used per person during a standard time period, generally per day.

5. Find in the text English equivalents to the following word-combinations.

потребление воды
забор пресной воды
спрос на пресную воду
увеличиваться до 64 млрд. кубометров в год
несколько видов потребления
составлять 70%

включать воду для противопожарной защиты
зависеть от географического положения
различаться в зависимости от сезона
тщательно изучать
модели потребления воды
разрабатывать эффективную систему водоснабжения

6. In each sentence the main verb has been omitted. Fill in the blanks from the words given. (Some sentences are active, and some are passive.)

to account for	to characterize	to include	to vary
to depend	to express	to average	to occur

1. Water consumption in a community ... by several types of demand, including domestic, public, commercial, and industrial uses.
2. Agriculture ... 70% of all water consumption.
3. Domestic demand ... water for drinking, cooking, washing, laundering, and other household functions.
4. Total water demand among different communities ... on population, geographic location, climate, and the cost of water.
5. Water use or demand ... numerically by average daily consumption per capita.
6. Water consumption in some developing countries ... as little as 15 liters per capita per day.
7. Water demand ... on a seasonal, daily, and hourly basis.
8. The peak demands in residential areas usually ... in the morning and early evening hours.

7. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Freshwater withdrawals have doubled over the last 50 years.
2. Water consumption in a community is characterized by two types of demand, including domestic and industrial uses.
3. Domestic demand includes water for fire protection, street cleaning, and use in schools and other public buildings.
4. Commercial and industrial demands include water for stores, offices, hotels, laundries, restaurants, and most manufacturing plants.
5. In the Republic of Belarus, the average daily consumption is about 380 liters per capita.
6. In any community, water demand varies on a seasonal, daily, and hourly basis.
7. The peak demands in residential areas usually occur in the very early or predawn morning hours.
8. Civil and environmental engineers must carefully study each community's water use patterns in order to design efficient pumping and distribution systems.

8. Answer the following questions:

1. What types of demand characterize water consumption?
2. What percentage of all water consumption does agriculture/industry/domestic use account for?
3. What water does domestic /industrial/public demand include?
4. How is water demand expressed?

5. What is the average daily consumption per capita in the Republic of Belarus?
6. On what basis does water demand vary?
7. When do the peak/minimum demands in residential areas occur?
8. Why must civil and environmental engineers carefully study each community's water use patterns?

9. Try and think of possible reasons why freshwater withdrawals have tripled over the last 50 years.

UNIT 3 DRINKINING WATER QUALITY

1. Before reading the text learn the terms used in the text:

odourless – без запаха, непахнущий
to dissolve – растворять; растворяться
carbon dioxide – углекислый газ
hydrogen sulfide – сероводород
impurity – примесь, загрязнение
turbidity – мутность
contaminant – загрязняющее вещество
thrihalomethanes – тригалометаны
arsenic – мышьяк
percolate – просачиваться, проникать сквозь; проходить

2. Match the phrases below with the appropriate Russian equivalents.

1. pure condition	a. мелкие частицы почвы
2. fine soil particle	b. промышленный растворитель
3. soluble mineral	c. трубы для горячего водоснабжения
4. health concern	d. нормативы качества питьевой воды
5. industrial solvent	e. жесткая вода
6. intestinal tract	f. беспримесное состояние
7. hot water pipes	g. сырая (неочищенная) вода
8. hard water	h. растворимый минерал
9. raw water	i. процесс очистки
10. treatment process	j. общественное здравоохранение
11. allowable concentration	k. допустимая концентрация
12. drinking-water regulations	l. кишечник

3. Read and translate the text.

DRINKINING WATER QUALITY

Water is colourless, tasteless, and odourless at room temperature, but it has such a strong tendency to dissolve other substances that it is rarely found in nature in a pure condition. When it falls as rain, small amounts of gases such as oxygen and carbon dioxide become dissolved in it; raindrops also carry tiny dust particles and other substances. As it flows over the ground, water picks up fine soil particles, microbes, organic material, and soluble minerals. In lakes, bogs, and swamps, water may gain colour, taste, and odour from decaying vegetation

and other natural organic matter. Groundwater usually acquires more dissolved minerals than does surface runoff because of its longer direct contact with soil and rock. It may also absorb gases such as hydrogen sulfide and methane. In populated areas the quality of surface water as well as groundwater is directly influenced by human activities and the effects of pollution.

Health concerns

Five general types of impurities are of public health concern. These are organic chemicals, inorganic chemicals, turbidity, microorganisms, and radioactive substances. Organic contaminants include various pesticides, industrial solvents, and trihalomethanes such as chloroform. Inorganic contaminants of major concern include arsenic, nitrate, fluoride, and toxic metals such as lead and mercury. All these substances can harm human health when present above certain concentrations in drinking water. A low concentration of fluoride, however, has been proved to promote dental health. Some communities add fluoride to their water for this purpose.

Turbidity refers to cloudiness caused by very small particles of silt, clay, and other substances suspended in water. Even a slight degree of turbidity in drinking water is objectionable to most people. Groundwater normally has very low turbidity owing to the natural filtration that occurs as it percolates through the soil. Surface waters, though, are often high in turbidity.

The most important microbiological measure of drinking-water quality is a group of bacteria called coliforms. Coliform bacteria normally are not pathogenic, but they are always present in the intestinal tract of humans. Water contaminated with human waste always contains coliforms. Coliforms are used as indicator organisms for measuring the biological quality of water. If coliforms are not found in the water, it can be assumed that the water is also free of pathogens. The coliform count thus reflects the chance of pathogens being present; the lower the coliform count, the less likely it is that pathogens are in the water.

Radioactive materials from natural as well as industrial sources can be harmful water contaminants. Wastes from uranium mining, nuclear power plants, and medical research are possible pollutants. Strontium-90 and tritium are radioactive contaminants that have been found in water as a result of nuclear weapons testing. Naturally occurring substances such as radium and radon gas are found in some groundwater sources. The danger from dissolved radon gas arises not from drinking the water but from breathing the gas after it is released into the air.

Aesthetic concerns

Colour, taste, and odour are physical characteristics of drinking water that are important for aesthetic reasons rather than for health reasons. Colour in water may be caused by decaying leaves or algae, giving it a brownish yellow hue. Taste and odour may be caused by naturally occurring dissolved organics or gases. Some well-water supplies, for example, have a rotten-egg odour caused by hydrogen sulfide gas. Chemical impurities associated with the aesthetic quality of drinking water include iron, manganese, copper, zinc, and chloride. Dissolved metals impart a bitter taste to water and may stain laundry and plumbing fixtures. Excessive chlorides give the water an objectionable salty taste.

Hardness

Another parameter of water quality is hardness. This is a term used to describe the effect of dissolved minerals (mostly calcium and magnesium). Minerals cause deposits of scale in hot water pipes, and they also interfere with the lathering action of soap. Hard water does not harm human health, but the economic problems it causes make it objectionable to most people.

Standards

Water quality standards set limits on the concentrations of impurities allowed in water. Standards also affect the selection of raw water sources and the choice of treatment processes. Modern testing methods allow the detection of contaminants in extremely low concentrations – as low as one part contaminant per one billion parts water or even, in some cases, per one trillion parts water. Water quality standards are continually evolving, usually becoming more stringent. As a result; the number of regulated contaminants increases over time, and their allowable concentrations in water are lowered.

Drinking-water regulations include two types of standards: primary and secondary. Primary standards are designed to protect public health, whereas secondary standards are based on aesthetic factors. Primary standards specify maximum contaminant levels for many chemical, microbiological, and radiological parameters of water quality. Turbidity is included in the primary standards because of its tendency to interfere with disinfection. Secondary standards are guidelines or suggested maximum levels of colour, taste, odour, hardness, corrosiveness, and certain other factors.

a. Match these terms with their definitions:

1. water quality	a. anything found in water (including microorganisms, minerals, chemicals, radionuclides etc.) which may be harmful to human health
2. water-soluble substance	b. a group of related bacteria whose presence in drinking water may indicate contamination by disease-causing microorganisms
3. contaminant	c. a substance that can be dissolved in water
4. coliform	d. a characteristic of water determined by the levels of calcium and magnesium
5. turbidity	e. the chemical, physical, biological, radiological, and thermal condition of water
6. hardness	f. the state of having sediment or foreign particles suspended or stirred up in water

b. Find in the text English equivalents to the following word-combinations.

1. при комнатной температуре
2. растворять другие вещества
3. приобретать цвет
4. впитывать газы
5. подвергаться влиянию человеческой деятельности
6. вредить здоровью человека
7. улучшать состояние зубов
8. взвешенные в воде частицы
9. просачиваться сквозь почву
10. выделяться в атмосферу
11. придавать горький вкус
12. неприятный соленый вкус
13. служить причиной образования накипи (твердого осадка)
14. служить причиной экономических проблем
15. устанавливать норму (предел)

16. влиять на выбор источника сырой воды
17. становиться более строгими
18. защищать здоровье населения
19. мешать дезинфекции

c. In each sentence the main verb has been omitted. Fill in the blanks from the words given. (Some sentences are active, and some are passive.)

to dissolve	to refer	to include	to use
to harm	to pick up	to reflect	to cause

1. Water is rarely found in nature in a pure condition because it readily ... different substances.
2. As water flows over the ground, it ... fine soil particles, microbes, organic material, and soluble minerals.
3. Organic contaminants ... various pesticides, industrial solvents, etc.
4. Contaminants ... human health when present above certain concentrations in drinking water.
5. Turbidity ... to cloudiness caused by very small particles of silt, clay, and other substances suspended in water.
6. Coliforms ... as indicator organisms for measuring the biological quality of water.
7. The coliform count ... the chance of pathogens being present in the water.
8. Hard water ... economic problems.

d. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Water is colourless, tasteless, and odourless at room temperature.
2. Water is rarely found in nature in a pure condition.
3. There are four general types of impurities: organic chemicals, inorganic chemicals, turbidity, and microorganisms.
4. Turbidity is caused by hard water.
5. Surface water normally has very low turbidity owing to the natural filtration.
6. Colour, taste, and odour are physical characteristics of drinking water that are important for aesthetic reasons rather than for health reasons.
7. Hard water harms human health.
8. Water quality standards set limits on the concentrations of impurities allowed in water.

e. Answer the following questions:

1. Why is water rarely found in nature in a pure condition?
2. What are five general types of impurities of public health concern?
3. What substances do organic/inorganic contaminants include?
4. What is turbidity?
5. What is the most important microbiological measure of drinking-water quality?
6. Are coliform bacteria normally pathogenic?
7. What radioactive substances can occur naturally?
8. What water physical characteristics are important for aesthetic reasons?
9. What is hardness?
10. What water quality standards are mentioned in the text?

f. Identify and explain the reasons why water quality should be monitored.

UNIT 4 DEVELOPMENTS IN SUPPLY SYSTEMS. HISTORICAL BACKGROUND.

1. Before reading the text learn the terms used in the text:

BCE от before the Common Era; B.C.E. –до нашей эры

CE от Christian Era, Common Era; C.E. – новой эры, нашей эры, н.э.; от Рождества Христова, Р.Х.

well – колодец

dweller - жилец, житель; обитатель

to channel – направлять в определённое русло, проводить через канал

aqueduct – акведук, водопровод

to meander – извиваться (о реке, дороге)

arcade – аркада (ряд равных по величине арок, опирающихся на столбы или колонны); сводчатая галерея

arch – арка; свод

pipe – (сущ.) труба,трубопровод; (гл.) подавать по трубопроводу

pipeline – трубопровод

sewer – сто чная труба; коллектор, канализационная труба

flush – смывание; промывание сильной струёй воды (какой-л. ёмкости)

rubble – бут, бутовый камень, булыжник

concrete – бетон

clay – глина

cast iron – чугун

steam engine – паровая машина; паровой двигатель

asbestos cement – асбестоцемент

ductile iron – ковкое железо

reinforced concrete – железобетон

steel – сталь

trace amount – следовое количество

2. Read and translate the text.

DEVELOPMENTS IN SUPPLY SYSTEMS. HISTORICAL BACKGROUND

Water was an important factor in the location of the earliest settled communities, and the evolution of public water supply systems is tied directly to the growth of cities. In the development of water resources beyond their natural condition in rivers, lakes, and springs, the digging of shallow wells was probably the earliest innovation. As the need for water increased and tools were developed, wells were made deeper. Brick-lined wells were built by city dwellers in the Indus River basin as early as 2500 BC, and wells almost 500 metres (more than 1,600 feet) deep are known to have been used in ancient China.

Construction of *qanāt*s, slightly sloping tunnels driven into hillsides that contained groundwater, probably originated in ancient Persia about 700 BC. From the hillsides the water was conveyed by gravity in open channels to nearby towns or cities. The use of *qanāt*s became widespread throughout the region, and some are still in existence. Until 1933 the Iranian capital city, Tehrān, drew its entire water supply from a system of *qanāt*s.

The need to channel water supplies from distant sources was an outcome of the growth of urban communities. Among the most notable of ancient water-conveyance systems are the

aqueducts built between 312 BC and 455 CE throughout the Roman Empire. Some of these impressive works are still in existence. The writings of Sextus Julius Frontinus (who was appointed superintendent of Roman aqueducts in 97 CE) provide information about the design and construction of the 11 major aqueducts that supplied Rome itself. Extending from a distant spring-fed area, a lake, or a river, a typical Roman aqueduct included a series of underground and aboveground channels. The longest was the Aqua Marcia, built in 144 BCE. Its source was about 37 km (23 miles) from Rome.

The aqueduct itself was 92 km (57 miles) long, however, because it had to meander along land contours in order to maintain a steady flow of water. For about 80 km (50 miles) the aqueduct was underground in a covered trench, and only for the last 11 km (7 miles) was it carried aboveground on an arcade. In fact, most of the combined length of the aqueducts supplying Rome (about 420 km [260 miles]) was built as covered trenches or tunnels. When crossing a valley, aqueducts were supported by arcades comprising one or more levels of massive granite piers and impressive arches.

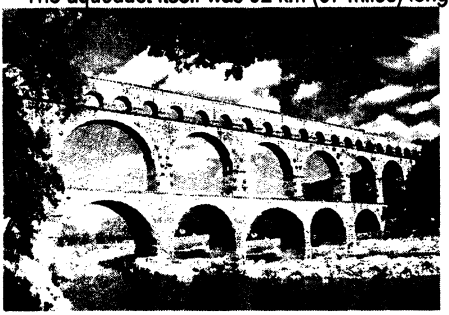


Fig.1 Pont du Gard, an ancient Roman aqueduct in Nimes, France.

The aqueducts ended in Rome at distribution reservoirs, from which the water was conveyed to public baths or fountains. A few very wealthy or privileged citizens had water piped directly into their homes, but most of the people carried water in containers from a public fountain. Water was running constantly, the excess being used to clean the streets and flush the sewers.

Ancient aqueducts and pipelines were not capable of withstanding much pressure. Channels were constructed of cut stone, brick, rubble, or rough concrete. Pipes were typically made of drilled stone or of hollowed wooden logs, although clay and lead pipes were also used. During the Middle Ages there was no notable progress in the methods or materials used to convey and distribute water.

Cast-iron pipes with joints capable of withstanding high pressures were not used very much until the early 19th century. The steam engine was first applied to water-pumping operations at about that time, making it possible for all but the smallest communities to have drinking water supplied directly to individual homes. Asbestos cement, ductile iron, reinforced concrete, and steel came into use as materials for water supply pipelines in the 20th century.

Developments in water treatment

In addition to quantity of supply, water quality is also of concern. Even the ancients had an appreciation for the importance of water purity. Sanskrit writings from as early as 2000 BCE tell how to purify foul water by boiling and filtering. But it was not until the middle of the 19th century that a direct link between polluted water and disease (cholera) was proved, and it was not until the end of that same century that the German bacteriologist Robert Koch proved the germ theory of disease, establishing a scientific basis for the treatment and sanitation of drinking water.

Water treatment is the alteration of a water source in order to achieve a quality that meets specified goals. At the end of the 19th century and the beginning of the 20th, the main goal

was elimination of deadly waterborne diseases. The treatment of public drinking water to remove pathogenic, or disease-causing, microorganisms began about that time. Treatment methods included sand filtration as well as the use of chlorine for disinfection. The virtual elimination of diseases such as cholera and typhoid in developed countries proved the success of this water-treatment technology. In developing countries, waterborne disease is still the principal water quality concern.

In industrialized countries, concern has shifted to the chronic health effects related to chemical contamination. For example, trace amounts of certain synthetic organic substances in drinking water are suspected of causing cancer in humans. The added goal of reducing such health risks is seen in the continually increasing number of factors included in drinking-water standards.

Some dates

4000BC	water supply tunnels in Middle East
2000BC	water purification in Egypt and Iraq they learn the benefits of filtration
312 BC	Roman aqueducts built (Aqua Appia, 18 km) they learn that lead in water is toxic
300 BC	storage cisterns used in cities (e.g. Istanbul)
1100 AD	polluted water supplies in Europe = plagues
1183	Paris aqueduct built
1235	London makes same mistake as Romans, uses lead pipes
1619	London provides house connections
1804	Sand filters used in Scotland, 4 millenia after Mesopotamia
1835	Charles Storrow writes *Treatise on Water-works*
1850s	polluted water again = major cholera outbreaks
1860	Hamilton water works
1890	chlorine disinfection
1993	cryptosporidium infects 400000, Milwaukee

3. **Find in the text English equivalents to the following word-combinations.**

1. развитие системы коммунально-бытового водоснабжения
2. неглубокий колодец
3. перемещаться под воздействием гравитации
4. стать широко распространенным
5. системы транспортировки воды
6. серия подземных и надземных каналов
7. поддерживать постоянный поток
8. перекрытая траншея
9. общая длина
10. выдерживать высокое давление
11. методы, используемые для транспортировки воды и водоснабжения (распределения воды)
12. соответствовать определенным задачам

13. уничтожение смертельных болезней, передаваемых через воду
14. удалять болезнетворные микроорганизмы
15. служить причиной рака
16. снижать риск для здоровья

4. In each sentence the main verb has been omitted. Fill in the blanks from the words given. In some cases two variants are possible. (Some sentences are active, and some are passive.)

to build	to convey	to tie	to carry
not to withstand	to construct	to come into	to include

1. The evolution of public water supply systems ... directly to the growth of cities.
2. Brick-lined wells ....by city dwellers in the Indus River basin as early as 2500 BC.
3. From the hillsides, the water ... by gravity in open channels to nearby towns or cities.
4. A typical Roman aqueduct ... a series of underground and aboveground channels.
5. Most of the people ... water in containers from a public fountain.
6. Ancient aqueducts and pipelines .... much pressure.
7. Ancient channels ... of cut stone, brick, rubble, or rough concrete.
8. Asbestos cement, ductile iron, reinforced concrete, and steel ... use as materials for water supply pipelines in the 20th century.

5. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Water was an important factor in the location of the earliest settled communities.
2. The digging of shallow wells was probably the earliest innovation in the development of water resources.
3. A system of qanāts was used to convey water to nearby towns or cities in ancient China.
4. The need to channel water supplies from distant sources was an outcome of the growth of population.
5. Some of Roman aqueducts are still in existence.
6. Ancient pipes were typically made of drilled stone or of hollowed wooden logs.
7. Cast-iron pipes with joints capable of withstanding high pressures were introduced in the early 19th century.
8. In the middle of the 18th century a direct link between polluted water and disease (cholera) was proved.
9. At the end of the 19th century and the beginning of the 20th, the main goal of water treatment was elimination of deadly waterborne diseases.
10. Water treatment is the alteration of a water source in order to achieve a quality that meets specified goals.

6. Answer the following questions:

1. What factor was an important one in the location of the earliest settled communities?
2. What were the first innovations in the development of water resources beyond their natural condition in rivers, lakes, and springs?
3. How did a system of *qanāts* function?
4. What is an aqueduct? What did a typical Roman aqueduct include?
5. What materials were used to construct channels of ancient aqueducts?

6. What materials came into use as materials for water supply pipelines in the 20th century?
7. What theory established a scientific basis for the treatment and sanitation of drinking water?
8. What is water treatment?
9. What was the main goal of water treatment at the end of the 19th century and the beginning of the 20th?
10. What is the main concern of water treatment in industrialized countries nowadays?

7. Find the information about ancient water-conveyance systems on the web and present it to your fellow students.

PART 2: WHAT HAPPENS AT A WATER TREATMENT PLANT?

UNIT 5 INTRODUCTION TO WATER TREATMENT

1. Before reading the text learn the terms used in the text:

consumption – потребление
potable – годный для питья; питьевой
intake screen – сороудерживающая решетка водосбора
debris – осколки, обломки; мусор
clarification – осветление воды, кларификация
screening – прохождение воды через решетку (сито)
coagulation – коагуляция, свёртывание
flocculation – флокуляция (вид коагуляции, при которой крошечные частицы в жидкой образуют рыхлые хлопьевидные скопления)
flotation – флотация
precaution – мера предосторожности

2. Match the phrases below with the appropriate Russian equivalents.

1. water treatment	a. питьевая вода
2. portable water	b. естественная (природная) фильтрация
3. objectionable colour	c. неприятный цвет
4. plumbing fixture	d. легкодоступный
5. natural filtration	e. обработка воды, очистка воды
6. suspended solids	f. взвешенные твердые частицы
7. dissolved minerals	g. санитарно-техническое оборудование
8. water treatment plant	h. растворенные минералы
9. freshwater supplies	i. водоочистная станция
10. readily available	j. запасы пресной воды

3. Read the text.

INTRODUCTION TO WATER TREATMENT

Water in rivers or lakes is rarely clean enough for human consumption if it is not first treated or purified. Groundwater, too, often needs some level of treatment to render it potable. The primary objective of water treatment is to protect the health of the community. Potable water must, of course, be free of harmful microorganisms and chemicals, but public supplies should

also be aesthetically desirable so that consumers will not be tempted to use water from another, more attractive but unprotected source. The water should be crystal clear, with almost no turbidity, and it should be free of objectionable colour, odour, and taste. For domestic supplies, water should not be corrosive, nor should it deposit troublesome amounts of scale and stains on plumbing fixtures. Industrial requirements may be even more stringent; many industries provide special treatment on their own premises.

Thus, the treatment of water can be classified into three categories,

- treatment of raw water for drinking purposes;
- treatment of raw water for specialised industrial applications;
- treatment of waste water to make it acceptable for release or reuse.

The type and extent of treatment required to obtain potable water depends on the quality of the source. The better the quality, the less treatment is needed. Surface water usually needs more extensive treatment than does groundwater, because most streams, rivers, and lakes are polluted to some extent. Even in areas remote from human populations, surface water contains suspended silt, organic material, decaying vegetation, and microbes from animal wastes. Groundwater, on the other hand, is usually free of microbes and suspended solids because of natural filtration as the water moves through soil, though it often contains relatively high concentrations of dissolved minerals from its direct contact with soil and rock.

Water is treated in a variety of physical and chemical methods. Water treatment in a typical water treatment plant is shown in the picture below, it is based on the characteristics of the raw water and on other factors; the treatment process may vary considerably from place to place.

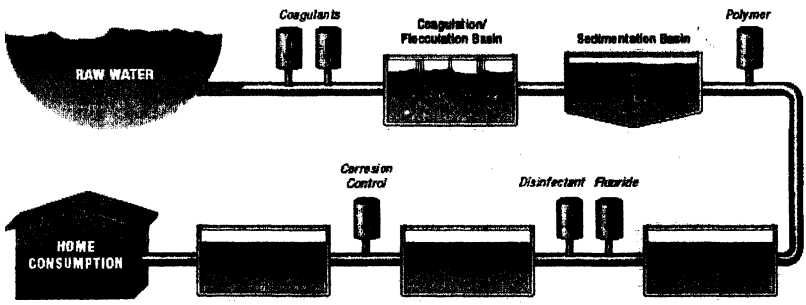


Fig. 1 Basic steps in the treatment of municipal water.

Treatment of surface water begins with intake screens to prevent fish and debris from entering the plant and damaging pumps and other components. Then, at the water plant, various characteristics of the raw water are tested. Conventional treatment of water primarily involves clarification. Clarification removes most of the turbidity, making the water crystal clear. It usually consists of several steps: screening, coagulation, flocculation, sedimentation or flotation, and filtration. Disinfection, usually the final step in the treatment of drinking water, destroys pathogenic microbes.

Groundwater does not often need clarification, but it should be disinfected as a precaution to protect public health. In addition to clarification and disinfection, the processes of softening, aeration, carbon adsorption, and fluoridation may be used for certain public water sources. Desalination processes are used in areas where freshwater supplies are not readily available.

4. Find in the text English equivalents to the following word-combinations.

1. превращать воду в питьевую (воду)
2. защищать здоровье населения
3. не содержать вредные микроорганизмы
4. коммунально-бытовое водоснабжение
5. незащищенный источник
6. загрязненная до определенной степени
7. содержать взвешенный ил
8. повреждать трубы
9. получать питьевую воду
10. зависеть от качества источника (воды)
11. значительно отличаться в различных местностях
12. проверять характеристики сырой воды
13. устранять мутность воды
14. уничтожать болезнетворные микробы

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given. In some cases two variants are possible. (Some sentences are active, and some are passive.)

to deposit	to provide	to depend	to contain
to need	to treat	to base	to involve

1. Water from rivers or lakes ... to be clean enough for human consumption.
2. Hard water ... troublesome amounts of scale and stains on plumbing fixtures.
3. Many industries ... special treatment on their own premises.
4. The type and extent of treatment required to obtain potable water ... on the quality of the source.
5. Surface water usually ... more extensive treatment than does groundwater.
6. Groundwater ... relatively high concentrations of dissolved minerals from its direct contact with soil and rock.
7. Water treatment ... on the characteristics of the raw water and on other factors.
8. Conventional treatment of water primarily ... screening, coagulation, flocculation, sedimentation or flotation, and filtration.

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. In areas remote from human populations, water in rivers or lakes is always clean enough for human consumption.
2. The primary objective of water treatment is to make water crystal clear.
3. Potable water must be free of harmful microorganisms and chemicals.
4. For domestic supplies, water should not be corrosive.
5. The better the water quality, the more treatment is needed.
6. The water treatment process may vary considerably from place to place.
7. Disinfection destroys pathogenic microbes.
8. The processes of softening, aeration, carbon adsorption, and fluoridation are used for certain public water sources.

7. Answer the following questions:

1. What is the primary objective of water treatment?
2. Why should public supplies be aesthetically desirable?
3. What categories is the treatment of water classified into?
4. What does the type and extent of treatment required to obtain potable water depend on?
5. Why does surface water usually need more extensive treatment than groundwater?
6. Why does groundwater often contain relatively high concentrations of dissolved minerals?
7. What basic steps does conventional treatment of water involve?
8. What is the purpose of disinfection?
9. What water treatment operations are mentioned in the text?

8. Use figure 1 to briefly describe key processes involved in water treatment.

9. WATER TREATMENT WORDS. Can you find these words? Find the words, circle them, and check them off the list.

treatment
freshwater
portable
clarification
flocculation
aeration
turbidity
screen
filtration
sedimentation

h	d	s	z	f	g	c	c	h	j	e	x	w	a	a	f	d
f	o	p	h	s	m	a	l	a	f	s	f	a	f	e	l	k
f	l	o	c	c	u	l	a	t	i	o	n	e	o	u	o	ɯ
r	g	t	f	r	n	a	r	a	g	y	e	s	t	o	f	m
e	v	a	s	e	b	s	i	f	a	d	d	u	r	f	i	f
s	d	b	a	e	c	a	f	a	s	c	u	s	e	a	l	d
h	a	l	z	n	x	s	i	y	y	s	f	y	a	f	t	f
w	r	e	x	e	d	f	c	l	a	a	g	h	t	a	r	e
a	t	l	c	a	e	r	a	t	i	o	n	y	m	y	a	e
t	u	r	b	i	d	i	t	y	u	a	s	u	e	j	t	d
e	y	k	v	r	t	u	i	u	y	h	f	s	n	k	i	g
r	u	j	b	f	g	c	o	a	g	u	l	a	t	i	o	n
i	s	e	d	i	m	e	n	t	a	t	i	o	n	e	n	b

UNIT 6 PRELIMINATY TREATMENT

1. Before reading the text learn the terms used in the text:

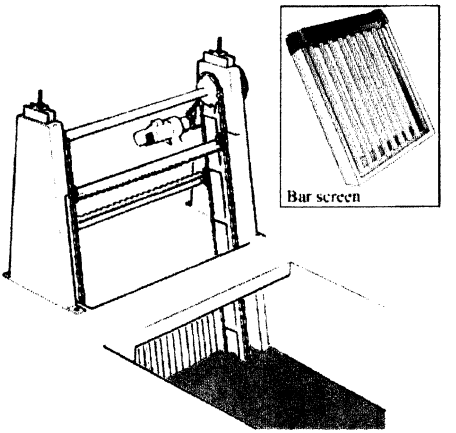
preliminary treatment – предварительная очистка
intake – водозаборное устройство
algae – морская водоросль
bar screen – решетка (из стальных прутьев)
wire-mesh screen – проволочная сетка, проволочное сито
velocity – скорость; быстрота
presedimentation – предварительное отстаивание
grit – крупнозернистый песок; гравий
basin – отстойник
activated carbon – активированный уголь
aeration – аэрация, насыщение кислородом

carbon dioxide –углекислота, углекислый газ
hydrogen sulfide (sulphide) – сероводород
manganese – марганец
detention – отстаивание (осадка)
coagulant – коагулянт, сгущающее вещество
coliform bacterium – колиформная бактерия
alkalinity – щёлочность
to floc – образовывать хлопья

2. Read and translate the text.

PRELIMINATY TREATMENT

Preliminary treatment, also known as pretreatment, is any physical, chemical or mechanical process used on water before it undergoes the main treatment process. The purpose of preliminary treatment processes is to remove any materials which will interfere with further treatment. Pretreatment may include screening, presedimentation, chemical addition, flow measurement, and aeration.



Screens. Screening may occur once or a series of times as the water flows from intake to treatment plant. The screens are used to remove rocks, sticks, leaves, and other debris. Very small screens can even be used to screen out algae in the water. All objects are removed by physical size separation - if they are small enough to pass through the holes in the screen, objects flow with the water into the treatment plant. If the objects are too large to pass through the holes, then they are caught by the screen.

Screens should be angled for easy cleaning. In addition, some screens are constructed so that they are self-cleaning. Screens on the outside of intakes are often cleaned by flushing water from the treatment plant backwards through the intake, knocking off any debris which has accumulated there.

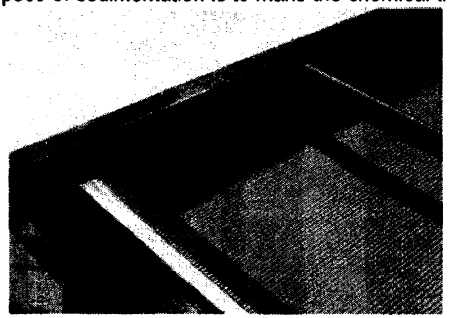
There are two primary types of screens - bar screens and wire-mesh screens. The two types differ in function and in the size of holes in the screens.

A bar screen, such as those shown below, is used to remove large debris from the water. The spaces between the bars are typically two to four inches wide.

A wire-mesh screen, in contrast, is used to remove smaller debris. As you can see in the picture below, the gaps are typically about half an inch wide. Water must be flowing relatively slowly in order to pass through a wire-mesh screen - velocity shouldn't be greater than 3.5 inches per second.

It should be noted that screening is often minimal or absent in groundwater systems. In essence, the water is screened as it trickles down through the earth into the groundwater.

Presedimentation. When raw water has a high turbidity level, the water is passed through a presedimentation basin to settle out sand, grit, and gravel. The presedimentation stage is similar to the sedimentation stage which will be discussed later. Here in pretreatment, the purpose of sedimentation is to make the chemical treatment phase of the water treatment process more efficient by removing sediment from the raw water.



While in the presedimentation basin, activated carbon may be added to the basin for taste, odour, and colour problems. Chemicals may also be added to control the growth of algae.

Aeration. Aeration removes carbon dioxide and hydrogen sulfide from the water. It also oxidizes the iron and manganese.

Flow Measurement. Flow measurement is an important part of the pretreatment process. By measuring the rate at which water flows into the water treatment plant, the operator is able to adjust chemical feed rates, calculate detention times, and monitor the amount of water being treated.

Other Monitoring. As the raw water enters the treatment plant, it is also monitored for a variety of characteristics including pH, turbidity, total alkalinity, temperature, and coliform bacteria. These tests determine the amounts of alkali, coagulants, and other chemicals which must be added to the water during the treatment process.

The pH and total alkalinity of the water will influence the amount of alkali to be added and can also influence the flocculation conditions. The level of turbidity will influence the amount of polymer (coagulant) added to the water. Temperature is also measured since cold water does not floc as well as warm water and requires the addition of more polymer. Based on the results of the pretests, feed rates are set for various chemicals to be added to the water.

Thus, preliminary treatment may include some or all of the following:

- screening - to remove rocks, sticks, leaves, etc.
- presedimentation - to remove sand, grit, and gravel
- aeration - to remove carbon dioxide and hydrogen sulfide; to oxidize iron and manganese
- monitoring - to measure flow, pH, turbidity, total alkalinity, temperature, and coliform bacteria.

3. Find in the text English equivalents to the following word-combinations.

1. подвергаться процессу очистки
2. влиять на дальнейшую обработку (очистку)
3. извлекать камни, ветки, листья и другой мусор
4. проходить через отверстия решетки
5. задерживаться решеткой
6. различаться по функциям
7. просачиваться сквозь почву
8. высокий уровень мутности
9. окислять железо и марганец
10. регулировать дозирование реагентов
11. вычислять время отстаивания

12. контролировать объем очищаемой воды
13. определять объём щёлочи, коагулянтов, и других реагентов
14. измерять температуру

4. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to include	to remove	to be	to use	to pass
to monitor	to measure	to add	to influence	to undergo

1. Preliminary treatment ..... any physical, chemical or mechanical process used on water before it ..... the main treatment process.
2. During preliminary treatment processes, any material which will interfere with further treatment ..... .
3. Pretreatment ..... screening, presedimentation, chemical addition, flow measurement, and aeration.
4. The screens .... to remove rocks, sticks, leaves, and other debris.
5. When raw water has a high turbidity level, it ..... through a presedimentation basin to settle out sand, grit, and gravel.
6. Chemicals ..... to control the growth of algae.
7. Raw water ..... for a variety of characteristics including pH, turbidity, total alkalinity, temperature, and coliform bacteria.
8. The level of turbidity ..... the amount of polymer (coagulant) added to the water.
9. Temperature ..... since cold water does not floc as well as warm water.

5. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Preliminary treatment is any physical, chemical or mechanical process used on water before it undergoes the main treatment process.
2. The purpose of preliminary treatment processes is to make water portable.
3. Screens should be angled for easy addition of chemicals.
4. A bar screen is used to remove small debris from the water.
5. The purpose of presedimentation is to make further water treatment process more efficient by removing sediment from the raw water.
6. The monitoring of raw water for a variety of characteristics including pH, turbidity, total alkalinity, temperature, and coliform bacteria is an important part of the pretreatment process.

6. Answer the following questions.

1. What is preliminary treatment of raw water?
2. How does preliminary treatment fit into the water treatment process?
3. What are the two primary types of screens and how are they used?
4. What is the purpose of presedimintation and why is activated carbon sometimes added to the water?
5. What does aeration remove from the water?
6. What problems does the water treatment plant operator have to deal with?
7. What other characteristics are monitored as raw water enters the treatment plant? Why are they important?

7. Describe the operation of the screens.

UNIT 7 AERATION. COAGULATION AND FLOCCULATION

1. Before reading the text learn the terms used in the text:

volatile organic compounds (VOCs) – летучие органические соединения (ЛОС)
precipitate – осадок
to dispel – разгонять; рассеивать
compound – (химическое) соединение; строение; смесь
chlorine – хлор
to enhance – увеличивать, усиливать, улучшать
flash mixer – устройство для быстрого смешивания
flocculation basin - резервуар для флоккуляции
blade – лезвие, лопасть (винта пропеллера, весла)
to shear – разрезать, стричь; обрезать
compartment – отделение, отсек, камера
cluster – скопление, концентрация
particle – частица; крупица

2. Match the phrases below with the appropriate Russian equivalents.

1. physical treatment process	a. мелкие частицы
2. dissolved gases	b. подверженный ч-л
3. stacks of perforated trays	c. несколько рядов тарелок с дырчатым основанием
4. flash mixing chamber	d. электрический заряд
5. electrical charge	e. камера для быстрого смешивания
6. fine particles	f. растворенные газы
7. subject to smth	g. процесс механической очистки

3. Read and translate the text.

AERATION

Aeration, the first step in the treatment process, adds air to water. It is a physical treatment process used for taste and odour control. Aeration removes dissolved gases or volatile organic compounds (VOCs), iron and manganese. It consists of spraying water into the air or cascading it downward through stacks of perforated trays. Dissolved gases that cause tastes and odours are transferred from the water to the air. Oxygen from the air, meanwhile, reacts with any iron and manganese in the water, forming a precipitate that is removed by sedimentation and filtration.

Thus, the purposes of aeration are

A. To dispel other dissolved gases such as carbon dioxide or chlorine

B. To oxidise a compound dissolved or suspended in water (For example, if source of water contains high concentration of ferrous ion (Fe^{2+}), aeration can oxidize ferrous ion to ferric ion (Fe^{3+}) that is more easily precipitated than ferrous ion)

C. To increase the oxygen content of water used to house animals, such as aquarium fish or fish farm

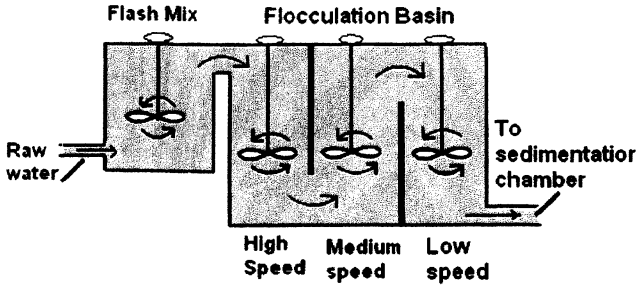
D. As an effective method of bacteria control

Aerators fall into two general categories. They either introduce air into the water or water into the air. The water-to-air method is designed to produce small drops of water that fall through

the air. The air-to-water method creates small bubbles of air that are injected into the water stream. All aerators are designed to create a greater amount of contact between the air and water to enhance the transfer of the gases.

COAGULATION AND FLOCCULATION

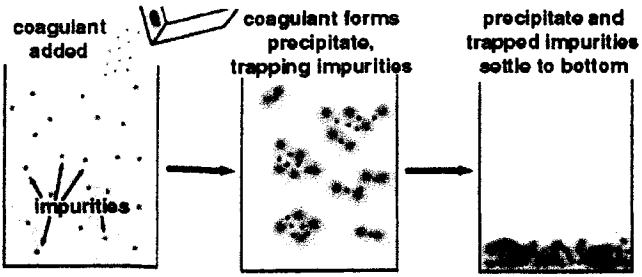
After the source water has been screened and has passed through the optional steps of pre-chlorination and aeration, it is ready for coagulation and flocculation.



In theory and at the chemical level, coagulation and flocculation is a three step process, consisting of flash mixing, coagulation, and flocculation. However, in practice in the treatment plant, there are only two steps in the coagulation/flocculation process - the water first flows into the flash mixing chamber, and then enters the flocculation basin.

The primary purpose of the coagulation/flocculation process is the removal of turbidity from the water. The process also removes many bacteria which are suspended in the water and can be used to remove colour from the water.

Turbidity and colour are much more common in surface water than in groundwater. As surface water flows over the ground to streams, through streams, and then through rivers, the water picks up a large quantity of particles. While aeration is more commonly required for groundwater, treatment involving coagulation and flocculation is typical of surface water.

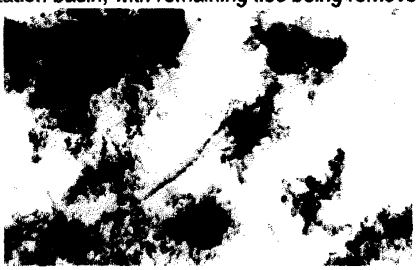


In the **flash mixer**, coagulant chemicals are added to the water and the water is mixed quickly and violently. The purpose of this step is to distribute evenly the chemicals through the water. Flash mixing typically lasts a minute or less. If the water is mixed for less than thirty seconds, then the chemicals will not be properly mixed into the water. However, if the water is mixed for more than sixty seconds, then the mixer blades will shear the newly forming floc back into small particles.

After flash mixing, coagulation occurs. During **coagulation**, the coagulant chemicals neutralize the electrical charges of the fine particles in the water, allowing the particles to come closer together and form large clumps. You may already be familiar with the process of coagulation from cooking. You can see coagulation occurring when preparing gelatin (jelly).

The final step is **flocculation**. During flocculation, a process of gentle mixing brings the fine particles formed by coagulation into contact with each other. Flocculation typically lasts for about thirty to forty-five minutes. The flocculation basin often has a number of compartments with decreasing mixing speeds as the water advances through the basin. This compartmentalized chamber allows increasingly large floc to form without being broken apart by the mixing blades.

The end product of a well-regulated coagulation/flocculation process is water in which the majority of the turbidity has been collected into **floc**, clumps of bacteria and particulate impurities that have come together and formed a cluster. The floc will then settle out in the sedimentation basin, with remaining floc being removed in the filter.



The best floc size is 0.1 to 3 mm. Smaller floc may not settle. Larger floc does not settle as well and is more subject to break up in the flocculation basin.

As the water and the floc particles progress through the treatment process, they move into sedimentation basins where the water moves slowly, causing the heavy floc particles to settle to the bottom.

4. Find in the text English equivalents to the following word-combinations.

1. добавление воздуха (кислорода воздуха) в воду
2. выделяться из воды в воздух
3. служить причиной неприятного запаха и вкуса
4. вступать в реакцию с железом и марганцем
5. образовывать осадок
6. окислять химическое соединение, растворенное в воде
7. увеличивать содержание кислорода
8. подавать воздух в воду
9. создавать больший контакт воздуха с водой
10. равномерно распределять реагенты
11. разрезать на мелкие частицы
12. нейтрализовать электрически заряд
13. осаживаться на дно

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to react	to remove	to add	to consist of	to form
to design	to last	to distribute	to transfer	to settle out

1. Aeration ... air to water.
2. Aeration ... dissolved gases or volatile organic compounds (VOCs), iron and manganese.

3. When water is aerated, dissolved gases that cause tastes and odours ... from the water to the air.

4. Oxygen from the air ... with any iron and manganese in the water, forming a precipitate.

5. All aerators ... to create a greater amount of contact between the air and water.

6. The coagulation and flocculation process ... flash mixing, coagulation, and flocculation.

7. In the flash mixer, coagulant chemicals ... evenly through the water.

8. Flash mixing typically ... a minute or less.

9. At the end of the flocculation process, most of the turbidity and particulate matter in the water ... into a material called floc.

10. The floc ... in the sedimentation basin.

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Aeration adds chemicals to water.

2. Aeration adds dissolved gases or volatile organic compounds (VOCs), iron and manganese to water.

3. Aeration increases the oxygen content of water.

4. Aerators fall into two general categories: they either introduce air into the water or water into the air.

5. The coagulation/flocculation process removes turbidity, suspended bacteria and objectionable colour from the water.

6. A flash mixer distributes chemicals evenly through the water.

7. During coagulation, particulate impurities come closer together and form a large floc.

8. Small floc particles are more subject to break up in the flocculation basin.

7. Answer the following questions.

1. Why is aeration used in the treatment of water?
2. What does aeration remove from water?
3. What categories do aerators fall into?
4. What is the primary purpose of the coagulation/flocculation process?
5. What is the purpose of the flash mixing stage?
6. What is a coagulant? Why are coagulants added to raw water?
7. How is the forming of a floc accomplished?
8. What factors influence floc settling?

8. Make a list of equipment and its components used for aeration/ coagulation/ flocculation processes.

UNIT 8 SEDIMENTATION

1. Before reading the text learn the terms used in the text:

sedimentation – отстаивание, осаждение; отложение осадка

suspension velocity – равновесная скорость, скорость витания (скорость вертикально восходящего потока газа или жидкости, при которой частицы взвеси остаются на одном уровне относительно стенок канала)

pinpoint – остриё булавки; что-л. очень маленькое; безделица, пустяк

predictability – предсказуемость
cost-effectiveness – доходность, прибыльность, рентабельность
short-circuiting – каналообразование в массе
inlet – впуск , вход; входное, вводное отверстие
sludge – ил, тина; густая грязь
outlet – сток, вытекание (из водного бассейна); выход, проход
sanitary sewer — санитарный коллектор
to pump - накачивать, выкачивать, откачивать (процесс действия насоса)
thickening – уплотнение
to thaw – таять, оттаивать; размораживаться
conditioning – обработка ила перед обезвоживанием, кондиционирование ила
lagoon – отстойный пруд, отстойник
landfill – мусорная свалка
drying bed – иловая площадка
to underlie – лежать в основе (чего-л.)
to drain – осушать, отводить воду; осуществлять дренаж
(belt) filter presses – (ленточный) фильтр-пресс

2. Read and translate the text.

SEDIMENTATION

Sedimentation is a treatment process in which the velocity of the water is lowered below the suspension velocity and the suspended particles settle out of the water due to gravity. The process is also known as settling or clarification.

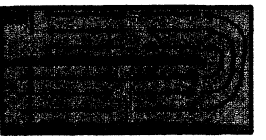
Most water treatment plants include sedimentation in their treatment processes. However, sedimentation may not be necessary in low turbidity water. In this case, coagulation and flocculation are used to produce pinpoint (very small) floc which is removed from the water in the filters.

The most common form of sedimentation follows coagulation and flocculation and precedes filtration. This type of sedimentation requires chemical addition (in the coagulation/flocculation step) and removes the resulting floc from the water. Sedimentation at this stage in the treatment process should remove 90% of the suspended particles from the water, including bacteria. The purpose of sedimentation is to decrease the concentration of suspended particles in the water, reducing the load on the filters.

Sedimentation basins, also called settling tanks or clarifiers, are large tanks in which water is made to flow very slowly in order to promote the sedimentation of particles or flocs. In water and wastewater treatment plants, these are so large that they are situated outdoor and usually have an open surface. Three common types of sedimentation basins are shown below:

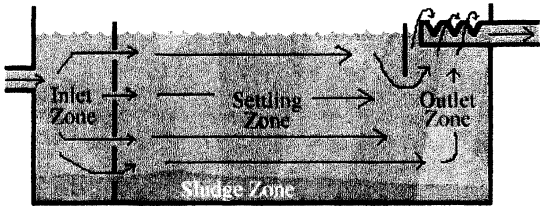
Rectangular basins are the simplest design, allowing water to flow horizontally through a long tank. This type of basin is usually found in large-scale water treatment plants. Rectangular basins have a variety of advantages - predictability, cost-effectiveness, and low maintenance. In addition, rectangular basins are the least likely to short-circuit, especially if the length is at least twice the width. A disadvantage of rectangular basins is the large amount of land area required.

Double-deck rectangular basins are essentially two rectangular sedimentation basins stacked one atop the other. This type of basin conserves land area, but has higher operation and maintenance costs than a one-level rectangular basin.



Square or circular sedimentation basins with horizontal flow are often known as clarifiers. This type of basin is likely to have short-circuiting problems.

All sedimentation basins have four zones - the inlet zone, the settling zone, the sludge zone, and the outlet zone. Each zone should provide a smooth transition between the zone before and the zone after. In addition, each zone has its own unique purpose. Zones can be seen most easily in a rectangular sedimentation basin, such as the one shown below:

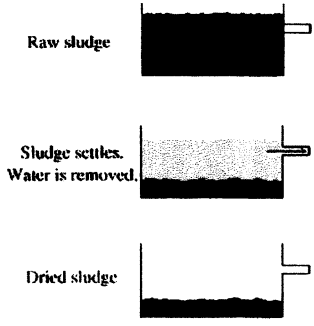


The sludge which is found in the bottom of a sedimentation tank is primarily composed of water. The solids concentration is only about 1% when automatically removed from the basin, or about 2% if manually removed. In the past, sludge was typically released into streams and other bodies of water. However, this practice is becoming much less common and is now well regulated. Alternatively, sludge may be piped directly to the sanitary sewer.

Most of the other alternatives ways of disposal require transporting sludge away from the treatment plant. Sludge is typically dried before it is trucked away since the greater volume of wet sludge makes it much more expensive to transport. This drying process is known as **dewatering** or **thickening**.

A variety of devices have been developed to thicken the sludge, some of which are explained below.

In many cases, the sludge is treated by the addition of polymers to aid in the dewatering process. Alternatively, the sludge can be heated or frozen and thawed to increase the solids concentration. Treating the sludge to aid in thickening is known as **conditioning** the sludge. Once the sludge has been conditioned, it may be thickened in a lagoon, drying bed, or one of several other devices.

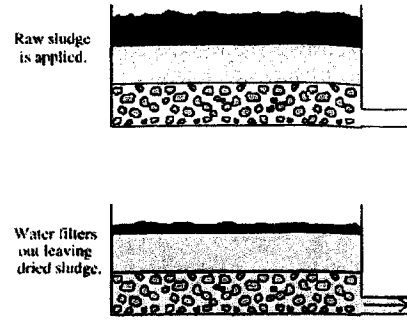


Lagoons, which are small-volume storage ponds, are the simplest device used to thicken sludge. These lagoons are filled with sludge and the solids are allowed to settled due to gravity to the bottom of the lagoon while the clear water is pumped off the top.

After a few months, gravity and evaporation will have reduced the sludge to a 30-50% solid state. The sludge can then be covered with soil and left on site, or may be trucked to a landfill off-site.

Drying beds are often used to thicken sludge destined for a landfill more quickly than the sludge would be thickened in a lagoon.

A drying bed is similar in design to a sand filter, with a layer of sand underlain by a layer of gravel. The sludge is applied to the top of the sand and the water percolates down through the sand and gravel and is drained away. When the sludge is sufficiently dry, it is carefully removed from the top of the sand and is trucked to a landfill. When sludge is preconditioned with chemicals, dewatering in a drying bed may take only a few days or weeks.



Other processes used to thicken sludge include filter presses, belt filter presses, centrifuges, and vacuum filters. These processes result in sludge with a solids content ranging from 30 to 50%.

3. Match these terms with their definitions:

1. Sedimentation	a) the floc which settles to the bottom of the sedimentation basin and must be removed as waste.
2. A sedimentation basin	b) a problem in sedimentation basins in which water bypasses the normal flow path through the basin and reaches the outlet in less than the normal detention time.
3. Short-circuiting	c) is a physical water treatment process using gravity to remove suspended solids from water.
4. Sludge	d) is a basin or tank in which water is retained to allow settleable matter, such as floc, to settle by gravity.
5. Lagoon	e) is a drying process which makes the sludge easier to transport away from the plant for disposal.
6. Thickening	f) A small-volume storage pond used to thicken sludge.

4. Find in the text English equivalents to the following word-combinations.

1. следовать за коагуляцией
2. предшествовать фильтрации
3. требовать добавления реагентов
4. удалять получающиеся в результате хлопья
5. сокращать концентрацию взвешенных частиц
6. уменьшать нагрузку на фильтры
7. способствовать осаждению частиц
8. иметь ряд преимуществ
9. экономить земельные площади
10. сбрасывать (ил) в реки
11. вывозить ил
12. обрабатывать ил
13. устройство, используемое для уплотнения ила
14. варьироваться от 30 до 50%

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to allow	to include	to make	to decrease	to compose
to release	to conserve	to remove	to dry	to promote

1. Most water treatment plants ... sedimentation in their treatment processes.
2. The most common form of sedimentation requires chemical addition and ... the resulting floc from the water.
3. Sedimentation ... the concentration of suspended particles in the water, reducing the load on the filters.
4. A very slow flow of water in sedimentation basins ... the sedimentation of particles or flocs.
5. Rectangular sedimentation basins ... water to flow horizontally through a long tank.
6. Double-deck rectangular basins ... land area.
7. The sludge which is found in the bottom of a sedimentation tank ... of water.
8. In the past, sludge ... into streams and other bodies of water.
9. Sludge ... before it is trucked away from the treatment plant.

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Sedimentation is a treatment process in which the suspended particles settle out of the water due to gravity.
2. The most common form of sedimentation precedes coagulation and flocculation and follows filtration.
3. The purpose of sedimentation is to increase the concentration of suspended particles in the water, reducing the load on the filters.
4. Rectangular basins have a variety of advantages - predictability, cost-effectiveness, and low maintenance.
5. Double-deck rectangular basins have lower operation and maintenance costs than a one-level rectangular basin.
6. Thickening (dewatering) is a sludge drying process.
7. Lagoons are the simplest device used to thicken sludge.
8. In a drying bed, the sludge is applied to the top of the sand and the water percolates down through the sand and gravel and is drained away.

7. Answer the following questions.

1. What is sedimentation?
2. How does sedimentation fit into the water treatment process?
3. What is the purpose of sedimentation?
4. What types of sedimentation basins are mentioned in the text? What advantages does each basin type have over other types?
5. What zones are present in a sedimentation basin?
6. What is thickening?
7. What devices are used to thicken sludge? How do they work?
8. How is sedimentation sludge disposed of?

8. Make up a plan of the text and retell it according to your plan.

UNIT 9 FILTRATION

1. Before reading the text learn the terms used in the text:

clearwell – отсек для очищенной воды
straining – процеживание, фильтрация
to capture – захватывать, брать силой; брать в плен
to attract – притягивать; привлекать, притягивать (внимание, инвестиции)
decomposition – разложение, расчленение, разбиение, декомпозиция
to soak – впитывание, всасывание, абсорбирование
underdrain – подземная дренажная труба
to rake – рыхлить, разравнивать граблями
backwashing – обратная промывка
controller – контроллер; регулятор; орган управления
influent – входящий поток; сточные воды, поступающие на очистку

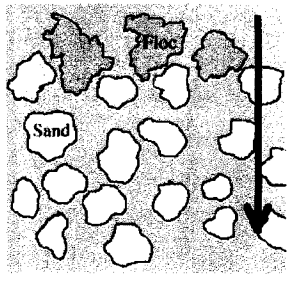
2. Match the phrases below with the appropriate Russian equivalents.

1. filter medium	a. скорость фильтрации
2. solids removal process	b. блок фильтров
3. slow sand filter	c. жёлоб для стока воды
4. rapid sand filter	d. медленный песчаный фильтр
5. filtration rate	e. система управления фильтром
6. filter box	f. процесс удаления твердых частиц
7. backwash water	g. промывочная вода
8. backwash trough	h. скорый песчаный фильтр
9. filter control system	i. загрузка фильтра, фильтрующий материал

3. Read the text.

FILTRATION

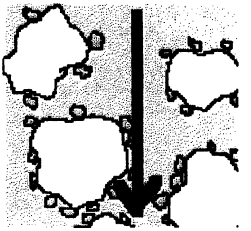
The purpose of filtration is to remove suspended particles from water by passing the water through a medium such as sand. As the water passes through the filter, floc and impurities get stuck in the sand and the clean water goes through. The filtered water collects in a clearwell, where it is disinfected and then sent to the customers. Filtration is usually the final step in the solids removal process which began with coagulation and advanced through flocculation and sedimentation. In the filter, up to 99.5% of the suspended solids in the water can be removed, including minerals, floc, and microorganisms.



How are particles removed from water using filtration? Four mechanisms have been found to be part of the filtration process - straining, adsorption, biological action, and absorption. Each mechanism will be explained below.

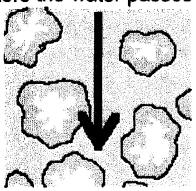
Straining is passing the water through a filter in which the pores are smaller than the particles to be removed. This is the most intuitive mechanism of filtration and one which you probably use in your daily life. Straining occurs when you remove spaghetti from water by pouring the water and spaghetti into a strainer.

The picture shows an example of straining in a filter. As you can see, the floc cannot fit through the gaps between the sand particles, so the floc are captured. The water is able to flow through the sand, leaving the floc particles behind.



The second, and in many cases the most important mechanism of filtration, is **adsorption**. Adsorption is the gathering of gas, liquid, or dissolved solids onto the surface of another material. In filtration, adsorption involves particles becoming attracted to and "sticking" to the sand particles. Adsorption can remove even very small particles from water.

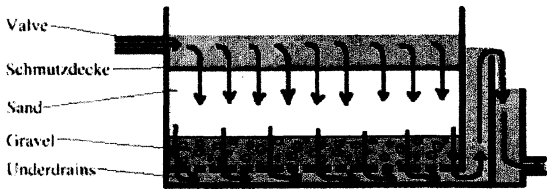
The third mechanism of filtration is **biological action**, which involves any sort of breakdown of the particles in water by biological processes. This may involve decomposition of organic particles by algae, plankton, and bacteria or it may involve microorganisms eating each other. Although biological action is an important part of filtration in slow sand filters, in most other filters the water passes through the filter too quickly for much biological action to occur.



The final mechanism of filtration is **absorption**, the soaking up of one substance into the body of another substance. Absorption should be a very familiar concept - sponges absorb water, as do towels. In a filter, absorption involves liquids being soaked up into the sand grains. After the initial wetting of the sand, absorption is not very important in the filtration process.

Filters can be categorized in a variety of ways. We will discuss two types of filters below - the slow sand filter and the rapid sand filter.

The slow sand filter is the oldest type of large-scale filter. In the slow sand filter, water passes first through about 36 inches of sand, then through a layer of gravel, before entering the underdrain. The sand removes particles from the water through adsorption and straining.



Unlike other filters, slow sand filters also remove a great deal of turbidity from water using biological action. A layer of dirt, debris, and microorganisms builds up on the top of the sand. This layer is known as **schmutzdecke**, which is German for "dirty skin." The schmutzdecke breaks down organic particles in the water biologically, and is also very effective in straining out even very small inorganic particles from water.

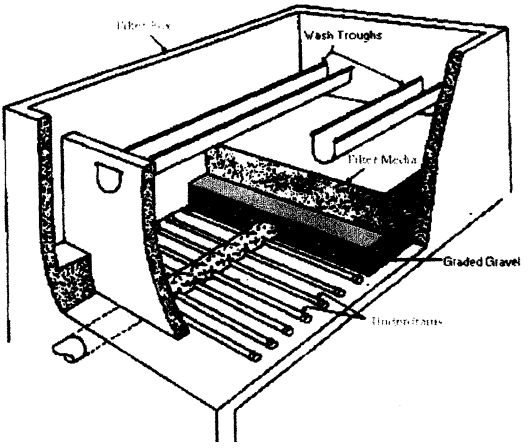
Maintenance of a slow sand filter consists of raking the sand periodically and cleaning the filter by removing the top two inches of sand from the filter surface. After a few cleanings, new sand must be added to replace the removed sand.

Slow sand filters are very reliable filters. However, water passes through the slow sand filter very slowly, and the rate is slowed yet further by the schmutzdecke layer. As a result, large land areas must be devoted to filters when slow sand filters are part of a treatment plant.

The rapid sand filter differs from the slow sand filter in a variety of ways, the most important of which are the much greater filtration rate and the ability to clean automatically using backwashing. The mechanism of particle removal also differs in the two types of filters - rapid

sand filters do not use biological filtration and depend primarily on adsorption and some straining.

A diagram of a typical rapid sand filter is shown on the left. The filter is contained within a **filter box**, usually made of concrete. Inside the filter box are layers of **filter media** (sand, anthracite, etc.) and gravel. Below the gravel, a network of pipes makes up the **underdrain** which collects the filtered water and evenly distributes the backwash water. **Backwash troughs** help distribute the influent water and are also used in backwashing. Most rapid sand filters contain a **controller**, or **filter control system**, which regulates flow rates of water through the filter.



Operation of a rapid sand filter during filtration is similar to operation of a slow sand filter. The influent flows down through the sand and support gravel and is captured by the underdrain. However, the influent water in a rapid sand filter is already relatively clear due to coagulation/flocculation and sedimentation, so rapid sand filters operate much more quickly than slow sand filters.

4. Match these terms with their definitions:

1. Filtration	a) is the process of adhering to a surface by a combination of complex physical forces and chemical action.
2. Straining	b) is the soaking up of one substance into the body of another substance.
3. Adsorption	c) is a material in a filter which removes particles from the water. Typical filter media include sand,gravel, anthracite, and garnet.
4. Absorption	d) a layer of dirt, debris, and microorganisms that builds up on the top of the sand in a slow sand filter.
5. Schmutzdecke	e) is the removal of particles from water by passing the water through a filter in which the pores are smaller than the particles to be removed.
6. Filter medium	f) is a mechanical means of removing impurities and floc from the water by passing it through sand and gravel or some other filter.

5. Find in the text English equivalents to the following word-combinations.

пропускать воду через фильтрующее вещество, такое как песок
отправлять (воду) потребителям
использовать в повседневной жизни
проходить сквозь промежутки между частицами песка
частицы, которые начинают притягиваться к частицам песка и слипаться с ними

биологическое действие
проходить через фильтр слишком быстро
впитывать воду
впитываться в песчинки
попадать в дренажную трубу
удалять частицы при помощи адсорбции
расщеплять органические частицы
отфильтровывать даже очень маленькие неорганические частицы
техническое обслуживание фильтра
очень надежные фильтры
отводить большие земельные площади под фильтры

6. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to soak	to disinfect	to pass	to gather	to contain
to break down	to depend	to remove	to involve	to collect

1. The filtration ... suspended particles from water by passing the water through a medium such as sand.
2. The filtered water ... in a clearwell.
3. During straining, water ... through a filter in which the pores are smaller than the particles to be removed.
4. During adsorption, gas, liquid, or dissolved solids ... onto the surface of another material.
5. Biological action ... any sort of breakdown of the particles.
6. During absorption, one substance ... into the body of another substance.
7. The schmutzdecke ... organic particles biologically.
8. The slow sand filter ... by removing the top two inches of sand from the filter surface.
9. The rapid sand filter ... within a filter box, made of concrete.
10. The underdrain ... the filtered water and evenly distributes the backwash water.

7. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. The purpose of filtration is to remove suspended particles from water by passing the water through a medium such as sand.
2. As the water passes through the filter, the clean water gets stuck in it but floc and impurities go through.
3. Filtration is usually the final step in the solids removal process.
4. Straining, adsorption, biological action, and absorption are mechanisms, which have been found to be part of the filtration process.
5. Straining is the gathering of gas, liquid, or dissolved solids onto the surface of another material.
6. Adsorption can remove only very large particles from water.
7. Absorption is the soaking up of one substance into the body of another substance.
8. The slow sand filter is the oldest type of a small-scale filter.
9. The rapid sand filter depends primarily on adsorption and some straining.
10. Rapid sand filters operate much more quickly than slow sand filters.

8. Answer the following questions.

1. What is the purpose of filtration?
2. How does filtration fit into the water treatment process?
3. What mechanisms take part in the filtration process?
4. What types of filters are mentioned in the text?
5. What are the advantages/disadvantages of slow sand filters?
6. What are the advantages/disadvantages of rapid sand filters?
7. How are filters cleaned?
8. What media are used in filters?
9. What factors affect filter efficiency?

9. Describe the operation of a slow (or rapid) sand filter.

UNIT 10 DISINFECTION

1. Before reading the text learn the terms used in the text:

chlorine – хлор
residual – остаточный
to aid – помогать, оказывать помощь, поддержку; способствовать
clearwell – резервуар для очищенной воды
hypochlorinator – гипохлоратор, устройство для хлорирования воды
hypochlorite – гипохлорит
holding chamber – приемная камера, клапанная камера
germ – бактерия, микроб, микроорганизм
injector – инжектор (струйный насос для сжатия газов и паров, а также нагнетания жидкости в различные аппараты и резервуары)
negative head – отрицательное давление
rotameter – ротаметр (прибор для измерения скорости и расхода жидкости или газа)
to adjust – приводить в порядок; улаживать; подгонять, пригонять, прилаживать
to disrupt – разрывать, разрушать
leak – течь , протечка; утечка
emergency – непредвиденный случай; крайняя необходимость; крайность
lack – недостаток, нужда; отсутствие (чего-л.)
gpm от gallons per minute; = g.p.m. (столько-то) галлонов в минуту

2. Match the phrases below with the appropriate Russian equivalents.

1. residual chlorine	a. скорость потока воды
2. continuous chlorination	b. клапан регулирования давления
3. heavily contaminated water	c. непостоянное водоснабжение
4. pressure regulating valve	d. раствор гипохлорита
5. motor driven pump	e. пропорциональный регулятор потока
6. hypochlorite solution	f. непрерывное хлорирование
7. chlorine feed rate	g. остаточный хлор
8. flow proportional controller	h. скорость подачи хлора
9. flow rate of the water	i. электронасос, насос с электроприводом
10. non-permanent water supplies	j. сильно загрязненная вода

3. **Read the text.**

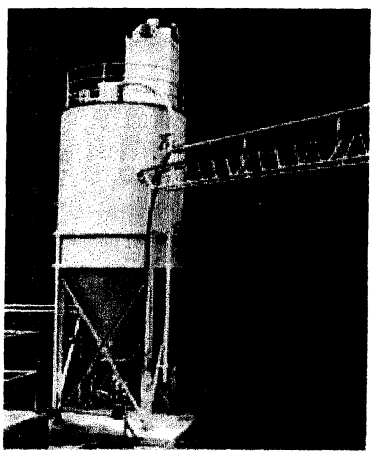
DISINFECTION

Before water treatment became common, waterborne diseases could spread quickly through a population, killing or harming hundreds of people. The primary goal of water treatment is to ensure that the water is safe to drink and does not contain any disease-causing microorganisms.

This unit will be concerned with **disinfection**, which is the process of destroying pathogenic organisms in water, usually by chemical means.

Chlorination is currently the most frequently used form of disinfection in the water treatment field. It is the application of chlorine for the purpose of water disinfection.

Like several other water treatment processes, chlorination can be used as a pretreatment process (**prechlorination**) or as part of the primary treatment of water (**postchlorination**). Water treatment usually involves either postchlorination only or a combination of prechlorination and postchlorination.

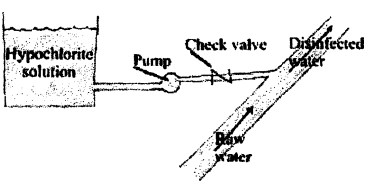


Prechlorination is the act of adding chlorine to the raw water. During prechlorination, chlorine is usually added to water after screening and before flash mixing. The residual chlorine is useful in several stages of the treatment process – aiding in coagulation, controlling algae problems in basins, reducing odour problems. In addition, the chlorine has a much longer contact time when added at the beginning of the treatment process, so prechlorination increases safety in disinfecting heavily contaminated water.

Postchlorination is often the last stage in the treatment process. After flowing through the filter, water is chlorinated and then pumped to the clearwell to allow a sufficient contact time for the chlorine to act. From the clearwell, the water may be pumped into a large, outdoor storage tank such as the one shown in the picture. Finally, the water is released to the customer.

The simplest method of continuous chlorination of small water supplies is the use of a hypochlorinator. **Hypochlorinators** are motor driven pumps which are used to add hypochlorite solutions to water. The pump pulls the hypochlorite solution out of a holding chamber and pumps it into the water to be treated.

Hypochlorinator

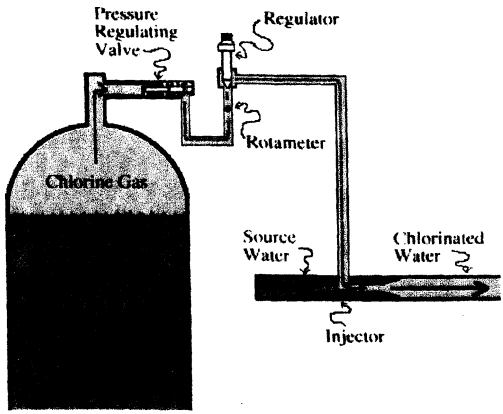


When chlorine remains in contact with the water for 20 minutes or more, it can kill most of the disease-causing germs in the water. The contact time must be at least 20 minutes, otherwise the water cannot be considered safe for drinking.

While hypochlorinators are usually used to perform continuous chlorination in smaller systems, chlorinators are more economical when the supply source is greater than 75 gpm. **Chlorina-**

tors are devices which introduce chlorine gas to water using liquid chlorine supplied in steel cylinders.

The most typical kind of chlorinator, a **vacuum chlorinator**, is shown below:



In a vacuum chlorinator, chlorine gas is pulled from the cylinder into the source water by a vacuum. The vacuum is created by water flowing through the injector and creating a negative head. This negative head forces open the pressure regulating valve on the cylinder and allows chlorine gas to flow out of the cylinder and into the chlorinator.

Once the gas has entered the chlorinator, the chlorine feed rate is measured using an indicator known as a **rotameter**. Just beyond the rotameter, the chlorine gas flows past a regulating device (a V-notch plug or a valve) which is used to adjust the chlorine feed rate.

Then the chlorine gas is pulled into the **injector**, also known as an **ejector**. The flowing water pulls chlorine into the water, both chlorinating the source water and creating a vacuum in the chlorine line which pulls more chlorine gas out of the cylinder. Chlorinators can be controlled manually (using the regulator) or with a controller. The most common type of controller is the **flow proportional controller** which automatically feeds chlorine based on the flow rate of the water. Vacuum chlorinators are very safe since any break in the line with disrupt the vacuum and close the pressure regulating valve. As a result, chlorine leaks are very uncommon.

Up until this point, we have been concerned only with disinfection using chlorine. However, a variety of other methods can be used to disinfect water. The table below summarizes five disinfection processes.

Disinfection Method	Advantages/Disadvantages	Uses
Iodine	- good disinfectant; - high cost; harmful to pregnant women	emergency treatment of water supplies; disinfecting small, non-permanent water supplies
Bromine	- handling difficulties; residuals hard to obtain; supply is limited	very limited use, primarily for treating swimming pool water

Ozone	- good disinfectant; better destroys viruses than chlorine; oxidizes iron, manganese, sulfide, and organics; removes color, odor, and taste; - high cost; lack of residual; storage difficulties; maintenance requirements; safety problems; unpredictable disinfection; no track record	disinfection; treating iron and manganese, helping flocculation, removing algae, oxidizing organics, removing color, treating tastes and odors
Ultraviolet	- lack of dangerous by-products; - lack of measurable residual;cost of operation; turbidity interferes with disinfection	small or local systems and industrial applications
Ultrasonic	(sound waves destroy pathogens by vibration) very expensive	

4. Match these terms with their definitions:

1. Disinfection — a. is a reservoir containing potable water which has been previously treated before entering the distribution lines.
2. Chlorination — b. is a process of selectively destroying or inactivating pathogenic organisms in water, usually by chemical means.
3. A clearwell — c. are machines which use liquid chlorine supplied in steel cylinders to chlorinate water.
4. Hypochlorinators — d. is the destruction of waterborne pathogens through disinfection with various forms of chlorine
5. Chlorinators — e. are used to feed hypochlorite solutions into water in treatment plants.

5. Find in the text English equivalents to the following word-combinations.

заболевания, передающиеся через воду
наносить вред людям
не содержать болезнетворные микроорганизмы
сокращать проблемы, связанные с неприятным запахом (воды)
повышать безопасность
закачивать (воду) в резервуар для очищенной воды
обеспечить достаточное время контакта
добавлять раствор гипохлорита в воду
контактировать с водой в течение 20 или более минут
убивать большинство болезнетворных микробов
жидкий хлор, поставляемый в стальных цилиндрах
вытягиваться из цилиндра вакуумом
создавать отрицательное давление
измерять скорость подачи хлора
утечка хлора
дезинфицировать воду
отсутствие опасных побочных продуктов

6. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to apply	to release	to increase	to aid	to control
to remain	to destroy	to add	to measure	to pull

1. Disinfection ... pathogenic organisms in water, usually by chemical means.
2. During chlorination, chlorine ...for the purpose of water disinfection.
3. The residual chlorine ... in coagulation, controlling algae problems in basins, reducing odour problems.
4. Prechlorination ... safety in disinfecting heavily contaminated water.
5. After disinfection, water ... to the customer.
6. Hypochlorinators ... hypochlorite solutions to water.
7. The pump ... the hypochlorite solution out of a holding chamber.
8. When chlorine ... in contact with the water for 20 minutes or more, it kills most of the disease-causing germs in the water.
9. A rotameter ... the chlorine feed rate.
10. Chlorinators ... manually (using the regulator) or with a controller.

7. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Before water treatment became common, waterborne diseases had been killing hundreds of people throughout the world.
2. The primary goal of water treatment is to ensure the safety of drinking water.
3. Disinfection adds useful organisms to water, usually by chemical means.
4. Chlorination is currently the most rarely used form of disinfection.
5. The residual chlorine is harmful to people's health.
6. Postchlorination is often the last stage in the treatment process.
7. Hypochlorinators are manually driven pumps which are used to add hypochlorite solutions to water.
8. Chlorinators are devices which introduce treated water to chlorine gas.
9. A variety of disinfectant can be used to disinfect water.

8. Answer the following questions.

1. What is the purpose of disinfection?
2. How does chlorination fit into the water treatment process?
3. How does chlorination work?
4. Does prechlorination increase safety in disinfecting heavily contaminated water?
5. Which stage is often the last one in the water treatment process?
6. What equipment is used for chlorination?
7. Why are vacuum chlorinators considered to be very safe?
8. What other disinfectant can be used to disinfect water? Do they have advantages over chlorine?

9. Describe the operation of a chlorinator.

PART 3: WHAT HAPPENS AT A WASTEWATER TREATMENT PLANT?

UNIT 11 WHAT IS WASTEWATER

1. Before reading the text learn the terms used in the text:

drain – дренаж; дренажная канава; водосток, труба; канализация
to handle – управлять (чем-л.) , справляться (с чем-л.)
sewage сточные воды; нечистоты
runoff – поверностный сток (в результате дождя или снеготаяния)
putrescible – подверженный гниению
nutrient – питательное вещество
identifiable – опознаваемый
BOD (biological oxygen demand) – биологическая потребность в кислороде
to decompose – разлагать на составные части
deplete – истощать, исчерпывать (запасы)
to perish – гибнуть, погибать, умирать
septic – гнилостный
eutrophication – евтрофикация

2. Match the phrases below with the appropriate Russian equivalents.

1. wastewater system	a. взвешенные примеси
2. storm sewage	b. сброс сточных вод
3. suspended impurities	c. питательные вещества для растений
4. chemical compound	d. ливнёвые воды
5. organic substance	e. водные биологические виды
6. aquatic species	f. химическое соединение
7. septic conditions	g. избыточное количество
8. excessive amount	h. условия загнивания
9. intestinal tract	i. система сбора и отведения сточной воды
10. sewage discharge	j. кишечный тракт

3. Read the text.

WHAT IS WASTEWATER

As you know, clean water is essential to life. Have you ever thought about how much water you use and how much wastewater you produce each day?

Consider the variety of products you wash down the drain each day, and then imagine that everyone else in your city is using similar products. There is also the natural human waste we all produce each day. All of this wastewater runs through the city's wastewater system and ends up at a local wastewater treatment plant. Can you imagine the amount of wastewater this system handles?

There are three types of wastewater, or sewage: domestic sewage, industrial sewage, and storm sewage. Domestic sewage carries used water from houses and apartments; it is also called sanitary sewage. Industrial sewage is used water from manufacturing or chemical processes. Storm sewage, or storm water, is runoff from precipitation that is collected in a system of pipes or open channels.

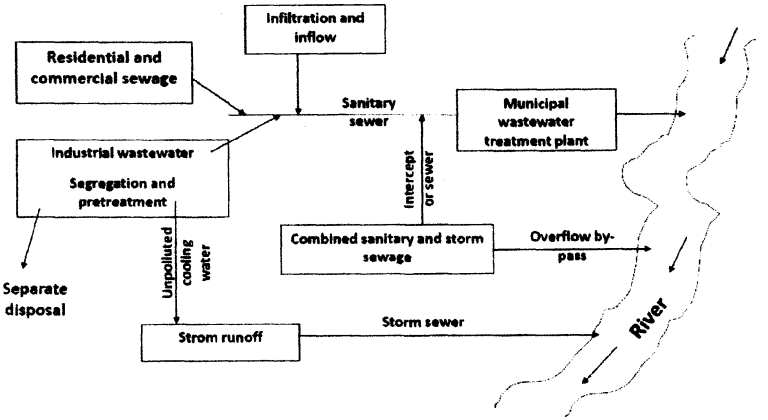


Fig. 1 Sources of wastewater

Domestic sewage is slightly more than 99.9 percent pure water by weight. The rest, less than 0.1 percent, contains a wide variety of dissolved and suspended impurities. The nature of these impurities and the large volumes of sewage in which they are carried make disposal of domestic wastewater a significant technical problem. The principal impurities are putrescible organic materials and plant nutrients, but domestic sewage is also very likely to contain disease-causing microbes. Industrial wastewater usually contains specific and readily identifiable chemical compounds, depending on the nature of the industrial process. Storm sewage carries organic materials, suspended and dissolved solids, and other substances picked up as it travels over the ground.

Organic material. The amount of putrescible organic material in sewage is measured by the biochemical oxygen demand, or BOD; the more organic material there is in the sewage, the higher the BOD. BOD is the amount of oxygen required by microorganisms to decompose the organic substances in sewage. It is among the most important parameters for the design and operation of sewage treatment plants. Industrial sewage may have BOD levels many times that of domestic sewage. The BOD of storm sewage is of particular concern when it is mixed with domestic sewage in combined sewer systems.

Dissolved oxygen is an important water quality factor for lakes and rivers. The higher the concentration of dissolved oxygen, the better the water quality. When sewage enters a lake or stream, decomposition of the organic materials begins. Oxygen is consumed as microorganisms use it in their metabolism. This can quickly deplete the available oxygen in the water. When the dissolved oxygen levels drop too low, trout and other aquatic species soon perish. In fact, if the oxygen level drops to zero, the water will become septic. Decomposition of organic compounds without oxygen causes the undesirable odours usually associated with septic conditions.

Suspended solids. Another important characteristic of sewage is suspended solids. The volume of sludge produced in a treatment plant is directly related to the total suspended solids present in the sewage. Industrial and storm sewage may contain higher concentrations of suspended solids than domestic sewage. The extent to which a treatment plant removes suspended solids, as well as BOD, determines the efficiency of the treatment process.

Plant nutrients. Domestic sewage contains compounds of nitrogen and phosphorus, two elements that are basic nutrients essential for the growth of plants. In lakes, excessive amounts of nitrates and phosphates can cause the rapid growth of algae. Algal blooms, often caused by sewage discharges, accelerate the natural aging of lakes in a process called eutrophication.

Microbes. Domestic sewage contains many millions of microorganisms per gallon. Most are harmless coliform bacteria from the human intestinal tract, but domestic sewage is also likely to carry pathogenic microbes. Coliforms are used as indicators of sewage pollution; a high coliform count usually indicates recent sewage pollution.

4. Match these terms with their definitions:

1. Sewage	f. is the quantity of oxygen used by microorganisms in the aerobic stabilization of wastewater.
2. Domestic sewage	g. is used water from manufacturing or chemical processes.
3. Storm sewage	h. is runoff from precipitation that is collected in a system of pipes or open channels.
4. Industrial sewage	i. is used household water and water-carried solids. It is also known as "wastewater".
5. BOD	j. carries used water from houses and apartments; it is also called sanitary sewage.

5. Find in the text English equivalents to the following word-combinations.

быть важным для жизни
производить сточные воды
смывать в канализацию
вода, использованная в производстве
содержать большое количество разнообразных растворенных и взвешенных примесей
легко распознаваемые химические соединения
измеряться с помощью БОД
проектирование и функционирование очистных сооружений
заслуживать особого внимания
смешиваться с бытовыми сточными водами
чем выше содержание растворенного кислорода, тем лучше качество воды
напрямую зависеть от чего-либо
определять эффективность процесса очистки
содержать соединения азота и фосфора
избыточное количество
ускорять естественное старение озер
переносить болезнетворные микробы

6. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to carry	to run through	to collect	to pick up	to cause
to call	to contain	to drop	to measure	to consume

1. Wastewater ... the city's wastewater system and ends up at a local wastewater treatment plant.

2. Domestic sewage ... used water from houses and apartments.
3. Domestic sewage ... also ...sanitary sewage.
4. Storm sewage ... in a system of pipes or open channels.
5. Domestic sewage ... less than 0.1 percent of dissolved and suspended impurities.
6. Storm sewage ... different substances as it travels over the ground.
7. The amount of putrescible organic material in sewage ... by the BOD.
8. Oxygen ... as microorganisms use it in their metabolism.
9. If the oxygen level ... to zero, the water will become septic.
10. In lakes, excessive amounts of nitrates and phosphates ... the rapid growth of algae.

7. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. There are two types of wastewater, or sewage: domestic sewage, industrial sewage.
2. Domestic sewage is slightly more than 89.9 percent pure water by weight.
3. The principal impurities of domestic sewage are putrescible organic materials and plant nutrients.
4. Industrial wastewater usually contains specific and hard identifiable chemical compounds.
5. The amount of putrescible organic material in sewage is measured by the biochemical oxygen demand.
6. The higher the concentration of dissolved oxygen, the lower the water quality.
7. Industrial and storm sewage may contain higher concentrations of suspended solids than domestic sewage.
8. Domestic sewage contains many millions of microorganisms per gallon.

8. Answer the following questions.

1. What is wastewater?
2. What types of wastewater are mentioned in the text?
3. What carries domestic sewage/industrial sewage/storm sewage?
4. What percentage of dissolved and suspended impurities does domestic water contain?
5. What are possible pollutants of domestic sewage/industrial sewage/storm sewage?
6. What is measured by BOD?
7. Why is dissolved oxygen considered to be an important water quality factor for lakes and rivers?
8. What is the volume of sludge produced in a treatment plant directly related to?
9. What can excessive amounts of nitrates and phosphates cause in lakes?
10. What microorganisms does domestic sewage contain?

9. Explain what is wastewater. Think how much wastewater you produce each day.

UNIT 12 WASTEWATER COLLECTION SYSTEMS

1. Before reading the text learn the terms used in the text:

appurtenance – дополнительное устройство, дополнительное приспособление
combined sewer – объединённый коллектор для коммунально-бытовых и ливневых вод
manhole – канализационный колодец

whirlpool – вихрь, водоворот, воронка
sanitary sewer – система канализации для бытовых сточных вод
storm sewers – ливневые стоки
surface runoff – поверхностный сток
detention basin – водохранилище с регулируемым выпуском
reinforced concrete –железобетон
corrugated pipe – гофрированная труба
right-of-way – полоса отвода, трасса (трубопровода, линии электропередачи)
easement – удобства, подсобные помещения, пристройки, службы
intermittent – нерегулярный, прерывистый; скачкообразный;
lateral – поперечный канал; поперечная дренажная канава; поперечная траншея; поперечный трубопровод (ответвление)
submain – кол лектор канализации, принимающий сточные воды от нескольких зданий
interceptor – коллектор для сточных вод, подающий сточные воды к очистной станции
trunk line – магистральный трубопровод
vitrifying clay – плотноспекающаяся глина
asbestos cement – асбестоцемент
ductile iron – ковкое (мягкое) железо
force main – напорный трубопровод (насосной станции)
nonclogging – незасоряющийся; незабивающийся
dry well – поглощающий колодец; машинный зал насосной станции
wet well водоприёмный колодец
submersible pump – погружной насос

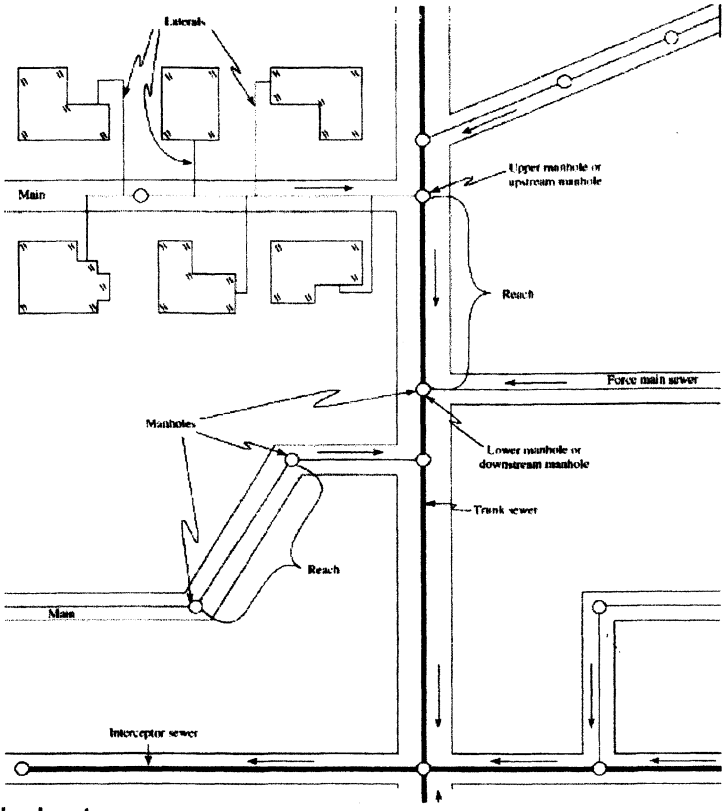
2. Match the phrases below with the appropriate Russian equivalents.

1. wastewater collection system	a. насосная станция
2. pumping station	b. насосная станция подъема сточных вод
3. sewerage facilities	c. первый смыв (дождем)
4. receiving water	d. нерегулярный поток
5. water-pollution problems	e. объем потока
6. overflow problem	f. система сбора сточных вод
7. first flush	g. средняя интенсивность потока
8. swirl concentrator	h. вихревой концентратор
9. intermittent flow	i. канализационная сеть
10. reinforced concrete pipe	j. водоприемник
11. storm water inlets	k. проблемы загрязнения воды
12. sewage lift station	l. проблема переполнения
13. peak flow rate	m. пиковый объем потока
14. average flow rate	n. дождеприемник, ливнесток
15. flow quantity	o. железобетонная труба

3. Read the text.

WASTEWATER COLLECTION SYSTEMS

A wastewater collection system is a network of pipes, pumping stations, and appurtenances that convey sewage from its points of origin to a point of treatment and disposal.



Combined systems

Systems that carry a mixture of both domestic sewage and storm sewage are called combined sewers. Combined sewers typically consist of large-diameter pipes or tunnels, because of the large volumes of storm water that must be carried during wet-weather periods. They are very common in older cities but are no longer designed and built as part of new sewerage facilities. Because wastewater treatment plants cannot handle large volumes of storm water, sewage must bypass the treatment plants during wet weather and be discharged directly into the receiving water. These combined-sewer overflows, containing untreated domestic sewage, cause recurring water-pollution problems and are very troublesome sources of pollution.

In some large cities, the combined-sewer overflow problem has been reduced by diverting the first flush of combined sewage into a large basin or underground tunnel. After temporary storage, it can be treated by settling and disinfection before being discharged into a receiving body of water, or it can be treated in a nearby wastewater treatment plant at a rate that will not overload the facility. Another method for controlling combined sewage involves the use of swirl concentrators. These direct sewage through cylindrically shaped devices that create a vortex, or whirlpool, effect. The vortex helps concentrate impurities in a much smaller volume of water for treatment.

Separate systems

New wastewater collection facilities are designed as separate systems, carrying either domestic sewage or storm sewage but not both. Storm sewers usually carry surface runoff to a point of disposal in a stream or river. Small detention basins may be built as part of the system, storing storm water temporarily and reducing the magnitude of the peak flow rate. Sanitary sewers, on the other hand, carry domestic wastewater to a sewage treatment plant. Pretreated industrial wastewater may be allowed into municipal sanitary sewer systems, but storm water is excluded.

Storm sewers are usually built with sections of reinforced concrete pipe. Corrugated metal pipes may be used in some cases. Storm water inlets or catch basins are located at suitable intervals in a street right-of-way or in easements across private property. The pipelines are usually located to allow downhill gravity flow to a nearby stream or to a detention basin. Storm water pumping stations are avoided, if possible, because of the very large pump capacities that would be needed to handle the intermittent flows.

A sanitary sewer system includes laterals, submains, and interceptors. Except for individual house connections, laterals are the smallest sewers in the network. They usually are not less than 8 inches (200 mm) in diameter and carry sewage by gravity into larger submains, or collector sewers. The collector sewers tie in to a main interceptor, or trunk line, which carries the sewage to a treatment plant. Interceptors are usually built with precast sections of reinforced concrete pipe, up to 15 feet (5 metres) in diameter. Other materials used for sanitary sewers include vitrified clay, asbestos cement, plastic, steel, or ductile iron. The use of plastic for laterals is increasing because of its lightness and ease of installation. Iron and steel pipes are used for force mains or in pumping stations. (Force mains are pipelines that carry sewage under pressure when it must be pumped.)

Pumps

Pumping stations are built when sewage must be raised from a low point to a point of higher elevation or where the topography prevents downhill gravity flow. Special nonclogging pumps are available to handle raw sewage. They are installed in structures called lift stations. There are two basic types of lift station: dry well and wet well. A wet-well installation has only one chamber or tank to receive and hold the sewage until it is pumped out. Specially designed submersible pumps and motors can be located at the bottom of the chamber, completely below the water level. Dry-well installations have two separate chambers, one to receive the wastewater and one to enclose and protect the pumps and controls. The protective dry chamber allows easy access for inspection and maintenance. All sewage lift stations, whether of the wet-well or dry-well type, should include at least two pumps. One pump can operate while the other is removed for repair.

Flow rates

There is a wide variation in sewage flow rates over the course of a day. A sewer system must accommodate this variation. In most cities, domestic sewage flow rates are highest in the morning and evening hours. They are lowest during the middle of the night. Flow quantities depend upon population density, water consumption, and the extent of commercial or industrial activity in the community. The average sewage flow rate is usually about the same as the average water use in the community. In a lateral sewer, short-term peak flow rates can be roughly four times the average flow rate. In a trunk sewer, peak flow rates may be two-and-a-half times the average.

4. Match these terms with their definitions:

1. Wastewater collection system	a) are systems that carry a mixture of both domestic sewage and storm sewage.
2. Combined systems	b) is a small diameter sewer that connects the building or residence to the mainline.
3. Separate systems	c) is a system of sewers.
4. Sewerage	d) channels wastewater from the source to the wastewater treatment plant.
5. A lateral sewer	e) are systems that carry either domestic sewage or storm sewage but not both.
6. A submain sewer	f) are large sewer pipes, which form the backbone of a wastewater transport system and deliver wastewater to a wastewater treatment plant.
7. Interceptors	g) collects sewage from one or more laterals as well as house sewers.

5. Find in the text English equivalents to the following word-combinations.

транспортировать сточные воды
трубы большого диаметра
справляться с большими объемами ливневых вод
сбрасываться непосредственно в водоприемник
неочищенные коммунально-бытовые сточные воды
очищать с помощью осаживания и дезинфекции
не перегружать оборудование
создавать эффект водоворота
временно накапливать ливневые воды
предварительно очищенные промышленные сточные воды
трубы из гофрированного металла
делать возможным течение самотеком (под уклон)
объединяться в магистральный трубопровод
поднимать (стоки) из нижней точки трубопровода в вышележащую точку
препятствовать течению (сточных вод) самотеком
ниже уровня горизонта вод
делать возможным легкий доступ для осмотра и технического обслуживания
колебания интенсивности подачи сточных вод
в четыре раза больше средней интенсивности потока

6. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to convey	to divert	to carry	to discharge	to build
to include	to store	to direct	to locate	to be

1. A wastewater collection system ... sewage from its points of origin to a point of treatment and disposal.
2. During wet weather, storm water ... directly into the receiving water.
3. In some large cities, the first flush of combined sewage ... into a large basin or underground tunnel to avoid overflow problem.

4. Swirl concentrators ... sewage through cylindrically shaped devices that create a vortex, or whirlpool, effect.

5. Separate systems ... either domestic sewage or storm sewage but not both.

6. Small detention basins ... storm water temporarily and reduce the magnitude of the peak flow rate.

7. The pipelines ... to allow downhill gravity flow to a nearby stream or to a detention basin.

8. A sanitary sewer system ... laterals, submains, and interceptors.

9. Pumping stations ... when sewage must be raised from a low point to a point of higher elevation.

10. In most cities, domestic sewage flow rates ... the highest in the morning and evening hours.

7. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. A wastewater collection system is a network of pipes, pumping stations, and appurtenances that convey sewage from its points of origin to a point of treatment and disposal.

2. Systems that carry a mixture of both domestic sewage and industrial sewage are called combined sewers.

3. Combined-sewer overflows cause recurring water-pollution problems.

4. Pretreated storm water may be allowed into municipal sanitary sewer systems, but industrial wastewater is excluded.

5. Storm sewers are usually built with sections of reinforced concrete pipe.

6. Interceptors are made of reinforced concrete, vitrified clay, asbestos cement, plastic, steel, or ductile iron.

7. A wastewater collection system always involves pumping stations.

8. In most cities, an even sewage flow rate is maintained over the course of a day.

8. Answer the following questions.

1. What is the purpose of a wastewater collection system?
2. What facilities are used for wastewater collection?
3. What is the difference between combined and separate systems?
4. What causes combined-sewer overflows?
5. What types of sewers are used for a sanitary sewer system?
6. What materials are used for sanitary sewers?
7. What is the difference between dry-well and wet-well installations?
8. When are domestic sewage flow rates the highest?

9. Describe the operation of a wastewater collection system.

UNIT 13 WASTEWATER TREATMENT AND DISPOSAL

1. Before reading the text learn the terms used in the text:

biodegradable – портящийся под действием микроорганизмов
deterioration – ухудшение (состояния или качества); порча, повреждение
effluent – сброс, отток, отвод сточных вод (после очистки нечистот)

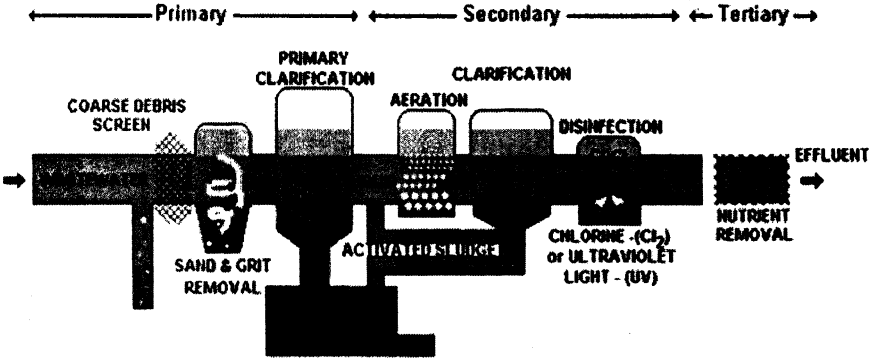
2. Match the phrases below with the appropriate Russian equivalents.

1. predominant method	a. стандарты качества отводимых сточных вод
2. subsurface disposal	b. вторичная обработка
3. stream standards	c. глубокая очистка
4. effluent standards	d. стандарты качества воды в водотоке
5. maximum beneficial use	e. контактный резервуар
6. primary treatment	f. максимально полезное водопотребление
7. secondary treatment	g. преобладающий метод
8. tertiary (advanced) treatment	h. подземный сброс
9. contact tank	i. первичная обработка
10. adverse effect	j. вредное воздействие

3. Read and translate the text.

The predominant method of wastewater disposal in large cities and towns is discharge into a body of surface water. Suburban and rural areas rely more on subsurface disposal. In either case, wastewater must be purified or treated to some degree, in order to protect both public health and water quality. Suspended particulates and biodegradable organics must be removed to varying extents. Pathogenic bacteria must be destroyed. It may also be necessary to remove nitrates and phosphates (plant nutrients) and to neutralize or remove industrial wastes and toxic chemicals.

WASTEWATER TREATMENT AND DISPOSAL



The degree to which wastewater must be treated varies, depending on local environmental conditions and governmental standards. Two types of standards are stream standards and effluent standards. Stream standards, designed to prevent the deterioration of existing water quality, set limits on the amounts of specific pollutants allowed in streams, rivers, and lakes. The limits depend on a classification of the "maximum beneficial use" of the water. Water quality parameters that are regulated by stream standards include dissolved oxygen, coliforms, turbidity, acidity, and toxic substances. Effluent standards, on the other hand, refer directly to the quality of the treated wastewater discharged from a sewage treatment plant. The factors controlled under these standards usually include biochemical oxygen demand, suspended solids, acidity, and coliforms.

There are three levels of wastewater treatment: primary, secondary, and tertiary (or advanced). Primary treatment removes about 60 percent of total suspended solids and about 35 percent of BOD; dissolved impurities are not removed. It is usually used as a first step before secondary treatment. Secondary treatment removes more than 85 percent of both suspended solids and BOD. When more than 85 percent of total solids and BOD must be removed, or when dissolved nitrate and phosphate levels must be reduced, tertiary treatment methods are used. Tertiary processes can remove more than 99 percent of all the impurities from sewage, producing an effluent of almost drinking-water quality. Tertiary treatment can be very expensive, often doubling the cost of secondary treatment. It is used only under special circumstances.

For all levels of wastewater treatment, the last step prior to discharge of the sewage effluent into a body of surface water is disinfection. Disinfection is usually accomplished by mixing the effluent with chlorine gas in a contact tank for at least 15 minutes. Because chlorine residuals in the effluent may have adverse effects on aquatic life, an additional chemical may be added to dechlorinate the effluent. Ultraviolet radiation, which can disinfect without leaving any residual in the effluent, is becoming more competitive with chlorine as a wastewater disinfectant.

4. Find in the text English equivalents to the following word-combinations.

отведение сточных вод
сбрасывать (сточные воды) в наземный водоем
защищать как здоровье населения, так и качество воды
биохимически разлагаемые органические вещества
предотвращать ухудшение существующего качества воды
устанавливать нормы
снижать уровень содержания растворенного азота и фосфора
удалять загрязняющие примеси из сточных вод
качество питьевой воды
удваивать стоимость вторичной обработки
использовать только при особых обстоятельствах
дехлорировать отводимые сточные воды
становиться более конкурентоспособным

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to discharge	to design	to refer	to add	to accomplish
to regulate	to remove	to vary	to use	to treat

1. In large cities and towns, wastewater ... into a body of surface water.
2. Wastewater ... to some degree, in order to protect both public health and water quality.
3. The degree to which wastewater must be treated ..., depending on local environmental conditions and governmental standards.
4. Stream standards ...to prevent the deterioration of existing water quality.
5. Water quality parameters ... by stream standards include dissolved oxygen, coliforms, turbidity, acidity, and toxic substances.
6. Effluent standards ... directly to the quality of the treated wastewater discharged from a sewage treatment plant.

7. Primary treatment ... about 60 percent of total suspended solids and about 35 percent of BOD.

8. Tertiary treatment... only under special circumstances.

9. Disinfection ... by mixing the effluent with chlorine gas.

10. An additional chemical ... to dechlorinate the effluent.

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. The predominant method of wastewater disposal in large cities and towns is subsurface disposal.

2. The degree to which wastewater must be treated varies, depending on local environmental conditions and governmental standards.

3. Water quality parameters that are regulated by stream standards include dissolved oxygen, coliforms, turbidity, acidity, and toxic substances.

4. Effluent standards, refer directly to the transparence of the treated wastewater discharged from a sewage treatment plant.

5. The factors controlled under effluent standards usually include biochemical oxygen demand, suspended solids, acidity, and coliforms.

6. Secondary treatment is used only under special circumstances.

7. Secondary treatment removes more than 99 percent of both suspended solids and BOD.

8. Tertiary treatment can double the cost of secondary treatment.

9. Ultraviolet radiation can disinfect without leaving any residual in the effluent.

10. Disinfection is usually accomplished by mixing the effluent with nitrogen.

7. Answer the following questions.

1. What methods of wastewater disposal are mentioned in the text?

2. What does the degree of wastewater treatment depend on?

3. What standards control the quality of discharged wastewater?

4. What water quality parameters are regulated by these standards?

5. What levels of wastewater treatment are mentioned in the text?

6. What percentage of suspended solids and BOD are removed by primary/secondary/tertiary treatment?

7. What stage precedes the discharge of the sewage effluent into a body of surface water?

8. Describe the stages of wastewater treatment.

UNIT 14 PRIMARY TREATMENT

1. Before reading the text learn the terms used in the text:

screening – фильтрация, экранирование

comminution – измельчение; дробление; отделение крупных отходов при одновременном их измельчении

sedimentation – процесс отстоя; осаждение; седиментация

metal bar – металлический пруток

rags – ветошь

bulky – большой, объёмистый; громоздкий, занимающий много места

to clog – засорять, забивать (чем-л.)
burial – захоронение (отходов)
to shred – измельчать; шинковать
debris – мусор; осколки, обломки
grit chamber – песколовка; гравиеловка
wear and tear – физический износ, изнашивание, порча
combined sewer system – общесплавная канализационная систем
detention time – продолжительность пребывания стоков на очистном сооружении
raw sludge – осадок, отстой после первичных отстойников; шлам
hopper – бункер; накопитель; приёмная воронка
digester – автоклав
anaerobic – анаэробный
volatile fatty acids – летучие жирные кислоты (ЛЖК)
to ferment – вызывать брожение, бродить
to gobble – глотать; пожирать
biogas – биогаз, (вид биотоплива; производится из отходов городских сточных вод; при сбраживании специально выращиваемых водорослей и других организмов с быстрорастущей биомассой)

2. Match the phrases below with the appropriate Russian equivalents.

1. grit removal	a. песколовка, гравиеловка
2. shredded material	b. первичный отстойник
3. grit chamber	c. дробленый материал
4. primary clarifier	d. улавливание песка
5. digestive system	e. отработавший газ, газообразные отходы
6. settled solids	f. процесс разложения
7. primary sludge	g. устройство, удаляющее вещества с поверхности (воды)
8. mechanical scraper	h. пищеварительная система
9. surface-skimming devices	i. осевшие твердые примеси
10. landfill site	j. место хранения отходов
11. waste gas	k. механический скребковое устройство
12. decomposition process	l. первичный осадок

3. Read and translate the text.

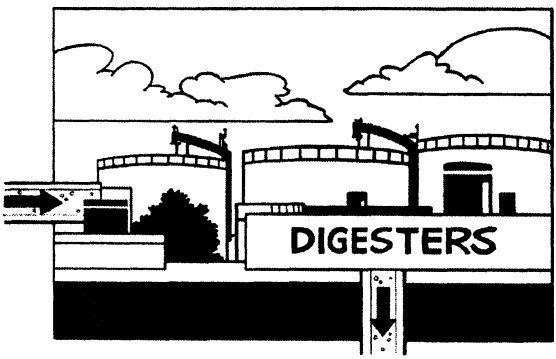
PRIMARY TREATMENT

Primary treatment removes material that will either float or readily settle out by gravity. It includes the physical processes of screening, comminution, grit removal. Screens are made of long, closely spaced narrow metal bars. They block floating debris such as wood, rags, and other bulky objects that could clog pipes or pumps. In modern plants the screens are cleaned mechanically, and the material is promptly disposed of by burial on the plant grounds. A comminutor may be used to grind and shred debris that passes through the screens. The shredded material is removed later by sedimentation or flotation processes.

Grit chambers are long narrow tanks that are designed to slow down the flow so that solids such as sand, coffee grounds, and eggshells will settle out of the water. Grit causes excessive wear and tear on pumps and other plant equipment. Its removal is particularly important in ci-

ties with combined sewer systems, which carry a good deal of silt, sand, and gravel that wash off streets or land during a storm.

Suspended solids that pass through screens and grit chambers are removed from the sewage in sedimentation tanks. These tanks, also called primary clarifiers, provide about two hours of detention time for gravity settling to take place. As the sewage flows through them slowly, the solids gradually sink to the bottom. The settled solids (known as raw or primary sludge) are moved along the tank bottom by mechanical scrapers. Sludge is collected in a hopper, where it is pumped out for removal. Mechanical surface-skimming devices remove grease and other floating materials.



The biological process of treatment begins in the digesters. As the name suggests, the digesters are not dissimilar to the human digestive system. The human digestive system contains microorganisms that work in anaerobic conditions (without oxygen). Anaerobic bacteria break down complex organic material (such as the food you eat) into simpler forms. Similarly, wastewater treatment digesters contain microorganisms that break down the organic materials in the wastewater into simple compounds.

In the digesters, different types of bacteria are at work. One type of bacteria consumes the simple organic material and produces organic waste called volatile fatty acids (VFA). Volatile fatty acids are organic compounds produced when material decomposes or ferments. They are important to the treatment process because they gobble up much of the phosphorous found in the wastewater. VFAs are then consumed by a different group of bacteria called Bio-P bacteria. The resulting waste gases (biogas) are released by the decomposition process. This biogas is composed of methane (65%), carbon dioxide (30%) and hydrogen sulphide (5%). Biogas is collected and 60 percent of it is used as fuel for heating the buildings and tanks at the plant. The remaining 40 percent of the biogas is flared off. Using 60 percent of the gas to heat buildings is an excellent example of recovering what otherwise would be a wasted product.

The sludge and scum (biosolids) remain in the digesters for 18–20 days. Then, it is transported by pipeline to a landfill site, where it is emptied into huge lagoons. In the lagoons, the water is removed from the biosolids so they can be used as compost and fertilizer.

4. Find in the text English equivalents to the following word-combinations.

близко расположенные узкие металлические прутья
легко осаждаться посредством гравитации
засорять трубы и насосы
механически очищать фильтры
измельчать мусор
служить причиной дополнительного износа
постепенно осаждаться на дно

перемещаться по дну отстойника с помощью механических скребков
удалять жир и другие вещества, плавающие на поверхности
содержать микроорганизмы, работающие в анаэробных условиях
расщеплять сложные органические вещества на более простые формы
поглощать большую часть фосфора, находящегося в сточных водах
использоваться для обогрева зданий
оставаться в автоклавах в течение 18-20 дней
перемещаться по трубопроводу на свалку

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to provide	to include	to block	to shred	to cause
to remove	to break down	to clog	to compose	to slow down

1. Primary treatment ... material that will either float or readily settle out by gravity.
2. Primary treatment ... the physical processes of screening, comminution, grit removal.
3. Screens ... floating debris such as wood, rags, and other bulky objects.
4. Floating debris such as wood, rags, and other bulky objects ... pipes or pumps.
5. A comminutor ...debris that passes through the screens.
6. Grit chambers ... the flow so that solids such as sand, coffee grounds, and eggshells will settle out of the water.
7. Grit ... excessive wear and tear on pumps and other plant equipment.
8. Primary clarifiers ... about two hours of detention time for gravity settling to take place.
9. Wastewater treatment digesters contain microorganisms that ... the organic materials in the wastewater into simple compounds.
10. This biogas ... of methane (65%), carbon dioxide (30%) and hydrogen sulphide (5%).

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Primary treatment removes material that will either float or readily settle out by gravity.
2. Screens shred floating debris such as wood, rags, and other bulky objects that could clog pipes or pumps.
3. Grit chambers are designed to speed up the flow of water.
4. Mechanical surface-skimming devices remove primary sludge from the bottom of the sedimentation tank.
5. In the digesters, different types of bacteria are at work.
6. The biogas can be used to heat buildings.

7. Answer the following questions.

1. What is the purpose of primary treatment?
2. What physical processes make up primary treatment?
3. What function do screens perform?
4. What equipment is used for primary settling?
5. How does a digester work?

8. Describe the operation of a primary clarifier.

UNIT 15 SECONDARY TREATMENT

1. Before reading the text learn the terms used in the text:

to escape – избежать (опасности и т. п.) , спастись; отделаться
trickling filter – капельный фильтр
activated sludge – активный ил
oxidation pond – окислительный бассейн, биологический пруд
trickling filter – капельный биофильтр
bed – (здесь) загрузка (фильтра)
in series – последовательно, по порядку
suspension – взвешенное состояние; суспензия; взвесь
to skim – снимать верхний слой
acclimate [– акклиматизироваться
to dredge – копать с помощью землечерпалки; производить дноуглубительные работы, драгировать
to bubble – барботировать, пузыриться
hopper – сборный лоток

2. Match the phrases below with the appropriate Russian equivalents.

1. dissolved oxygen balance	a. перемешивание, сбивание
2. fresh sludge	b. неперебродивший (сырой) ил
3. porous diffuser	c. пористый диффузор
4. churning action	d. главная особенность
5. propeller mixer	e. продленная аэрация
6. key feature	f. баланс растворенного в воде кислорода
7. extended aeration	g. кислород высокой степени очистки
8. contact stabilization	h. передвижная очистная установка
9. high-purity oxygen	i. пропеллерная мешалка (миксер)
10. package plant	j. контактная стабилизация

3. Read and translate the text.

SECONDARY TREATMENT

Secondary treatment removes the soluble organic matter that escapes primary treatment. It also removes more of the suspended solids. Removal is usually accomplished by biological processes in which microbes consume the organic impurities as food, converting them into carbon dioxide, water, and energy for their own growth and reproduction. The sewage treatment plant provides a suitable environment, though made of steel and concrete, for this natural biological process. Removal of soluble organic matter at the treatment plant helps to protect the dissolved oxygen balance of a receiving stream, river, or lake.

There are three basic biological treatment methods: the trickling filter, the activated sludge process, and the oxidation pond.

A **trickling filter** is simply a tank filled with a deep bed of stones. Settled sewage is sprayed continuously over the top of the stones and trickles to the bottom, where it is collected for further treatment. As the wastewater trickles down, bacteria gather and multiply on the stones. The steady flow of sewage over these growths allows the microbes to absorb the dissolved

organics, thus lowering the BOD of the sewage. Air circulating upward through the spaces among the stones provides sufficient oxygen for the metabolic processes.

Settling tanks, called secondary clarifiers, follow the trickling filters. These clarifiers remove microbes that are washed off the rocks by the flow of wastewater. Two or more trickling filters may be connected in series, and sewage can be recirculated in order to increase treatment efficiencies.

The **activated sludge** treatment system consists of an aeration tank followed by a secondary clarifier. Settled sewage, mixed with fresh sludge that is recirculated from the secondary clarifier, is introduced into the aeration tank. Compressed air is then injected into the mixture through porous diffusers located at the bottom of the tank. As it bubbles to the surface, the diffused air provides oxygen and a rapid mixing action. Air can also be added by the churning action of mechanical propeller-like mixers located at the tank surface.

Under such oxygenated conditions, microorganisms thrive, forming an active, healthy suspension of biological solids (mostly bacteria) called activated sludge. About six hours of detention is provided in the aeration tank. This gives the microbes enough time to absorb dissolved organics from the sewage, reducing the BOD. The mixture then flows from the aeration tank into the secondary clarifier, where activated sludge settles out by gravity. Clear water is skimmed from the surface of the clarifier, disinfected, and discharged as secondary effluent. The sludge is pumped out from a hopper at the bottom of the tank. About 30 percent of the sludge is recirculated back into the aeration tank, where it is mixed with the primary effluent. This recirculation is a key feature of the activated sludge process. The recycled microbes are well acclimated to the sewage environment and readily metabolize the organic materials in the primary effluent. The remaining 70 percent of the secondary sludge must be treated and disposed of in an acceptable manner.

Variations of the activated sludge process include extended aeration, contact stabilization, and high-purity oxygen aeration. Extended aeration and contact stabilization systems omit the primary settling step. They are efficient for treating small sewage flows from motels, schools, and other relatively isolated wastewater sources. Both of these treatments are usually provided in prefabricated steel tanks called package plants. Oxygen aeration systems mix pure oxygen with activated sludge. A richer concentration of oxygen allows the aeration time to be shortened from six to two hours, reducing the required tank volume.

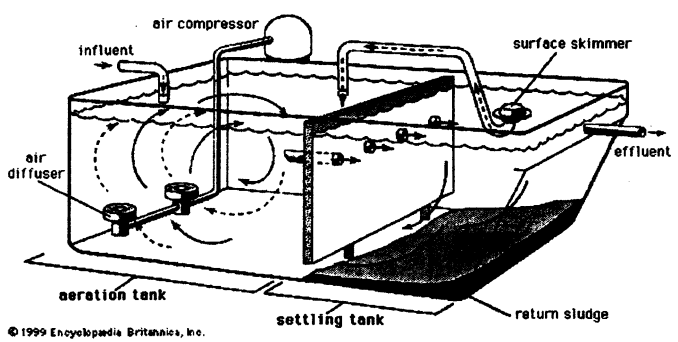


Fig. 1 Schematic diagram of a prefabricated package plant for the aeration treatment of small sewage flows

Oxidation ponds, also called lagoons or stabilization ponds, are large, shallow ponds designed to treat wastewater through the interaction of sunlight, bacteria, and algae. Algae grow using energy from the sun and carbon dioxide and inorganic compounds released by bacteria in water. During the process of photosynthesis, the algae release oxygen needed by aerobic bacteria. Mechanical aerators are sometimes installed to supply yet more oxygen, thereby reducing the required size of the pond. Sludge deposits in the pond must eventually be removed by dredging. Algae remaining in the pond effluent can be removed by filtration or by a combination of chemical treatment and settling.

4. Find in the text English equivalents to the following word-combinations.

удалять растворимые органические вещества
поглощать органические примеси
обеспечивать подходящую среду
баланс растворенного в воде кислорода
непрерывно разбрызгиваться
просачиваться на дно
собирать для дальнейшей обработки
впитывать растворенные органические вещества
уменьшать БПК стоков
соединяться последовательно
увеличивать эффективность обработки
подаваться в аэротенк
впрыскиваться в смесь
сточные воды, прошедшие вторичную очистку
выкачиваться из сборного лотка
повторно пропускаться через аэротенк
исключать стадию первичного осаждения
быть эффективным для обработки небольшого объёма сточных вод
взаимодействие солнечного света, бактерий и водорослей
выделять кислород
отложения ила

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to convert	to trickle	to absorb	to escape	to inject
to consist of	to provide	to follow	to design	to settle

1. Secondary treatment removes the soluble organic matter that ... primary treatment.
2. The organic impurities ... into carbon dioxide, water, and energy.
3. The sewage treatment plant ... a suitable environment for this natural biological process.
4. Settled sewage ... to the bottom of the filter, where it is collected for further treatment.
5. The microbes ... the dissolved organics, thus lowering the BOD of the sewage.
6. Secondary clarifiers ... the trickling filters.
7. The activated sludge treatment system ... an aeration tank followed by a secondary clarifier.
8. In the aeration tank, compressed air ... into the mixture through porous diffusers located at the bottom of the tank.

9. In the secondary clarifier, activated sludge ... out by gravity.

10. Oxidation ponds ... to treat wastewater through the interaction of sunlight, bacteria, and algae.

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Secondary treatment removes the soluble organic matter and the suspended solids that escape primary treatment.
2. A trickling filter is simply a tank filled with a deep bed of stones.
3. In a trickling filter, the microbes absorb the dissolved organics, thus increasing the BOD of the sewage.
4. Secondary clarifiers remove microbes that are washed off the rocks by the flow of wastewater.
5. The activated sludge treatment system consists of an aeration tank followed by a trickling filter.
6. About ten hours of detention is provided in the aeration tank.
7. In the aeration tank, activated sludge settles out by gravity.
8. Oxidation ponds are also called aeration tanks.

7. Answer the following questions.

1. What is the purpose of secondary treatment?
2. What equipment is used for secondary treatment?
3. How does a trickling filter work?
4. What equipment makes up the activated sludge treatment system?
5. How is BOD reduced in an aeration tank?
6. What is a key feature of the activated sludge process?
7. What allows the aeration time to be shortened in extended aeration and contact stabilization systems?
8. What are oxidation ponds? What do the do?

8. Describe the operation of a trickling filter.

UNIT 16 TERTIARY TREATMENT

1. Before reading the text learn the terms used in the text:

vulnerable – уязвимый; ранимый
microstrainer – сетчатый микрофильтр
ammonia – аммиак
ammonia nitrogen – аммиачный азот
infiltration – просачивание, инфильтрация
permeable – проницаемый, проходимый, негерметичный
feasibility – осуществимость, выполнимость

2. Match the phrases below with the appropriate Russian equivalents.

1. effluent polishing	a. вода обратной промывки
2. granular media filters	b. глубокая очистка сточных вод

3. backwash water	c. химическое осаждение
4. plant nutrients	d. процесс нитрификации-денитрификации
5. chemical precipitation	e. инфильтрационный бассейн
6. nitrification-denitrification process	f. отгонка аммиака
7. ammonia stripping	g. поле фильтрации
8. land treatment	h. сбросная канава
9. overland flow	i. фильтры с сыпучей фильтрующей загрузкой
10. sprinkler system	j. сточная яма
11. recharge basins	k. влагопроводимость
12. collection ditch	l. очистка фильтрацией через почву
13. hydraulic conductivity	m. вещества для питания растений, биогенные вещества
14. leaching field	n. оросительная установка
15. seepage pit	o. наземное разбрызгивание стоков

3. Read and translate the text.

TERTIARY TREATMENT

When the intended receiving water is very vulnerable to the effects of pollution, secondary effluent may be treated further by several tertiary processes.

Effluent polishing

For the removal of additional suspended solids and BOD from secondary effluent, effluent polishing is an effective treatment. It is most often accomplished using granular media filters, much like the filters used to purify drinking water. Polishing filters are usually built as prefabricated units, with tanks placed directly above the filters for storing backwash water. Effluent polishing of wastewater may also be achieved using microstrainers of the type used in municipal water treatment.

Removal of plant nutrients

When treatment standards require the removal of plant nutrients from the sewage, it is often done as a tertiary step. Phosphorus in wastewater is usually present in the form of organic compounds and phosphates that can easily be removed by chemical precipitation. This process, however, increases the volume and weight of sludge. Nitrogen, another important plant nutrient, is present in sewage in the form of ammonia and nitrates. Ammonia is toxic to fish, and it also exerts an oxygen demand in receiving waters as it is converted to nitrates. Nitrates, like phosphates, promote the growth of algae and the eutrophication of lakes. A method called nitrification-denitrification can be used to remove the nitrates. It is a two-step biological process in which ammonia nitrogen is first converted into nitrates by microorganisms. The nitrates are further metabolized by another species of bacteria, forming nitrogen gas that escapes into the air. This process requires the construction of more aeration and settling tanks and significantly increases the cost of treatment.

A physicochemical process called ammonia stripping may be used to remove ammonia from sewage. Chemicals are added to convert ammonium ions into ammonia gas. The sewage is then cascaded down through a tower, allowing the gas to come out of solution and escape into the air. Stripping is less expensive than nitrification-denitrification, but it does not work very efficiently in cold weather.

Land treatment

In some locations secondary effluent can be applied directly to the ground and a polished effluent obtained by natural processes as the wastewater flows over vegetation and percolates through the soil. There are three types of land treatment: slow-rate, rapid infiltration, and overland flow.

In the slow-rate, or irrigation, method, effluent is applied onto the land by sprinkler systems. Most of the water and nutrients are absorbed by the roots of growing vegetation. In the rapid infiltration method, the wastewater is stored in large ponds called recharge basins. Most of it percolates to the groundwater, and very little is absorbed by vegetation. For this method to work, soils must be highly permeable. In overland flow, wastewater is sprayed onto an inclined vegetated terrace and slowly flows to a collection ditch. Purification is achieved by physical, chemical, and biological processes, and the collected water is usually discharged into a nearby stream.

Land treatment of sewage can provide moisture and nutrients for the growth of vegetation, such as corn or grain for animal feed. It also can recharge, or replenish, groundwater aquifers. Land treatment, in effect, allows sewage to be recycled for beneficial use. Large land areas are required, however, and the feasibility of this kind of treatment may be limited further by soil texture and climate.

Subsurface disposal

In sparsely populated suburban or rural areas, it is usually not economical to build sewage collection systems and a centrally located treatment plant. Instead, a separate subsurface disposal system is provided for each home. For subsurface disposal to succeed, the permeability, or hydraulic conductivity, of the soil must be within an acceptable range. The capacity of the soil to absorb settled wastewater is determined by a "percolation test."

A subsurface disposal system consists of a buried septic tank and either a leaching field or seepage pits. A septic tank serves as a settling tank and sludge storage chamber. Although the sludge decomposes anaerobically, it eventually accumulates and must be pumped out periodically. A leaching field includes several perforated pipelines placed in shallow trenches. The pipes distribute the effluent over a sizable area as it seeps into the soil. If the site is too small for a conventional leaching field, deeper seepage pits may be used instead of shallow trenches. Both leaching fields and seepage pits must be placed above seasonally high groundwater levels.

4. Find in the text English equivalents to the following word-combinations.

подверженный воздействию загрязнения
очищать питьевую воду
требовать удаления биогенных веществ
увеличивать объём и вес активного ила
ядовитый для рыб
способствовать росту водорослей
выделяться в атмосферу
значительно увеличивать стоимость очистки
получать в результате естественных процессов
впитываться корнями
накапливаться в водоемах

стекать в сбросную канаву
служить отстойником

5. In each sentence the main verb has been omitted. Fill in the blanks from the words given.

to increase	not to work	to achieve	to replenish
to apply	to require	to spray	to absorb

1. Effluent polishing of wastewater ...using polishing filters or microstrainers.
2. Chemical precipitation ... the volume and weight of sludge.
3. Nitrification-denitrification process ... the construction of more aeration and settling tanks and significantly increases the cost of treatment.
4. Most of the water and nutrients ...by the roots of growing vegetation.
5. Stripping ...very efficiently in cold weather.
6. In some locations secondary effluent ... directly to the ground.
7. In overland flow, wastewater ... onto an inclined vegetated terrace and slowly flows to a collection ditch.
8. Land treatment ... groundwater aquifers.

6. Say whether the following statements are true or false in relation to the information in the text. If you think the statement is false, change it to make it true.

1. Tertiary treatment is applied when the intended receiving water is very vulnerable to the effects of pollution.
2. Effluent polishing is most often accomplished using granular media filters.
3. Nitrification-denitrification can be used to remove phosphorus.
4. Ammonia stripping removes ammonia from sewage.
5. In the slow-rate infiltration method, most of the water and nutrients are absorbed by the roots of growing vegetation.
6. In the rapid infiltration method, most of the wastewater percolates to the groundwater and very little wastewater is absorbed by vegetation.
7. It is beneficial to build sewage collection systems in sparsely populated suburban or rural areas.
8. A subsurface disposal system consists of a buried septic tank and either a leaching field or seepage pits.

7. Answer the following questions.

1. What is the purpose of tertiary treatment?
2. What is removed by effluent polishing?
3. What methods are used for plant nutrients removal?
4. What is land treatment?
5. What types of land treatment are mentioned in the text?
6. When is subsurface disposal used?
7. What equipment does a subsurface disposal system consist of?
8. What are leaching fields/seepage pits?

GLOSSARY

Activated sludge: Treatment process in which wastewater to be treated is mixed with previously grown micro-organisms and aerated.

Aeration: Mixing or agitation of wastewater, allowing for the mixture of air (oxygen) with the wastewater.

Algae: Type of simple aquatic plants.

Algal bloom: An extensive growth of algae in a body of water (river, lake, dam), usually as a result of high nutrient levels in the water.

Biosolids: The organic solid residues produced by the wastewater treatment process.

Catchment: The area of land from which surface and groundwater drains into a river or other watercourses.

Chlorination: The application of chlorine to water generally for the purpose of disinfection.

Coagulate: To thicken into a semi-thicken mass.

Coliform: Group of bacteria coming from animal intestines; used as an indicator of the bacteriological quality of water.

Colloidal matter: Very fine particles, which do not readily settle (or precipitate) but remain in suspension in a liquid.

Degradation: Any decline in quality of natural resources commonly used by humans. Pollution which enters a watercourse via numerous entry points or arises from a large number of dispersed sources

Disinfection: The destruction or inactivation of water-borne bacteria and viruses with a disinfectant such as chlorine.

Drainage: Systems of drains, natural or artificial, which intercept and remove excess surface and/or sub-surface water. The water is generally collected in a drainage disposal basin and the water allowed to evaporate.

Ecosystem: A community of plants and animals, considered as a total unity with its physical environment.

Effluent: The cleaned wastewater, that is, the final liquid by-product of the wastewater treatment process, flowing out of a treatment plant or lagoon.

Erosion: The wearing away of rocks and soil by an agent, eg wind and water.

Evaporation: Water evaporated from the Earth's waterways, lakes and the ocean and rises invisibly into the air as water vapour.

Flocculate: To form masses or aggregates of particles.

Freshwater: Water that has very low levels of salt.

Groundwater: Water that has soaked into the ground and permeates rock and soil layers.

Grit removal: Eliminates inorganic material such as sand and silt that could cause abrasions to plant and equipment.

Irrigation: The watering of crops and pastures in dry areas or during dry seasons.

Lagooning: Storage in treatment ponds (lagoons) for purification of primary or secondary treated effluent or wastewater.

Non-potable water: Water not suitable for human consumption, drinking or cooking.

Particulate matter: Particles or very small pieces of solid matter.

pH: Measure of the degree of acidity or alkalinity, expressed on a scale of 1 to 14. A pH of 7.0 denotes neutrality; higher values indicate alkalinity and lower values acidity.

Point source pollution: Pollution that is discharged at a discrete, identifiable location and can be readily measured -c.f. diffuse source pollution.

Potable water: Water of a quality suitable for drinking or cooking.

Primary treatment: The first stage of the wastewater treatment process which uses physical methods to remove pollutants in the water.

Pre-aeration: Minimises odour problems and increases the efficiency of the sedimentation stage.

Primary treatment: Primary treatment is a sedimentation process that may or may not involve chemical assistance.

Turbidity: The cloudy condition (opaqueness) in water caused by suspended solids and soil sediment.

Runoff: That part of rainfall that flows off the land surface into the drainage system.

Sand filter: A sand filter is a bed of fine sand over which wastewater s distributed and under which treated water is collected.

Salinisation: The accumulation of salts at the soil surface or in the root zone of plants, usually due to capillary rise of saline water from a shallow watertable.

Screening: Removes coarse materials that could damage or block pumps or other equipment.

Secondary treatment: The second stage of the wastewater treatment process, often using biological methods to remove organic pollutants from water.

Sediment: Solid material settled from suspension in water.

Sewage: Wastewater from domestic sources. May also be used to describe municipal wastewater, which includes industrial or trade wastewater.

Stormwater: Rain water that has run off roads, roofs, paved areas etc, and is conveyed to watercourses and the ocean.

Stream/watercourse: A small body of water that flows over the land surface in a channel. A large body of water is termed a river.

Suspended solids: Larger, often organic material, suspended in wastewater that may be removed by filtration.

Transpiration: Water is released into the air by plants by a process known as transpiration.

Wastewater: Wastewater comprises of used water from domestic toilets, sinks, bathrooms and washing machines. Also refers to water from industrial sources.

Water Cycle: The circulation of water on Earth as it evaporates from lakes and the ocean, condenses into clouds and precipitates as rain, hail or snow.

Watertable: A surface defined by the level to which water naturally rises in an open well or bore hole.

Watercourse: A stable water disposal area used to discharge surplus water runoff and allowing it to flow to a lower level.

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**ДЛЯ САМОСТОЯТЕЛЬНОЙ
АУДИТОРНОЙ И ВНЕАУДИТОРНОЙ РАБОТЫ
ПО ИЗУЧАЮЩЕМУ ЧТЕНИЮ НА АНГЛИЙСКОМ ЯЗЫКЕ**

для студентов специальности
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