Т.М. ВИХМАН

А.М. ЗНАМЕНСКАЯ

АНГЛИЙСКИЙ ЯЗЫК
“In search of new ways to work in harmony with the environment”

Учебно-методическое пособие по чтению английской научно-технической литературы

для студентов, обучающихся по направлениям:
20.03.01 «Техносферная безопасность»,
18.03.02 «Энерго- и ресурсосберегающие процессы в химической технологии, нефтехимии и биотехнологии»

Санкт-Петербург

2017

МИНИСТЕРСТВО ОБРАЗОВАНИЯ И НАУКИ РОССИЙСКОЙ ФЕДЕРАЦИИ

ФЕДЕРАЛЬНОЕ ГОСУДАРСТВЕННОЕ БЮДЖЕТНОЕ ОБРАЗОВАТЕЛЬНОЕ УЧРЕЖДЕНИЕ ВЫСШЕГО ПРОФЕССИОНАЛЬНОГО ОБРАЗОВАНИЯ

«САНКТ-ПЕТЕРБУРГСКИЙ ГОСУДАРСТВЕННЫЙ УНИВЕРСИТЕТ ПРОМЫШЛЕННЫХ ТЕХНОЛОГИЙ И ДИЗАЙНА»

ВЫСШАЯ ШКОЛА ТЕХНОЛОГИИ И ЭНЕРГЕТИКИ

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Санкт-Петербург

2017

УДК 802.2(075)

ББК 81.2(Англ)я7

В 548

Вихман Т.М., Знаменская А.М. Английский язык. “In search of new ways to work in harmony with the environment”: учебно-методическое пособие по чтению английской научно-технической литературы для студентов, обучающихся по направлениям: 20.03.01 «Техносферная безопасность», 18.03.02 «Энерго- и ресурсосберегающие процессы в химической технологии, нефтехимии и биотехнологии»/ ВШТЭ СПбГУПТД. – СПб., 2017. – 116 с.

Пособие содержит тексты для чтения и перевода, а также упражнения для усвоения терминологической лексики.

Настоящее учебно-методическое пособие предназначено для студентов института технологии, обучающихся по направлениям подготовки 20.03.01 «Техносферная безопасность» и 18.03.02 «Энерго- и ресурсосберегающие процессы в химической технологии, нефтехимии и биотехнологии», имеет целью развитие навыков чтения и перевода специальной литературы.

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Рекомендовано к изданию Редакционно-издательским советом университета в качестве учебно-методического пособия.

ОГЛАВЛЕНИЕ

ПРЕДИСЛОВИЕ

Пособие состоит из двух частей, каждая из которых содержит несколько уроков. Каждый урок представлен упражнениями на освоение и повторение новых терминологических единиц, а также текстами по специальности для перевода.

Дополнительно к данному учебно-методическому пособию следует использовать «Приложение к учебно-методическому пособию по чтению английской научно-технической литературы», содержащее грамматические упражнения на повторение наиболее распространённых грамматических структур, список сокращений, использованных в данном пособии и словарь, содержащий слова, встречающиеся в текстах и упражнениях в их контекстуальном значении, что облегчает работу над переводом текстов. В качестве справочника по грамматике использовать учебно-методическое пособие «Английский язык: некоторые грамматические трудности перевода с английского на русский язык литературы по специальности «Охрана окружающей среды», разработанное доц. Лиоренцевич Т.В., проф. Кирилловой В.В.,
ст. преп. Знаменской А.М.

List of words used in the tasks to exercises

Abbreviation – сокращение;

Adjective – прилагательное;

Adverbial modifier – обстоятельство;

Adverb – наречие;

Attribute chains – «цепочки» существительных;

Attribute – определение;

Belong to – принадлежать;

Choose – выбирать;

Complex subject – сложное подлежащее, субъектный инфинитивный оборот Interpret – расшифровать (напр., сокращение);

Comparative degree – сравнительная степень (прилагательных и наречий);

Corresponding – соответствующий;

Define – определить;

Determiner – определитель;

Interpret the abbreviation – расшифровать сокращение;

Instead of – вместо;

Infinitive of purpose - инфинитив в роли обстоятельства цели;

Infinitive of result – инфинитив в роли обстоятельства результата;

Pay attention to – уделять, обращать внимание на;

Polysyllabic (verb) – многосложный (глагол);

Prefix – приставка, префикс;

Preposition – предлог;

Root – корень;

Sentence – предложение;

Subjunctive mood – сослагательное наклонение;

Try – стараться, пытаться;

Name – назвать;

Verb – глагол;

Participle I- present participle – причастие I, причастие настоящего времени;

Participle II- past participle - причастие II, причастие прошедшего времени;

Write out – выписать;

Pronounce – произносить;

Pronunciation – произношение;

Meaning – значение;

Transcribe (the words) – транскрибировать;

Part of speech – части речи;

Mind – обратите внимание;

Stress – ударение;

False friends – «ложные друзья» переводчика;

Word combination – словосочетание;

Noun – существительное;

Match – подобрать;

Similar – похожий, подобный;

Superlative degree – превосходная степень (прилагательных и наречий);

Remember – (за)помнить;

Syllable – слог;

Refer to – относиться к.

Introduction

ENVIRONMENT AND ECOLOGY

I. Read and translate the following international words. Pay attention to the stress and the part of speech when translating them.

Baltic (Sea) – Балтийское (море);

commission – комиссия;

conception – концепция;

conference – конференция;

coral reefs – коралловые рифы;

chemical – химический;

ecosystem – экосистема;

emission – выброс (газообразных отходов), выпуск (дыма) *pl* отходы (газообразные);

European – Европейский;

genetic – генетический;

global – имеющий мировое значение, затрагивающий все страны мира;

harmony – гармония;

industry – промышленность, отрасль производства, предприятие;

international – международный;

metallurgical – металлургический;

modify– модифицировать, видоизменять, трансформировать, реконструировать;

negative – отрицательный;

practical – практический;

tone, ton – тонна;

total control – полный контроль;

tropical – тропический;

zero – ноль, нулевой.

II. Pay special attention to the following "false friends". Mind that you can choose the right meaning of the word only while reading the text and trying to understand it. Use the dictionary.

Human, *a*; public, *a*; public figure, matter, *n*; effect, *n*; degradation, *n*; complex, *a*; concern, *n,v*; production, *n*; technology, *n*; dramatic(al)ly; regulations, *n*; act, *n*; protection, *n*; decade, *n*;

III. Make and translate the following word combinations:

1. *contaminate* (air, environment, food (продукты питания), ground, ground water);

2. (pollution, earthquake (землетрясение), land use, emission) *intensity;*

3. (three, several, many, a few) *decades*;

4. (ash, gaseous, hydrocarbon, industrial, power plant, smoke) *emission;*

5. air, animal, biological plant, forest, fish and wildlife) *protection;*

6. (effluent, wastewater, industrial, pollutants, radioactive waste, zero wastewater) *discharge;*

7. *complex* (apparatus, situation, process);

8. (energy, heat, oxygen, water) *consumption;*

9. (ecological, environmental, dramatic) *consequences;*

10. (environmental, to feel great, to cause (вызывать), to express great public concern over the environment) *concern;*

11. (environmental, forest, land, water, water quality, antipollution, nature protective) *legislation;*

12. *current* (problems, regulations, marine environment requirements, consequences, legislation);

IV. Name the verbs from which the following nouns were formed and translate all the words:

User - ; warning - ; degradation - ; conservation - ; production - ; contamination- ; consumption- ; emission - ; implementation - ; regulations- ; development- ; difference - ; prediction- ; pollution - .

V. Translate the words having the same root paying attention to suffixes, prefixes and other determiners:

intensity – intensive – intensively – intensify;

science –scientific – scientist;

production – product – productivity – to produce – productive – nonproductive;

pollution – will pollute – gaseous pollutant – nonpolluting;

best available technique – availability (of water) – unavailable;

contaminate – contamination – contaminated atmosphere – industrial contaminant – uncontaminated; a complex device – complexity;

to use – user – when using this instrument – by using this instrument – the use of this instrument – the instrument used by them – useful – useless – usage;

environment – environmental – environmentalist.

VI. Match the words with the similar meaning.

A	B
effect	decrease
issue	ten years
impact, *n*	purpose
current, *a*	conserve
reduce	problem
goal	much
decade	pollute
a great deal of	technology
receive	influence
preserve, *v*	present, *a*
contaminate	consequence
technique	get

VII. Revise the degrees of comparison and translate.

more important
complex
contaminated
valuable

the most important
complex
contaminated
valuable

much (far) more important
complex
contaminated
valuable

less important
complex
contaminated
valuable

VIII. How will you translate the word "most" before nouns?

most discharges, effects, matters, challenges, emissions
predictions, consequences, acts, industries, regulations.

IX. Revise different meanings of the word *that (those)* and translate.

a) 1. technologies *that* could reduce fresh water usage;

2. limits on emissions and discharges *that* reflected what was technologically feasible and practical at the time

3. There are many mills *that* have no effluent flows.

4. Our legislation still differs from *that* of most countries; the conception of BAT corresponding to *that* used in all the countries.

5. It is necessary *that* the production technology and the product be brought into accord with the international standards and with *those* of European Community is very important.

b) The flux (поток) in scheme (схема) B is lower than *that* in scheme A. Toxicity of TMP effluents is comparable to that of groundwood (древесная масса) effluents.

X. Translate the following word combinations with "free (of)". Mind different ways of translation.

*Model: This compound is **free of** impurities.*

1. *Это вещество **не содержит** примесей.*
2. *В этом веществе **отсутствуют** примеси.*
3. *Это вещество **свободно от** примесей.*
4. *acid free - **не содержащий** кислоты.*

a) free of sulphur/nitrogen/suspended solids/chlorine admixtures

b) a trouble-free operation
a chlorine-free process
elemental chlorine-free bleaching (отбелка)
pollution-free environment

c) oxygen-free, alkaline-free, moist-free, sulfur-free, effluent-free mill, wood-free papers

d) 1. Biocides (биоциды) should be free of organic solvents and heavy metals and contain no dioxins or furans.

2. The fact that recycling operations are odor free allows mills to be located in metropolitan areas that are close to both the raw material supply and the consumer.

3. The fibers were immersed (погружать) in the cell-free extract, prepared as described above.

4. This gas is free of hydrogen chloride and other acidic gases.

5. An effluent-free pulp mill is the dream of environmentalists and many engineers and scientists.

XI. Words and word combinations to be remembered:

acid rain - кислотный дождь;

act, *n* - акт, действие;

affect, *n* – воздействие;

best available techniques (BAT) - самые лучшие доступные технологии;

biodiversity - биоразнообразие;

complex, *a* – сложный;

concern, *n,v* - проблема, вопрос, затруднение; касаться, иметь дело с, вызывать беспокойство, тревогу;

conservation - сохранение, охрана природы;

consequences – обстоятельства;

consumption – потребление;

contaminate – загрязнять;

decade - декада, десяток лет;

degradation - ухудшение, понижение;

develop - развивать, разрабатывать;

discharge, *n* – сброс;

discharge of effluents - отведение сточных вод;

effect, *n* - влияние, воздействие, результат;

effluent - сток, выброс, вытекающий поток;

effluent-free pulp mill - целлюлозно-бумажный завод без выбросов;

environment - окружающая среда;

environmental - связанный с окружающей средой;

fresh water - пресная вода;

goal – цель;

global warming - глобальное потепление;

greenhouse effect - парниковый эффект;

impact, *n* - воздействие, влияние, толчок;

implementation - внедрение, воплощение в жизнь, реализация;

issue, *n* - вопрос, проблема, выход;

legislation – законодательство;

limit *n* - предел, норма, ограничение;

meet the demands - удовлетворять требования;

preserve - сохранять, оберегать, хранить;

protect, protection - защищать, защита;

reduce – сокращать;

regulations - нормативно-правовые акты, установленные правила;

save - сохранять, накапливать;

technological standard - технологический стандарт;

usage – использование;

zero wastewater discharge – полное прекращение сброса сточных вод, бессточные технологии.

XII. Read and translate the text:

Environment and Ecology

Environmental issues are at the forefront of the public debate as the human impact on the natural environment continues to grow. Almost every public figure is expected to have opinion in such matters as global warming through the greenhouse effect, acid rain, the environmental impacts genetically modified crops, the long-term consequences of the loss of biodiversity and the degradation of ecosystems such as coral reefs and tropical forests. Current environmental problems are complex and multifaceted. The need to predict the effects of humanity on the natural world, together with public concern over the environment, have made environment and conservation one of the most important areas of science.

Pulp and paper industry is one of the heaviest users of air and water resources among all industries. In its water intensity it is the fourth after the metallurgical and chemical industries and water power engineering. The production of one tonne of pulp requires 250-300 m^3 of fresh water. In total discharges of contaminated wastewater by industrial enterprises the share of pulp and paper industry exceeds 20%.

That is why many mills throughout the world are striving to find technologies that could dramatically reduce their fresh water usage. Large consumption of water by the paper industry began to change in the 1960s and 1970s with the implementation of various environmental regulations which are reflected such important documents as the Clean Water Act (U.S.), the Clean Air Act (Great Britain, Canada, U.S.), the Recommendations of the Helsinki Commission on the protection of the marine environment of the Baltic Sea area, the Canadian Environmental Protection Act (CEPA) and many other acts which among other things promulgated limits on emissions and discharges that reflected what was technologically feasible and practical at the time.

Another way to save water is zero wastewater discharge. An effluent-free pulp mill was and sometimes is still the dream of the environmentalists and of many engineers and scientists. Research towards this goal has been ongoing for over four decades. During the last few years, the effluent-free pulp mill has been a hot subject of technical conferences and industry trade and research journals. Effluents from the pulp and paper industry have received a great deal of public attention. Today there are many mills in the world that have no effluent flows.

In the Russian Federation the nature protective legislation still differs from that of most foreign countries with the highly developed pulp and paper industry. At negative affects the development of the industry and the competitiveness of the product made. In 2002 the Federal Law concerning the environment protection came into effect which for the first time in the country introduced the conception of "Best Available Techniques" – BAT corresponding to that used in all the countries, and the conception of technological standard".

It is absolutely necessary that the production technology and the product be brought into accord with the international standards. Full compliance of the Federal nature protective legislation with the international standards and first of all with those of European Community is of primary importance.

Meeting environmental demands presents some tough challenges for pulp-and-papermakers. They are constantly looking for better ways to make the most of their valuable forest and water resources while preserving the world in which we live. They are much more active than ever developing new technologies to work in harmony with the environment.

Notes

at the forefront – на первом плане;
multifaceted – многосторонний, многогранный;
come into effect – вступить в силу, в действие;
bring into accord (with) – приводить в соответствие (с);
compliance – соответствие;
make the most (of) – использовать наилучшим образом, максимально;
the Clean Water Act (U.S.) – Закон о чистой воде;
Canadian Environmental Protection Act (CEPA) – Закон Канады об охране окружающей среды;
European Community – Европейское сообщество;
challenge – сложная задача.

Find in the text the English equivalents for the following words:

парниковый эффект, кислотный дождь, гидроэнергетика, биологическое многообразие, коралловые рифы, пресная вода, Закон о чистой воде, Закон о чистом воздухе, морская среда, наилучшая разработанная технология, удовлетворять требования, глобальное потепление, сточные воды, законодательство, бессточный технологический процесс, целлюлозно-бумажная промышленность, охрана (окружающей среды), область науки, действие (влияние, результат), предсказывать (прогнозировать), настоящий (текущий, современный), загрязнять, спасать (беречь, экономить).

Unit 1

WASTEWATER TREATMENT PREFACE

Lesson 1

Preface

I. Read and translate the following international words:

efficiency, adapt, optimize, thermodynamics, reaction, equivalent, industrial, percent, characterize, microorganism, technology, empirical, principle, kinetics, hydroelectric, atmosphere, hydrologic, biochemical, municipal, accumulate.

II. Read and translate the following "false friends" consulting the dictionary. Try to remember their pronunciation and meaning:

procedure, adequate, inadequate, interpret, data, variety, operation, fundamentals.

III. Pronounce the polysyllabic verbs with suffixes –ate, -ize (ise). You should remember that the verbs with these suffixes have the stress on the third syllable from the end.

Estimate, generate, accumulate, accelerate, irrigate, incorporate, evaporate, optimize, characterize.

IV. Translate the following words. Explain the meaning of the prefixes un-, in-, re-:

inadequate, uneven(ly), unproductive, reuse, recycle.

Translate the following pairs of words:

contaminated – uncontaminated, necessary – unnecessary, conventional –unconventional, required – unrequired, limited –unlimited, dissolved – undissolved, direct –indirect, dissolubility – indissolubility, soluble –insoluble, stability – instability, complete-incomplete, generate –regenerate, enter –reenter, use- - reuse, interpret – reinterpret, precipitated – reprecipitated, consider – reconsider, examination – re –examination (of the pectic acid).

V. Translate the following "attribute chains":

a) pollution standards, treatment operations, water purification, unit operation, transfer processes, reaction kinetics, solids contact, water supply;

b) mill effluents, treatment system, heat and mass transfer, process testing and monitoring, water treatment program changes, important quality and environmental parameters, low risk tactics consultant, necessary control systems, the chemical usage, mechanical treatment improvement, water treatment chemicals, pollution prevention, the chemical cost, a laboratory ozone generation, their low temperature properties.

VI. Name the verbs:

consumption, pollution, purification, evaporation, oxidation, irrigation, population, treatment, manufacturer, user, withdrawal, dependable, additional.

VII. Translate the sentences paying attention to different meanings of the word "since".

1. *Since* most contaminants are present in low concentrations, the treatment process must be able to function effectively with dilute streams.
2. This direct conversion is only approximate *since* the density (плотность) of the solids is different from that of water.
3. *Since* successful waste treatment depends upon suitable (соответствующий, подходящий) biological activity, it is necessary to operate the system to encourage (способствовать) microbial growth.
4. The water-use cycle is a closed loop (замкнутый) *since* water is considered on our planet.
5. *Since* the larger particles formed by agglomeration (агломерация, образование крупных частиц или хлопьев) have higher settling velocities, the rate (скорость) of settling changes with time.
6. *Since* the particles in the structure have little tendency to move past (мимо) one another, a clear line of demarcation is established between solids and clear fluid.
7. *Since* then, some mills have been using enzyme permanently to reduce the chlorine consumption, lower AOX (absorbable organic halogens – абсорбируемые органические галогены) and to decrease the BOD.
8. Both of these alternatives are relatively cheap, *since* they do not require a dedicated (специальный) device.
9. Although enzymes were being applied at the mill *since* 1992, the mill managers decided much later to quantify (определить) the benefits because the bleaching sequence (процесс) has changed *since* the trials (испытания) were conducted.
10. Most of the original (первоначальный) work had been done in the first extraction stage, but *since* the start of enzyme application, hydrogen peroxide addition was also initiated (начинают вводить) on the first extraction stage.
11. *Since* the operating conditions in Trials I and II were very similar, the results were combined, and average (средний) values were used in the calculations.
12. The published regulations are the result of additional revisions and modifications made *since* that time.

VIII. Translate the sentences paying attention to different meanings of the word "through".

1. The amount of air required by the microorganisms is not constant *through* the length of the reactor.

2. Secondary treatment generally involves (включает) a biological process to remove organic matter *through* biochemical oxidation.
3. As the flow passes *through* the tank, the oxygen demand will gradually decrease.
4. Pretreatment processes are used to screen out (улавливать) coarse solids, to reduce the size of solids, to separate floating oils (плавающая нефть) and to equalize fluctuations (колебания) in flow or concentration *through* short-term (кратковременный) storage.
5. Ammonia can be converted to nitrite and nitrate, and then to nitrogen gas *through* a controlled sequence (последовательность, ряд) of aerobic and anaerobic biological treatment steps.
6. Because the conventional system is closer to plug-flow (режим идеального вытеснения), any toxic material could pass *through* the reactor undiluted and kill the biological culture in the reactor.
7. These needs require a stewardship (управление) of our water resources to preserve water quality *through* waste treatment and to ensure adequate quantities *through* recycle.
8. Risk can be minimized when transitioning to a new water treatment program *through* careful supplier (поставщик) selection and some other factors.
9. SO_2 emissions are formed mainly *through* the oxidation of H_2S and carbonyl sulphide in the lower furnace (топка).
10. The strong liquor (щёлок) is introduced *through* one or several nozzles (форсунка, сопло) into the reducing zone.
11. The production of this type of polypropylene has only recently become possible *through* the progress made in catalyst research.
12. The addition of sulfuric acid is adjusted (регулировать) *through* a variable-speed pump (насос с переменной скоростью).
13. Chloride, on the other hand, can form only *through* chlorite oxidation.
14. The collected filtrate exits the membrane element through the central filtrate pipe.

IX. Translate the following adjectives and adverbs in the comparative and superlative degree given in the text:

newer (treatment operations), greater (treatment), less, more, (to adapt) more readily, heavier (use), greater (industrial output), the largest, the most important.

X. Define the functions of the verb “have” and translate:

1. Higher prices for chemical feedstocks (сырье) *have* led to major increases in water treatment chemical prices.
2. This does not always mean that the chemistry at the will *has* to be changed totally.
3. The remaining extra (лишний) water in the sheet (лист бумаги) *has* to be evaporated in the dryer section.
4. These systems *have* not only increased the efficiency of existing machines, they *have* made possible increasing machine speeds and sheet quality improvements.
5. Until now, the mechanism of the pretreatment *has* not been completely developed.
6. Water *has* a wide variety of end uses associated with it.
7. The characteristics of wastewater are broadly (приблизительно) classified into physical, chemical and biological according to the type of measurement test that *has* to be performed.
8. Flow rates (скорость) *have* to be minimized.
9. Mills *have* different reasons for reducing their water contamination and effluent generation.
10. The Russians *have* developed tertiary treatment (доочистка) system to minimize effluent impact on receiving waters.
11. Pressures from regulatory authorities and environmental activists *have* led to improved wastewater management.
12. This type of tertiary treatment *has* some technical advantages (преимущества).
13. The residual effluent *has* to be treated by new methods at the source (источник).
14. The pulp and paper industry *has* made significant progress in different volume reduction.
15. Issues of equipment arrosion will *have* to be considered in order to achieve further effluent volume reduction.
16. Operating a recovery boiler (котел-утилизатор) in an overloaded mode (режим) *has* an adverse effect on the emissions characteristics especially on the quantity of hydrogen sulphite products.
17. A survey (обзор) of the literature produced no information that such a system *has* ever been considered.

XI. Revise passive voice and translate:

1. The reaction mixture is

was
has been
has to be filtered
had to be
will be
must be
can be
could be

2. The typical temperature is
   was
   has been
   has to be
   must be indicated
   should be
   should have been
   could be
   will have to be
3. This sequence (процесс) is
   was
   will be
   has been
   has to be
   must be repeated several times
   should be
   can be
   could be
   had to be
   should not have been
4. In this paper the effluent analysis is
   will be
   has been discussed in details
   is being
5. They are not
   were not
   have not been

will not be investigated
can be
could be
do not have to be

6. Enzyme pretreatment is
was
will be
has been followed by peroxide bleaching (отбелка)
must be
may be

7. The trial must be
can be
could be
may be conducted
had to be
should be
should not have been

8. Industrial trials were
must be
are followed by laboratory experiment
have been
can be

9. The pulp quality was not
must not be
could be affected
has been
will not be

10. The peak flood discharge (паводковый расход) is
was influenced by many factors
can be

11. The membrane offers a physical barrier (барьер, преграда) to the organisms that
are
were
will be unaffected by the influent (сточные воды,
have to be поступающие на очистку) quality

XII. Revise the translation of the infinitive of purpose and translate:

1. To control pH and reaction rate to a certain extent, dilute carbon dioxide mixed with air was used.
2. Polymers may be added to enhance settling of the precipitate.
3. It is necessary to remove nutrients to limit eutrophication of sensitive water bodies.
4. Typically, filtration is used to remove residual biological floc from the secondary settling tank effluent.
5. Trash racks (сороудерживающие решетки) are used to remove large objects. These are followed by fine screens (сетки с мелкими отверстиями) to protect the pumps.
6. There must be enough depth to maintain the pump manufacturer's required submergence (погружение в воду) to prevent cavitation (кавитация) of the pump.
7. To communicate (сообщать) the benefits of the mill's by-products, several meetings were held with local farmers to present and discuss the by-products programs.
8. To achieve effluent flows below 10.000 gal/ton, significant process changes in cooking (варка), washing and bleaching areas are required.
9. This water is used to heat raw water in the winter periods.
10. The trials were performed to determine potential operating costs (эксплуатационные затраты) energy consumption, operational conditions and benefits associated with a low capital cost installation of this system.
11. The raw materials, in controlled proportions, are ground (grind – измельчать) and mixed together to form a homogeneous blend with the required chemical composition.
12. The phosphorus trichloride may behave similarly, or may react with chlorine to form phosphorus pentachloride.
13. High molecular weight organic complexes must be dissociated upon dilution to form low molecular weight aggregates.
14. Mixed with polymer to improve settling the water then proceeds (идти) to the primary clarifier.
15. A gas chromatograph was used to monitor the gas compositions for sulphur compounds before and after the filter.

16. Carboxylic acid groups contained in the effluent, however, do react with calcium and magnesium to form the corresponding salts.
17. It was supposed that enolic and phenolic hydroxyl groups under "alkaline conditions" react to form insoluble salts.

XIII. Find in the text:

a) Five sentences with the verbs in passive voice;
b) Two sentences with "have" as a modal verb.

XIV. Words and word combinations to be remembered. Write out the words into your vocabulary notebooks, transcribe them and pronounce correctly several times until you remember their pronunciation:

accumulate - скапливаться, накапливаться;
adequate - подходящий, соответствующий;
amount, *v* - насчитывать;
available - доступный;
BOD biochemical oxygen demand - биологическая потребность в кислороде;
consume - потреблять;
consumption - потребление;
conventional - обычный, простой;
dissolved oxygen - растворенный кислород;
domestic wastes - бытовые сточные воды;
ensure - гарантировать, обеспечивать;
estimate *v* - оценивать;
evaporation - испарение;
fresh water - пресная вода;
harmful - вредный, пагубный;
improve - улучшать, усовершенствовать;
industrial wastes - промышленные отходы;
level - уровень;
meet (the) needs (standards, requirements) - удовлетворять, отвечать, соответствовать нуждам, стандартам, требованиям и т.д.;
pollutant - загрязняющее вещество, загрязнитель;
pollution - загрязнение;
purification - очистка, очищение;
quality - качество;
quantity - количество;

rate - норма, скорость;

recycle *n* - повторная переработка;

reuse *n* - повторное использование;

runoff - сток;

sewage treatment plant - станция очистки сточных вод;

solids content - содержание твердых частиц (веществ);

surface water - поверхностные воды;

treatment - обработка, очистка;

unit per day - единиц в день;

wastewater - сточная вода, жидкие отходы, выбросы;

(municipal) wastewater treatment plant - (муниципальное) очистное сооружение;

water supply-водоснабжение.

XV. Read and translate the text. If necessary, do it several times until you remember most of the necessary words.

WASTEWATER TREATMENT

Preface

To meet current and proposed water pollution standards, it is often necessary to use newer treatment operations and to improve the efficiency of conventional processes. Since technology in the water treatment field is evolving rapidly, an enhanced knowledge of fundamentals will permit the engineer or scientist to adapt more readily to new processes. In many cases, the design of water purification processes is based on empirical formulas and procedures. Since these empirical methods are often inadequate for interpreting data and optimizing the process, a good understanding of basic principles is required.

The treatment of water and wastewater requires a variety of techniques and processes involving unit operations, transfer processes, thermodynamics and reaction kinetics.

The United States, as an industrial nation has a tremendous appetite for water. In 1970 about 370 billion gal per day (bgd) were withdrawn from all sources for use, a rate equivalent to 1800 gallons per person per day. Hydroelectric plants consumed an additional 2800 bgd. Of the 370 bgd industry withdrew over one-half and irrigation used most of the remainder. Consumption of water, which is water incorporated into a product or lost to the atmosphere, was 87 bgd in 1970 or about 24 % of the water withdrawn. Irrigation consumed 84 % of the 87 bgd, mainly through evaporation to the atmosphere.

Ground water furnished 19 % of all water withdrawn, fresh surface water 67 % and saline surface water 14 %. The supply of water is unevenly distributed due to hydrologic features in the

different sections of the United States. Since withdrawals are around 72 % of the 1980 supply, future water supplies will have to rely more heavily on reuse and recycle.

Since industry is the largest user of water, future industrial growth will be restricted largely to regions having adequate water supplies. The major industrial users of water are the primary manufacturers of metals, chemicals, paper, petroleum, and food products. The pollutant levels in wastewater are often characterized by solids content and by biochemical oxygen demand, (BOD), which is a measure of the dissolved oxygen used by microorganisms in biological oxidation of organic matter. The total biochemical oxygen demand of aqueous industrial wastes is three times the total BOD of wastes entering municipal wastewater treatment plants. Over 90 % of the industrial BOD is generated by the chemical, paper, food, and petroleum industries. The primary metals industry together with these four industries contribute 90 % of the solids entering industrial wastewater. The total solids entering sewage treatment plants from domestic wastes are less than one half of the total solids in industrial wastes. It is apparent that heavier industrial use of the available water must be accompanied by greater treatment to ensure that the levels of toxic chemicals do not accumulate and become harmful.

As our standard of living advances, our demand for water accelerates. We have to meet the needs of an increasing world population by irrigating more of the unproductive areas and fulfilling the demands for an even greater industrial output. These needs require a stewardship of our water resources to preserve water quality through waste treatment and to ensure adequate quantities through recycle.

Notes:

Stewardship – забота.

Lesson 2

WASTEWATER QUALITY

I. Translate the following international words paying special attention to their pronunciation and the part of speech. Try to remember the words:

criteria *n*, cycle *n*,
sulfate *n*, bacteria *pl*,
type *n*, nitrogen *n*,
phosphorus *n*, result *n*,
phenol *n*, chlorine *n*,
concentration *n*, bacteriological *a*,
pathogenic *a*, nitrate *n.*

II. Read and translate the following “false friends”. Consult your dictionary:

confusion, specific, critical

III. Translate the *attribute chains.* Mind that the main word in these "chains" is the last noun and all the previous nouns are used as attributes to the last one:

a) Transfer process, reaction kinetics, unit operation, end use, steam generation, quality criteria, water quality criteria, solids transport, water discharge, effluent standards, solid standards, water usage, sludge blanket, bio-assay technique, this use cycle, algae growth, water effluent regulations, flow rate

b) concentration limits, anaerobic treatment process, high rate anaerobic process, anaerobic treatment plant microorganisms, a higher ozone application rate, molecular chlorine use, the proposed effluent limitation guidelines (руководство), radiation protection guidelines.

IV. Pronounce the verbs with the suffixes –ify, -ize (-ise), -ate. Mind that such verbs have the stress on the third syllable from the end:

purify, minimize, stimulate, utilize, regulate, associate, indicate.

V. Name the verbs from which the following words were formed and translate all of them. Use the dictionary if necessary:

depletion, utilization, generalization, removal, acceptable, considerably, variety, usage, purification, application, regulation(s), concentration, adoption, government, improvement, generation, cooling, different, confusion, requirement, degradable.

VI. Form adjectives from the following adverbs and translate all the words:

considerably, generally, environmentally, commonly, quantitatively, qualitatively, mainly, largely.

VII. Translate the following:

a) most sources
regulations
receiving streams
effects
nutrients
cells
usages
impurities
requirements
improvements
pollutants

b) drinking
fresh
potable
effluent water
cooling
process
polluted

VIII. Mind the translation of "no longer" and translate:

Model: We *no longer* use this method. – Мы *больше не* используем этот метод.

1. We can no longer rely solely (только) on the environment to absorb and treat the vast quantities of materials in our wastewater.
2. Those biocides that were extremely toxic are no longer being used.
3. Some countries report only those solid wastes-primary inorganic solid wastes-which no longer can be recycled or reused, but have to be disposed to landfill.
4. Many species of plants and animals can no longer exist in the modern urban environment.
5. This device is no longer available in the laboratory.
6. At the mill chlorine is no longer used for bleaching (отбелка).
7. When the solution was made alkaline peroxide decomposition no longer occurred.

IX. What is the meaning of the verb "meet" in the following word combinations?

to meet (the) requirements, to meet (the) demands, to meet (the) criteria.

X. Revise the translation of *the infinitive as an attribute* and translate:

the parameters to be considered, the requirements to be complied with, the standards to be set, the impurities to be removed, the criteria to be established, organic substances to be dissolved, chlorate to be determined by ion chromatography, conditions to be changed, natural ecosystems to be conserved, denitrification to be enhanced by addition of a harmless and easily degradable carbon source, water to be converted (in)to steam, the criteria to be met, the requirements to be met, the water to be discharged to the environment, the safety of water to be relied on, the regulations to be controlled, effluent standards to be complied with, the number of cells to be measured.

XI. Find in the text "Wastewater quality":

1. three adjectives with negative prefixes;
2. five sentences with verbs in passive voice;
3. one sentence with the infinitive as an attribute.

XII. Words and word combinations to be remembered. Transcribe the words before pronouncing them:

a) common - распространенный, общепринятый;

closed loop cycle - замкнутый цикл;

comply with measure - соответствовать, подчиняться мере;

indicate - показывать, отражать;

convert (in) to - превращать (ся) в;

criterion – criteria – критерий, критерии;

degradable - способный к химическому или биологическому разложению;

depletion - истощение, исчерпывание;

deposit *v* - осаждаться, откладываться;

discharge, *v* - выделять(ся), сбрасывать,удалять, выпускать, расходовать (воду);

dissolve - растворять(ся);

govern - обусловливать, регулировать, consider рассматривать, считать;

impurities - загрязнения, загрязняющие вещества, примеси;

increase *n, v* - увеличение; увеличиваться;

involve - включать, содержать;

long-term toxic effect - длительное токсическое действие;

microbial count - микробное число, (определение) количества (числа) микробов;

nonpotable water - вода, непригодная для питья;

nutrients - питательные вещества, нутриенты;

prevent (from) - препятствовать, противодействовать;

purify - очищать;

receiving stream - водоприемник;

regulations - правила;

remove - удалять;

safety - безопасность;

sludge blanket - взвешенный слой осадка (в осветлителе);

soluble - растворимый;

source - источник;

stream - поток;

supply, *n, v* - запас, снабжать;

vary - различаться;

COD chemical oxygen demand - химическая потребность в кислороде;

TOC total organic carbon - содержание органического углерода;

TOD total oxygen demand - общая потребность в кислороде;

b) interprete the abbreviations and try to remember them: BOD, COD, TOC, TOD.

XIII. Read and translate the text:

Wastewater quality

Water was a wide variety of end use associated with it. Swimming, boating, fishing and drinking are common water usages, just as cooling, washing, and steam generation are common usages of water for industry. Each of these usages has different water quality criteria. Commonly there is confusion between criteria and standards. Criteria are the scientific requirements which a water source must meet in order to support a designated use. Thus water quality criteria govern the input of water to a particular use and will be different for each intended use. Standards on the other hand, govern the quality of the water after the user is through with the water and before he discharges it back to the environment.

Water quality criteria depend upon the use of the water and vary considerably in the number and levels of the parameters to be considered.

Probably the single most important criterion used in classifying water as "polluted' is the microbial count. The Safe Drinking Water Act of 1974 established Federal authority to control the drinking water quality by setting quantitative levels on chemical as well as biological criteria. Generally quality criteria for nonpotable uses are varied and generalizations are difficult.

The bridge between the discharge of the water and the standards involves water treatment and purification, which is the primary concern. Since most of industrial and domestic applications use water for solids transport or for dissolving solids, it is imperative that many of these impurities be removed before the water is discharged to the environment. The water-use cycle is a closed loop since water is conserved on our planet. Because our supply of fresh water is finite and the demand for it is increasing, our water will be travelling this cycle more often in the future. This use cycle is extremely critical on many river systems such as the Mississippi where water from the river is repeatedly used and discharged back into the river for reuse by someone else downstream. We can no longer rely solely on the environment to absorb and treat the vast quantities of materials in our wastewater. To comply with effluent standards the wastewater must be purified prior to its discharge.

Governmental bodies establish regulations setting standards for water discharge into the environment so that the criteria which have been set for reuse of that water can be met.

The U.S. Environmental Protection Agency (EPA) has proposed effluent standards for many industries to set some uniform minimum standards across the country. Generally the parameters covering soluble degradable organics (such as BOD, COD, TOC, and TOD) control the utilization or depletion of dissolved oxygen by the aerobic bacteria present in receiving

streams or lakes. The many types of solids standards for the wastewater prevent sludge blankets from being deposited as well as minimize carbon sources for bacteria in the stream. Sulfates are important since bacteria can convert them to H_2S and eventually to H_2SO_4 which will change the pH of the water. The influence of heavy metals has been studied widely and often can stop biological activity or have serious long-term toxic effects on humans. The nutrients, nitrogen and phosphorus, enhance eutrophication and stimulate undesirable algae growth. Although the form of the nitrogen and phosphorus can vary widely with the source and degree of treatment, the effect upon the environment is generally the same. Tates and odors may be the result of organic matter, minerals, specific compounds, such as phenol or mercaptans, or chlorine and its compounds. Such compounds become a nuisance at very low concentrations. The bacteriological safety of wastewater is determined by several bio-assay techniques which attempt to measure the number of cells per unit volume of water. Most coliform bacteria are not pathogenic but their presence indicates the probability of pathogenic organisms being present. Since the adoption of water effluent regulations by the federal and state governments, those parameters involving solids soluble organics, and bacterial counts have shown the highest improvement in the U.S. waterways while those involving nutrients (e.g., nitrate and phosphorus) have shown the least improvement.

In setting standards for discharges, it is important to consider both the concentration level of the pollutant and the flow rate of wastewater. A high flow rate can impose an unacceptable amount of pollutant on a receiving stream even if the concentration of pollutant is low. Percent removal is not an environmentally acceptable basis for setting standards. Thus the total quantity as well as concentration of pollutant in the discharge should be controlled by the regulations.

Notes:

The Safe Drinking Water Act – Закон о безопасной питьевой воде (США);

Environmental Protection Agency (EPA) – Управление охраны окружающей среды (США);

prevent from – не давать (не позволять) что-то сделать;

be through with smth. – окончить что-либо;

on the other hand - с другой стороны.

Lesson 3

WASTEWATER COMPONENTS

I. Read and translate the following international words paying special attention to their pronunciation and the part of speech they belong to:

component n, suspension n,

fraction n, filtration n,
sedimentation *n*, gravity *n*,
micron *n*, membrane *n*,
biomass *n*, inert *n*,
ion *n*, macromolecule *n*,
colloid *n*, category *n*,
carbonate *n*, classify *v*,
oxide *n*, carbon *n*,
biological reactor *n*, aquatic *a*,
group *n*, esthetics *n.*

II. Pronounce the verbs paying attention to the stress and translate them:

evaluate, vaporize, classify, volatilize, separate.

III. Name the verbs from which the following nouns and adjectives were formed and translate all the words. Use the dictionary:

suspension, separation, evaporation, volatility, measurement, addition, dryness, settleable, analytical, filtration, weight.

IV. Translate the following word combinations:

a) contaminated
   suspended sediments
   stream

b) gravity
   accelerated sedimentation
   chemical
   continuous

c) aerobic
   anaerobic decomposition
   bacterial
   radiation

   decomposition

d) degree of pollution
   purification
   treatment
   ideas

e) advanced method
   technology

f) adverse conditions
affect

g) bottom
air
water sample
laboratory

V. Find the pairs of words which have a similar meaning:

amount	reduce
determine	broadly
refer to as	use
lower	mainly
alter	quantity
apply	evaluate
widely	residue
assess	define
sediment	term
primarily	change

VI. Translate the following "attribute chains":

a water sample, separation process, suspended solids level, dissolved oxygen solubility, solids content, activated sludge reactor, measurement test, solids categories.

VII. In what meaning are the following words used in the text?

perform, lie, in order (to), either …or, through, call, refer to, any, refer to as, operation, as well as, public health, due to.

VIII. Define the meaning of the word "as" and translate:

1. The hypochlorous acid then further reacts with the chlorite to regenerate chlorine dioxide which once more reacts with the lignin *as* expressed in Eq. 2
2. Enzyme trial 1 was not as successful in removing ink (типографская краска) *as* we had anticipated (ожидать).
3. Although this trial was considerably better than the control one, it was not *as* effective *as* our laboratory experiments.
4. *As* was expected, the dirt count dropped most significantly after flotation in all trials.

5. This legislation developed *as* a result of growing concern throughout Canada and indeed throughout the world, about the lack of control over the dispersion of toxic substances into the environment.
6. Treatment of segregated (раздельный) D- and E- stage effluents did not reduce polymer consumption, but this approach (подход) shows promise (перспектива) *as* a means of reducing equipment size and thus capital cost.
7. Our journal will publish additional details on the conference *as* they become known.
8. Compost systems rely on soil, wood chips (щепа), pulverized (измельченный) limestone, manure (перегной, компост), etc., as media for microbial growth.
9. In composting (компостирование) the initial pH can be *as* low *as* 5 in first 2 or 3 days it then begins to rise up to about 8,5 for *as* low *as* aerobic conditions are maintained.
10. This is true as long as the hydraulic loading (гидравлическая нагрузка) is sufficient.
11. As the substrate becomes limited, the growth rate declines and some microorganisms die.
12. Micro-nutrients are just as essential as macro-nutrients, but they are needed only in trace amounts.
13. All of the biological systems require carbon as a food source.
14. As the effluent flows into the second tank, floculant is added to form larger flocs from the coagulated chromophores.
15. Despite improved color and COD removal at pH values as low as 3, operating at such low values of pH impedes (затруднять) floc formation.
16. However, while readily biodegradable BOD represents the majority of BOD in clarified primary effluent, a considerable portion of the BOD is present as slowly biodegradable and/or colloidal material.

IX. Translate the following sentences with the words *"whether"* and *"whether …or (not)"*:

Models: 1. We must decide whether to perform the experiment under these conditions. – Нам необходимо решить *проводить ли* эксперимент в этих условиях.

2. This method is used whether the compound is pure or contains some impurity. – Этот метод применяется *независимо от того,* является *ли* соединение чистым *или* содержит примесь.

1. It depends on *whether* we have enough money for a new installation.
2. Please inform us *whether* you will be able to publish this paper (статья).
3. There is some question as to *whether* current wastewater technologies can reach these levels.
4. Other odor-causing compounds, *whether* they contain sulfur *or not*, have not been previously identified.
5. This means that the same amount of the elemental chlorine ends up as AOX (абсорбируемые органические галогены) *whether* it originates (происходить) from Cl_2 or ClO_2.
6. This will all take some time. But we will know by next year *whether or not* we will use this process.
7. The purpose of such a selection was to assess *whether* other components contribute to (способствовать) their toxicity.
8. All these things must be done regularly to know *whether* the plant is being operated on an economical basis *or not*.
9. Thus some statistical test method should be used to determine *whether or not* differences among mean (средний).
10. In addition, we will be determining *whether* similar action is required for the broader category of chlorinated organics.
11. The substances on the priority substances list (список) (Canada) should be immediately assessed to determine *whether* they are toxic *or* capable of becoming toxic.
12. Various operational conditions were used to determine *whether* the reactor was capable of performing oxygen delignification under medium consistency (MC) conditions.

X. Define the function of "those":

a) Most solids above 10 microns can be removed by filtration and sedimentation, while *those* below one micron in size require one of the more advanced separation process;

b) Settleable solids are *those* which will settle under quiescent conditions within one hour under the influence of gravity.

XI. Define the part of speech of the words with –ed. Translate:

1) a new method was developed;
   the new method developed in the laboratory;
   they developed a new method;

2) the amount of sediment was evaluated;
   we evaluated the amount of sediment;
   the amount of sediment evaluated was…;
3) the moisture removed from the sample;
   the moisture should be removed;
   the moisture was removed;
4) the physical properties were determined;
   the properties determined;
   the determined properties;
   they determined the properties;
5) the liquid was vaporized;
   the vaporized liquid;
   the liquid is being vaporized;
6) we performed a test;
   a test was performed;
   the test performed;
7) any organic fraction is decomposed;
   any decomposed organic fraction;
8) the level of settleable solids must be measured;
   the level of settleable solids measured;
   the measured level of settleable solids;
   they measured the level of settleable solids;
9) the temperature and pH of wastewater affected aquatic and biological life in the receiving body of water;
   aquatic and biological life in the receiving body of water affected by the temperature and pH of wastewater;
   aquatic and biological life in the receiving body of water was affected by the temperature and pH of wastewater.

XII. Find in the text and translate:

a) three sentences with infinitive of purpose
b) six sentences with verbs in passive voice
c) two sentences with “have” as a modal verb
d) one sentence with “be” as a modal verb
e) two sentences with adjectives in comparative degree.

XIII. Words and word combinations to be remembered. Write them out in your vocabulary notebooks, transcribe and pronounce several times until you remember their pronunciation:

adversely – неблагоприятно;

apply - применять;

be composed of - состоять из;

body of water – водоем;

clarity - прозрачность, чистота;

decompose - разлагаться, разрушаться;

degree (of treatment) - степень очистки (обработки);

deplete - истощать, исчерпывать;

determine - определять;

dry weight - сухой вес, сухая масса, масса сухого вещества;

eutrophication - эфтрофикация;

evaluate - оценивать;

evaporation - испарение;

fiber - волокно;

mg/l (L) milligrams per litre (liter) - мг/л;

mixed liquor suspended solids (MLSS) - взвешенные вещества в смеси сточных вод с активным илом;

odor – запах;

oxygen level - уровень кислорода;

perform (a test) - проводить (исследование, анализ, опыт);

range *n, v* – диапазон, классифицировать;

remain – оставаться;

residue - осадок, отстой;

salt – соль;

sample – образец;

sediment n, - осадочное вещество, осадок, отстой;

sedimentation - осаждение, отстаивание;

sedimentation unit - осаждающее устройство;

sediments removal – удаление;

settle - осаждать, оседать, отстаиваться;

settleable solids - частицы, осаждающиеся вещества;

size *n, v* - размер; измерять, определять размер, величину;

taste – вкус;

tertiary method - третичный метод;

under quiescent conditions - в состоянии покоя;

unless - пока не, до тех пор, пока не;

vaporize - превращать(ся) в пар, испаряться;

volatility - изменчивость, неустойчивость;

whether - ли, при условии, будь то.

Try to learn the above words only while translating the text several times.

XIV. Read and translate the text

Wastewater Components

Solids: The total solids in a water sample is the residue on evaporation of the sample at 103-105°C. Any low-boiling compounds in water will be lost during this test. The total solids are composed of matter which is settleable, in suspension, or in solution. Analytical tests are performed to separate out the fraction of the total solids which lie in each area. Most solids above 10 microns can be removed by filtration and sedimentation, while those below 1 micron in size require one of the more advanced separation processes. For this reason, the analytical tests are commonly divided into settleable solids, suspended solids, and dissolved solids.

Settleable solids are those which will settle, under quiescent conditions, within one hour under the influence of gravity. It is important to measure the level of settleable solids in order to size sedimentation units and to evaluate the amount of sediment which could potentially enter a natural body of water. The total suspended solids level is determined by filtering wastewater through either a fiber pad or more recently through a 0.45 micron membrane and measuring the dry weight of the material collected in mg/l.

If the sample is the liquid from an activated sludge reactor, then the total suspended solids are commonly called the mixed liquor suspended solids (MLSS) and refer to the concentration of suspended biomass and inerts in the reactor. The filtrate from this test contains the total dissolved solids which are composed of small ions, macromolecules, and very small colloids. The level of total dissolved solids is obtained by evaporation of the filtrate to dryness and is expressed as mg/l.

All of the above solids categories may be further classified on the basis of their volatility at 600°C in air. Any organic fraction will be decomposed to water, ammonia, and oxides of carbon while most inorganic material will remain as their oxides, carbonates, or other salts. The vaporized portion is referred to as “volatile” and the inorganic residue is termed “fixed”. If the MLSS is volatilized at 600°C, then the result is reported as mixed liquor volatile suspended

solids (MLVSS) and gives a closer indication of the biomass in the biological reactor than the MLSS.

The temperature and pH of wastewater are important primarily because they affect aquatic and biological life in the receiving body of water. Higher temperatures lower the dissolved oxygen solubility in the water making fish kills more likely in the summer months. However unless the wastewater has been used for heat exchange in power plants or industrial operations, the wastewater temperature is not significantly altered before discharge.

Characteristics of Wastewater

The characteristics of wastewater are broadly classified into physical, chemical, and biological according to the type of measurement test that has to be performed. The analyses range from the very specific quantitative tests usually applied for chemicals to the broad group tests applied to biological classes. Although the nitrogen, phosphorus and dissolved solids can be removed by the addition of chemicals and by certain tertiary methods, they are not easily removed in a conventional plant. If water reuse is to be widely practiced, these minerals will have to be removed.

Chemical characteristics

The chemical characteristics of wastewater can adversely affect the environment in many different ways. Soluble organics can deplete oxygen levels in streams, and give taste and odor to water supplies. Toxic materials can affect food chains as well as public health. Nutrients can cause eutrophication of lakes.

Physical characteristics

The most important physical characteristic of wastewater is its solids content as it affects the esthetics, clarity and color of the water. Other physical parameters are temperature and odors which are largely the result of baseline levels for that geographical area and are not commonly altered in a wastewater treatment plant.

Biological characteristics

Biological tests on water and wastewater determine whether pathogenic organisms are present by testing for certain indicator organisms. Biological information is needed to measure water quality for such uses as drinking and swimming, and to assess the degree of treatment of the wastewater before its discharge to the environment.

10) Find in the text the English equivalents:

Водоём, слой активного ила, отстойник, проводить (выполнять) анализ, твердый остаток, более вероятно, понижать растворимость, называть (три глагола), более современный (усовершенствованный), неблагоприятно влиять, вызывать эвтрофикацию, электростанция, общее содержание взвешенных веществ, доочистка (третичная очитска),

замор рыб (гибель рыбы), водные флора и фауна, сухость, реактор активного ила, понижать растворимость, водные ресурсы, пищевая цепь, очистное сооружение, сброс сточных вод, истощать уровень кислорода, здравоохранение.

Lesson 4

INDUSTRIAL WASTES

I. Read and translate the following international words paying special attention to their pronunciation:

scheme n, limit n, v,
function n, v, nitrification n,
ozone n.

II. Read and translate the "false friends" given below. Try to remember their pronunciation and meaning:

alternative, specific.

III. Pronounce and translate the following verbs. Mind the stress:

contaminate, condensate, segregate, separate, equalize, neutralize, recirculate, fluctuate, precipitate, approximate, ultimate.

IV. Pronounce the following nouns and adjectives having the suffix – *ate*. Mind that the suffix – *ate* in nouns and adjectives should be pronounced [-it]. Translate the words.

Model: gradu**ate v** [-eit]:

graduate n [-it], separate *a*, estimate *n*, approximate *a*, coordinate *a*, precipitate *n*, ultimate *a*.

V. Name the verbs from which the following nouns were formed. Translate all of them:

fluctuation, storage, floating, settling, generation, coagulation, adsorption.

VI. Give adjectives of the following adverbs and translate them:

generally, commonly, effectively.

VII. Match the words of similar meaning:

portion; lower;
particular; purpose;
option; generally;
primary; amount;
reduce; fraction;
quantity; mainly;
commonly; specific;

largely; main;

objective n; choice.

VIII. In what meaning are the following words used in the text?

since, through, performance, packing, film

IX. Form "attribute chains" instead of word combinations with the preposition "of". Translate them.

Model: the concentration of the solids – the solids concentration:

the quantity of wastewater, the bottom of a tank, availability of land, maintenance of new cells, the surface of the packing, characteristics of the wastewater, disposal of sludge, the treatment of industrial wastes, the process of wastewater treatment, primary reduction of solids, biodegradability of waste, a portion of the thickened biomass, removal of phosphorus compounds, removal of dissolved solids.

X. Translate some sentences and combinations with the words: "available", "be available", "availability":

Models:

1) *available* techniques – *имеющиеся/используемые/распространенные* методы; the books *available* at the library – книги, *имеющиеся/появившиеся* в библиотеке;
2) currently this literature *is available* at the library – в настоящее время эта литература *есть/имеется/доступна* в библиотеке; this literature *is not available* at the library –этой литературы *нет* в библиотеке;
3) I know of the *availability* of this literature at the library – *Я* знаю о *наличии/появлении* этой литературы…; I know of *unavailability* of this literature – Я знаю об *отсутствии* этой литературы …

1. Industry is concerned for the continuous availability of renewable resources, not the least of which is cleaner.
2. Traditional odor control technologies available to pulp mills (целлюлозный завод) for the reduction of TRS (общая восстановленная сера) gases include incineration or oxidation, liquid scrubbing (мокрая очистка газа), and adsorption.
3. These results can be explained by the formation of a complex between DT (diethylene-triamine pentaacetic acid) and manganese species, so that less Mn^{3+} is available for the redox (окислительно-восстановительный) cycle.
4. If sufficient hot air for drying is not available from the kiln (сушильная печь) or from the cooler, an auxiliary furnace (печь) may be needed.

5. However, depending on the availability and economics, other fuels are also used, such as anthracite or coal.
6. Reliable data on costs were not available.
7. Best available techniques for reducing waste is to minimize the generation of solid waste and recover, recycle and re-use these materials, wherever practicable.
8. In order to reduce the consumption of fresh steam and electric power a number of measures are available.
9. Available data on annual average emissions in kg/t of kraft pulp are summarized in Table 2.
10. In this paper all relevant (необходимый, важный) techniques currently commercially (в промышленности) available for prevention or reducing the level of emissions, waste and reducing the consumption of energy and raw material, both for new and existing installations are given.
11. It should be noted that there is little detailed and reliable (надежный) information available on achievable (достигаемый, который можно достичь) amount of solid wastes.
12. Careful segregation or less expensive preconcentrating method appears to be needed, the possible availability of such concentrated liquid residues offers a broad potential (возможность) for utilization, recovery or disposal.

XI. Translate the given word combinations with comparative and superlative adjectives:

a wider variety of processing schemes, a broader range of characteristics, a less offensive form, larger particles, higher settling velocities, four times greater, more resistant to shock loads, the most widely used, the most commonly used, the most important characteristic, the most well-known biological treatment processes.

XII. How should "most" be translated in the following word combinations:

most sludges, most contaminants, most of these solids, most conventional plants?

XIII. Translate the following sentences with complex subject (subjective infinitive construction):

A

1. These chemicals
   - are found
   - were found
   - are likely
   - are unlikely
   - are certain

   to have a serious environmental impact

	seem		
	appear		
	turned out		
2. This method	is assumed		
	is thought		
	is believed		
	is claimed	to be theoretically correct	
	is known		
	is said		
	can be shown		
	can be stated		
	can be predicted		
	can be expected		
3. The first two factors	are likely		
	are not likely		
	seem		
	do not seem	to play a significant role	
	are sure		
	were found		
	were shown		
4. The amount of AOX (абсорбируемые органические галогены)	was found		
	was expected	to be lower than in	
	was supposed	the laboratory	
	proved	bleaching	
	was thought	experiments	
5. Color (цветность, окраска) removal from mill effluents	is expected		
	can be expected	to become a	
	is certain	concern in the	
	is believed	near future	
	is likely		
6. Numerous compounds	are known		
	are reported		
	are claimed		
	were supposed	to have this effect	

		seem	
		are likely	
		were predicted	
		were observed	
7.	Rosin size (смоляной клей)	was reported	to break down
		was observed	(растворяться)
		is known	at this high
		was expected	temperature
		is assumed	
		turns out	
8.	This stage	seems	
		was shown	
		is stated	to produce mainly
		turned out	substances of
		is found	relatively low
		appeared	molecular weight
		is reported	

B

1. The color of bio-treated effluent was found to be nearly two times higher than the untreated effluent.
2. The two chlorinated phenolic compounds were observed to be partially removed.
3. A5-day aerated lagoon is expected to provide adequate detoxification in addition to BOD reduction.
4. A change in pressure does not seem to affect the bleaching response (реакция) significantly.
5. The actual mechanism for the conversion of alkali compounds in the carbonate form is known to be very complicated.
6. The product, which on analysis was found to contain 37, 4 % chlorine and 8,0 % oxygen, was soluble.
7. The amplitude of this current signal is supposed to correspond to the concentration of the gas in the sample air.
8. Methyl mercaptan is believed to have physiological effects similar to hydrogen sulphide with possibly equal or less toxicity.
9. These final and proposed regulations are expected to be published in January.

10. The provisions (положения) highlight (освещать, придавать большое значение) below 10 are believed to be the most critical for mills.
11. This white water (оборотная вода) system was reported to give significant cost savings in chemical additives (добавки).
12. The effect of the surface area of MnO_2 on the peroxide decomposition was studied, and the peroxide decomposition was found to increase with the increase in the surface area of the particles.
13. The catalytic activity of precipitated MnO_2 was shown to be much higher than MnO_2 in particular form.
14. Effluents in these two categories should be given the highest priority for further anaerobic testing and process development studies since they are likely to be the least problematic.
15. Substitution appears to have a negligible (незначительный) impact on the stability of AOX present in the effluent.
16. Such concentrations are not likely to be found in primary effluents.
17. The presence of turpenes did not show any toxicity effects on the aerobic biological system, and actually proved to be highly biodegradable.
18. The problem of many traditional pulp mill pollutants such as e.g. dioxin and chlorate are considered to have been solved, as the remaining emissions are very low today.
19. These compounds especially calcium salts are thought to be soluble in water and do not contribute significantly to the color removal process.
20. Both treatment systems were found to be effective in detoxification.
21. The BOD of refiner groundwood (древесная масса из щепы) effluents was found to be easily removed using either an activated sludge or a 5-day aerated lagoon.
22. The BOD and toxicity of refiner groundwood effluents were reported to be successfully reduced to levels in compliance with (в соответствии) the regulations.
23. These dyes (красители) are not expected to be present in mill effluents under normal conditions.
24. There appear to be no exotic compounds formed in aerobic biological systems.
25. The absorption per weight unit of clay is said to increase continuously with increasing chemical concentration in the waste effluent.
26. Any single manufacturer is unlikely to have ready solutions to all the problems.

27. The biological process itself has been found to cause the formation of additional color.
28. This may be because cellulase (целлюлаза) enzymes are reported to form aggregates in the absence of surface pollutants (ПАВ), depending on the enzyme concentration in solution.
29. Hydrogen ion concentration is known to be a major modifying factor for the toxicities of those compounds, which can be presented in different ionization forms due to the pH variations.

XIV. Define the function of Present Participle (Participle I) and translate the word combinations and sentences:

1) a. While selecting a method for…
   b. they are selecting the only possible method for…
   c. a researcher selecting the only possible method for…
2) a. We are classifying conventional wastewater treatment processes.
   b. when classifying conventional wastewater treatment processes…
   c. specialists classifying the processes
3) a. biochemical oxidation removing organic matter
   b. biochemical oxidation is removing organic matter
   c. removing organic matter biochemical oxidation creates conditions for…
4) a. pretreatment processes are reducing the size of solids and screening out coarse solids
   b. pretreatment processes reducing the size of solids and screening out coarse solids
   c. reducing the size of solids and screening out coarse solids they carry out the wastewater treatment at the pretreatment stage.
5) Treating industrial wastes a wide variety of processing schemes is used.
   b. A wide variety of processing schemes is treating industrial wastes.
   c. a wide variety of processing schemes treating industrial wastes

XV. Revise the following modal verbs and their equivalents. Translate:

1) can
   could
   are able to process
   were
   will be
2) may
   might process
3) should process

should have processed

4) must
   is to process
   was to
   have
   had to process
   will have
5) needn't process
   don't need to process

XVI. Find in the text and translate:

a) one sentence with complex subject (Subjective Infinitive Construction);
b) eight sentences with verbs in passive voice;
c) two sentences with gerund;
d) seven sentences with infinitive of purpose;
e) two sentences with Participle II used as an attribute;
f) two sentences with Participle I.

XVII. Words and word combinations to be remembered.

Write out these words into your vocabulary notebook. Pay attention to their pronunciation:

municipal plant - городская станция очистки сточных вод;
pretreatment - предварительная обработка, предочистка (сточных вод);
treat - обрабатывать;
separate *a* - отдельный, раздельный;
wastewater load - загрузка сточных вод;
recirculate - повторно пропускать через циркуляционную систему, рециркулировать;
contaminate – загрязнять;
segregate - изолировать, отделять;
strength - прочность, сила;
substitute – заменять;
recover – восстанавливать;
contaminant - загрязнитель, посторонние примеси;
by-product - побочный продукт;
availability – доступность;
objective *n* – цель;
reduction - сокращение, уменьшение;

primary treatment - первичная очистка (сточных вод);

secondary treatment - вторичная очистка;

tertiary treatment - доочистка, третичная очистка (сточных вод);

sludge disposal - удаление осадка;

float - держаться на поверхности;

equalize - уравнивать, уравновешивать;

fluctuation - колебание, неустойчивость;

storage – хранение;

short-term (storage) - кратковременное хранение;

activated sludge - активированный ил;

trickling filter - бактериальный, биологический фильтр;

clarifier - очиститель, осветлитель;

advanced wastewater treatment - усовершенствованная очистка сточных вод;

ammonia stripping отгонка аммиака;

activated carbon - активированный углерод;

receiving water - приемник очищенных сточных вод;

in addition (to) - в дополнение к;

capital costs - капитальные затраты;

operational costs - расходы, затраты на эксплуатацию;

alternative *n* - альтернатива, вариант.

XVIII. Read and translate the text:

Industrial Wastes

Since industrial wastes have a broader range of characteristics than domestic wastes, they are treated by a wider variety of processing schemes. Industrial wastes are more likely to contain toxic and nonbiodegradable components that require physical-chemical instead of biological treatment. In some cases, industrial wastes are discharged to a municipal plant directly or after limited pretreatment. In other cases, they are treated in a separate plant designed for the specific wastes. The wastewater load in an industrial plant can often be reduced by recirculating slightly contaminated water, segregating low and high strength wastes for separate treatment, substituting less polluting chemicals or process, and recovering selected contaminants as byproducts or for reuse.

Design of a wastewater treatment process for industrial or domestic wastes depends upon many factors, such as characteristics of the wastewater, required effluent quality, availability of land, and options for sludge disposal. In addition to capital and operating costs, stability,

reliability, and flexibility are important considerations when selecting a process from the various alternatives.

Wastewater Treatment Processes

The main objectives of conventional wastewater treatment processes are reduction of biochemical oxygen demand, suspended solids, and pathogenic organisms. In addition, it may be necessary to remove nutrients, toxic components, nonbiodegradable compounds, and dissolved solids. Since most contaminants are present in low concentrations, the treatment processes must be able to function effectively with dilute streams. Many operations are used to purify water before discharge to the environment.

Classification of processes

Conventional wastewater treatment processes are often classified as pretreatment, primary treatment, secondary treatment, tertiary treatment and sludge disposal.

Pre-and Primary Treatment

Pretreatment processes are used to screen out coarse solids, to reduce the size of solids, to separate floating oils and to equalize fluctuations in flow or concentration through short-term storage. Primary treatment usually refers to the removal of suspended solids by settling or floating.

Sedimentation is currently the most widely used primary treatment operation. In a sedimentation unit, solid particles are allowed to settle to the bottom of a tank under quiescent conditions. Chemicals may be added in primary treatment to neutralize the stream or to improve the removal of small suspended solid particles. Primary reduction of solids reduces oxygen requirements in a subsequent biological step and also reduces the solids loading to the secondary sedimentation tank.

Secondary Treatment

Secondary treatment generally involves a biological process to remove organic matter through biochemical oxidation. The particular biological process selected depends upon such factors as quantity of wastewater, biodegradability of waste, and availability of land. Activated sludge reactors and tricking filters are the most commonly used biological processes.

In the activated sludge process, wastewater is fed to an aerated tank where microorganisms consume organic wastes for maintenance and for generation of new cells. A portion of the thickened biomass is usually recycled to the reactor to improve performance through higher cell concentrations. Trickling filters are beds packed with rocks, plastic structures, or other media. Microbial films grow on the surface of the packing and remove

soluble organics from the wastewater flowing over the packing. Excess biological growth washes off the packing and is removed in a clarifier.

Tertiary Treatment

Many effluent standards require tertiary or advanced wastewater treatment to remove particular contaminants or to prepare the water for reuse. Some common tertiary operations are removal of phosphorus compounds by coagulation with chemicals, removal of nitrogen compounds by ammonia stripping with air or by nitrification- denitrification in biological reactors, removal of residual organic and color compounds by adsorption on activated carbon, and removal of dissolved solids by membrane processes.

The effluent water is often treated with chlorine or ozone to destroy pathogenic organisms before discharge into the receiving waters.

Lesson 5

SLUDGE DISPOSAL

I. Read and translate the following international words, paying special attention to their pronunciation:

generate v, hydrophilic a,
approximate v, method n,
system n, constant a,
aeration n, reactor n,
local a.

II. Read and translate the "false friends" consulting the dictionary. Try to remember their pronunciation and meaning:

accurately, mixture, agitate.

III. Name the verbs from which the following nouns were formed. Use your dictionary. Translate all the worlds:

conversion, composition, fertilizer, incineration, equipment, combustion, description, thickening, oxidation, suitability, modification.

What suffixes of nouns were used to form them from the corresponding verbs?

IV. Find in the text words of similar meaning:

commonly, objective, decrease.

V. Form "attribute chains" instead of word combinations with the preposition "of" and translate them:

the method of plant operation, thickening of dilute sludges, the content of nitrogen, the fuel value of sludges, heat of combustion, variations of the conventional process, the concentration of waste and sludge, the density of solids content.

VI. Mind different translation of "in addition" "in addition to":

in addition – кроме того, к тому же;

In addition, it is necessary to remove nutrients, toxic components and dissolved solids. – Кроме того, необходимо удалить...

in addition to- кроме;

in addition to capital and operating costs – кроме капитальных и эксплуатационных затрат.

Translate:

1. In addition, recycling of wastewater is going to determine (определять) a large part of the success of these new technologies.
2. In addition, the bleaching power of the E-stage can be increased by raising the temperature.
3. In addition to tests carried out on secondary-treated combined mill (комбинат) effluent, color-removal tests were also carried out on the major color-bearing filtrates.
4. In addition, all the official methods specify (определять) several sample treatments including pH adjustment (регулирование), refrigeration (охлаждение), freezing, and addition of sulfite. These aim to stabilize AOX during storage (хранение).
5. However, in addition to the low average value, several samples produced less than 20 % COD removal after extended periods of contact with an anaerobic sludge.
6. In addition to the subcommittees, a project team was formed to develop guidelines for the integration of environmental aspects in new and existing products.

VII. Don't confuse "because" and "because of":

1. … high price compared to similar commercially (в промышленности) available dibasic (двухосновный) acids.
2. Because of greater volume it is essential that there be good mixing in the ASBs (aeration stabilization basin).
3. Translate the following word combinations (-handling, cause):

1) the cause of
   - eutrophication
   - air pollution
   - algal bloom (цветение воды)
   - health problems
   - oxygen depletion

		fish kill (замер рыбы)
2)	to cause	acid rains
		global warming
		water contamination
		flooding
		adverse health effects
		the depletion of ozone layer
		the depletion of natural resources
3)	sludge	
	snow	
	ash	
	refuse	handling
	data	
	radioactive waste	
	handling of samples	

VIII. Translate paying special attention to the words: *cause n v, handle v, handling n:*

A

1. This limited conversion was probably caused by the limited surface area of MnO_2 particles used in the study.
2. An increase in temperature or in the amount of added sodium sulfide will cause an increase in the amount of organo-sulfur compounds liberated during the process.
3. The eutrophication of the Baltic Sea was mainly caused by excessive nitrogen and phosphorus loads coming from land-based sources.
4. Dioxins may be the cause of reproductive or developmental effects, e.g. abnormal physical development, weakened immune responses and behavioral changes.
5. An overwhelming majority (подавляющее большинство) of water-quality problems are caused by diffuse nonpoint sources of pollution (рассредоточенные источники загрязнения) that are more difficult to monitor effectively.
6. While the International Agency on Cancer Research (IARC-Международное агентство по изучению рака) classifies dioxin as carcinogenic to humans, uncertainty (неуверенность) remains over how dioxin causes cancer, and at what level it may be carcinogenic or have other effects.

7. Backwashing (промывка обратным потоком жидкости) with water can be performed at relatively low pressure while backwashing with air causes additional stress to the membrane reducing its lifetime (срок эксплуатации).
8. This can cause a significant decrease in AOX results.
9. Organics burnt during incineration cause environmental pollution.
10. Municipal and industrial sewages and stack gases (дымовые газы) along with diffuse inputs from agriculture and traffic are the main causes of the increasing phosphate and nitrate concentrations in the Baltic Sea.

B

1. Anaerobic digestion handles more concentrated waste streams than the above process.
2. Composting handles the most concentrated waste streams (up to 50 % solids content) and requires the longest retention periods.
3. Of the four biological wastewater treatment processes the activated sludge treatment system is best suited (suit – подходить, годиться) for handling industrial wastes with organic constituents.
4. Because of possible risks, peroxide should be handled with care.
5. The technical and environmental aspects of storage and handling of chemicals do not specifically (зд. в данном случае) relate to (относиться к) The pulp and paper industry and are therefore only briefly treated (treat – рассматривать).
6. Their waste-treatment facilities (очистные сооружения) handle effluents from large-scale, integrated mills (комбинаты) located in the far northern United States where temperatures can drop to lows of 0°F during the winter, and reach highs of 70°F during the summer.

IX. Find in the text and translate:

a) four sentences with the verb in passive voice;
b) four sentences with infinitive of purpose;
c) one sentence with complex subject;
d) two sentences with present participle as an attribute;
e) three sentences with past participle as an attribute;
f) three sentences with past participle as an attribute (one of the participles is “followed (by)”).

X. How should the following words be translated:

along with, through, since, as, at least?

XI. Word and word combinations to be remembered:

accurately – точно;

adjust – приладить, отрегулировать, приводить в порядок;

agitate – смешивать, взбалтывать;

Btu (British thermal unit) - британская тепловая единица 0, 252 ккал;

bulky – массивный, громоздкий, рыхлый, объемный, пухлый;

content – содержание;

conversion – перевод, переход, видоизменение;

decrease *v* – уменьшать(ся), убавлять, убывать, сокращать;

density – плотность;

dewater – отводить воду, выкачивать, удалять воду, обезвоживать;

digested sludge – перегнивший ил (осадок сточных вод);

dilute *v, a* – разбавлять, разжижать, разводить;

disposal – удаление (нечистот и пр.), обезвреживание;

domestic sewage – коммунально-бытовые сточные воды;

error - ошибка;

evaluate – оценивать;

excess – избыток, излишек;

express – выражать;

fertilizer – удобрение;

generate – производить, вырабатывать;

goal – цель;

grade – сорт, марка, степень, ступень;

handle *v* – обращаться, обрабатывать;

handling *n* – обращение, обработка;

incineration - сжигание;

load *n* – загрузка;

mixture – смесь.

origin – источник, начало, происхождение;

oxidize – окислять;

per unit volume – на единицу объема;

pipe *v* – подавать (отводить) по трубам, пропускать по трубам;

piping *n* – образование каналов, заключение в трубопровод;

precipitate *n, v* – осадок, выделять осадок;

primary sludge – первичный осадок (отстой, шлам);

pump *n, v* – насос; выкачивать, нагнетать;

ratio – пропорция, соотношение, степень;

raw wastewater – неочищенная (необработанная) сточная вода;

reduce – снижать, понижать, уменьшать, сокращать;

reduction – снижение, понижение, уменьшение, сокращение;

residence time – время удержания, продолжительность пребывания;

residual – остаточный;

settle (out) – выделять, выпадать в осадок;

settler – осадитель, отстойник;

suitability – соответствие, пригодность;

tapered aeration – аэрация с убывающей интенсивностью, ступенчатая аэрация;

thickening – утолщение, уплотнение, загустевание;

treatment plant – водоочистная станция; установка для обработки, очистное сооружение;

ultimate – предельный. максимальный, высочайший, окончательный результат, предел;

value – ценность, важность, значение;

viscosity - вязкость, тягучесть, липкость;

volume – объем;

Write out these words into your vocabulary notebook. Pay attention to their pronunciation.

XII. Read and translate the text:

Sludge Disposal

Many of the treatment processes used to remove dissolved and suspended materials from water and wastewater generate residual sludges. The main sources of sludges are settleable solids in raw wastewater, excess biomass from biological processes and precipitates from chemical treatment. Since solids concentrations are often below 5 %, large volumes of sludges must be handled. In addition, most sludges are comprised of light hydrophilic solids that are difficult to dewater. The usual goals of sludge treatment are to reduce the volume of material for disposal and to change it to a less offensive form. Sludge handling and disposal usually constitute 25 to 40 % of the total cost of a wastewater treatment plant.

Sludge Characteristics

The quantity and characteristics of wastewater sludges depend upon the origin of the waste, the type of treatment plant, and the method of plant operation. Since activated sludges are very bulky, large volumes must be handled. Thickening of dilute sludges can achieve significant

reductions in volume. For example, if an activated sludge is concentrated from 1 to 3 %, the volume of sludge is reduced by about a factor of 3.

Solids concentrations in primar sludges are generally 3 to 4 times greater than in activated sludges. Although concentrations are normally expressed as weight per unit volume (e.g., mg/l), they are usually expressed as weight % solids. Thus, a measured concentration of 10,000 mg/l would be considered as 1 weight %. This direct conversion is only approximate since the density of the solids is different from the density of water. If the density of the solids content is known, mg/l can be accurately converted to weight %. At low solids concentrations, however, the error incurred in expressing mg/l as weight % is small.

Rheological properties are needed to design pumping and piping systems for transport of sludges. The viscosity of a sludge depends upon its source, concentration, temperature, and shear rate. The viscosity of activated sludge is about 6 cp and primary sludge is about 25 cp.

The chemical composition of sludge is of interest in selecting an ultimate disposal method and in evaluating its suitability for byproduct use, such as fertilizers. The fertilizer value of sludge is based mainly on the content of nitrogen, phosphorus, and potassium. Domestic wastewater sludges are low-grade fertilizers and have not found extensive use in agriculture. The fuel value of sludges is important in design of incineration equipment. Heat of combustion per pound of dry solids is about 7500 Btu for primary sludges, 6500 Btu for activated sludge and 4500 Btu for digested sludge.

Activated Sludge Process

Process Descriptions

Activated sludge systems are well suited to handling dilute wastewaters such as domestic sewage which contain both soluble and suspended organic matter. They use recycled microorganisms to oxidize the organic compounds in the presence of molecular oxygen to CO_2, water and new cells. Several variations of the conventional process have become standardized.

Conventional

The conventional activated sludge system contains a tank for wastewater aeration followed by a secondary settler and a solid's recycle line. The wastewater leaving the primary settlers enters one end of a rectangular tank along with the recycled sludge. It flows through under constant aeration in the presence of the activated sludge and exits at the other end of the tank after 4-8 hours of residence time. The activated sludge contains biologically active microorganisms which convert the organic wastes to biomass and other oxidized compounds and gases.

The mixing in this reactor is ideally taken to be plug-flow since the length/width ratio is usually greater than 10. In practice, however, the mixing is approximated by 3-6 completely

mixed tanks in a series. The activated sludge mixture is piped to the secondary settler, where the sludge is settled out and a fraction of it is recycled to the inlet of the reactor. The excess sludge generated in the process by the production of biomass and by the settling of inert solids is usually wasted from the recycle line. The amount of air required by the microorganisms is not constant through the length of the reactor. The high BOD of the wastewater entering the reactor will cause a high oxygen demand gradually will decrease. The oxygen concentration in the reactor should be at least 2 mg/l. Most conventional plants use tapered aeration to adjust the air rate along the reactor length to satisfy the local oxygen demand.

Some processes replace the long rectangular tank reactor of the conventional process with a circular mechanically agitated vessel in which the concentration of waste and sludge is uniform throughout the reactor. This modification makes the reactor more resistant to shock loads of BOD and toxic compounds in the inlet wastewater since the reactor also acts as a diluting vessel. Because the conventional system is closer to plug-flow, any toxic material could pass through the reactor undiluted and kill the biological culture in the reactor.

Lesson 6

SEDIMENTATION, THICKENING AND FLOTATION

I. Read and translate the following international words, paying special attention to their pronunciation:

flotation n, tendency n,
granular a, regime n,
hydrodynamic a, hydraulic a,
compression n.

II. Read and translate the following "false friends" consulting the dictionary. Try to remember them:

collision, examine, normally.

III. Name the verbs from which the following nouns were formed. Translate all the words:

removal, settling, processing, selection, thickener, reactor, consideration, flocculation, coagulation, softening, compression, tendency, behavior, gravitation, collision, agglomeration.

What suffixes of nouns were used to form them from the corresponding verbs?

IV. Form adverbs using the suffix *–ly* and translate all the words:

general, proper, adequate, common, dry, adverse, primary, ultimate, efficient, main, frequent, rough, constant, independent.

V. Don't confuse "both" – оба and "both…and" – как … так и, и… и. Translate:

1. This will make pollution abatement both easier and cheaper.
2. The reports covered monitoring, control, and environmental response in both air and water quality.
3. Both the fiber and the lignin were recovered and stored properly.
4. Lab results mirrored (отражать) mill results for both low and medium consistency.
5. The ability to carry both aerobic and anaerobic bacteria also increases the system efficiency.
6. Both temperature and weather conditions can cause fluctuations in the thermocline (слой температурного скачка).
7. In this study micro-, ultra-, and nano- filtration of some paper mill waters both on a laboratory and a pilot scale (полупромышленный масштаб) were compared.
8. Both, ozone and chlorine dioxide supply require major investments (капиталовложения).
9. The evaporation of the acid filtrate increases the flow to evaporation with ca. (приблизительно) 50 %, which affects both investment and operational cost.
10. The project complements (дополнять) our previous work on both wastewater treatment and sludge dewatering.
11. When the chlorine dioxide dosage was higher, the concentration of chlorate increased both in the incoming pulp and the washed pulp (промытая целлюлоза).
12. The atmospheric deposition entering the Baltic Sea results from emission sources both inside and outside the Baltic's own catchment area (водосборная площадь).
13. The overall reductions in discharges for both phosphorus and nitrogen have been roughly 40 % from all sources.
14. Therefore, considering both flux (поток) and recovery, scheme A is the best among the three schemes.
15. Both sets (set – группа, ряд) of samples were then stored at 4°C and 25°C.

VI. Translate the given word combinations

a) social behavior
   behavior of environmental pollutants
b) air conditioning
   snow removal device
   cleaning
c) adverse
   aeration

aerobic
atmospheric conditions
discharge
living
wastewater

d) settling
reaction velocity
wind

e) proper performance
processing
support
selection
behavior
design of the treatment system

behave properly
do the job

The amount of food available per microorganism (F/M) must be properly ratioed (ratio – устанавливать соотношение).

f) provide proper conditions
proper functioning of wastewater treatment plant
state-of-the-art (современный) equipment

Good aeration provides oxygen for the bacteria to carry out their biochemical reactions.

Water Quality Center (the U.S.) has two aeration basins, which provide a theoretical HRT (hydraulic retention time – время пребывания воды в очистном сооружении) of greater than two days.

VII. Find in the text the words with similar meaning:

clarifier, take place, operation, goal, use v, refer to as.

VIII. Find in the text and translate:

a) one sentence with gerund;
b) one sentence with infinitive of result (after an adjective);
c) one sentence with modal “should”;
d) one sentence with “no longer”;
e) one sentence with the infinitive after the verb “be”;
f) two sentences with Participle I as an attribute.

IX. Words and word combinations to be remembered. Write them out into your vocabulary notebooks. Pay attention to their pronunciation:

adhere – присоединяться, приклеиваться, твердо держаться;

behavior – поведение, протекание (процесса);

bottom – дно, нижняя часть;

clarification – осветление, очищение;

clarifier – очистная установка, прибор для осветления, отбеливатель;

thickener – загущающий наполнитель (агент, вещество), заугститель, отстойник, уплотнитель ила;

coagulate – сворачиваться, коагулироваться, сгущаться, свёртываться;

cohesive - когезивный, связывающий, обладающий сцеплением;

compressive stress – сжимающее напряжение, напряжение при сжатии;

condition(s) – условия;

consider – рассматривать;

detention time – время удержания; продолжительность пребывания воды на очистном сооружении;

device – устройство;

efficiency – эффективность;

enhance – увеличивать, усиливать, благоприятствовать, наращивать;

escape *v* – выпускать, утекать;

flocculate – образовывать комочки, выпадать в осадок, осаждаться хлопьями;

fluid – жидкость;

floc (flocs) – куча, хлопья;

force *n* – мощь, сила, принуждение, вмешательство;

gravitational settling - гравитационное осаждение; осаждение частиц силой тяжести;

grit chamber – гравиеуловитель, отстойник для песка;

interface – поверхность раздела, граница между разделами, стыковка, контактная поверхность;

occur - случаться. происходить;

primary settling tank – первичный отстойник;

proper performance – надлежащее выполнение;

provide – обеспечивать;

refer to as - именовать, называть,

secondary settling tank – вторичный отстойник; бак конечной ступени очистителя;

sedimentation basin – бассейн-отстойник, пруд-отстойник;

settling rate – скорость оседания частиц;

settling tank - отстойник;

softening – смягчение, смягчающий;

support *n, v* –поддержка, поддерживать;

velocity – скорость;

vessel – сосуд, камера.

X. Read and translate the text:

Sedimentation, Thickening and Flotation

Sedimentation is the removal of solid particles from a suspension by gravitational settling. Sedimentation basins are often referred to as either clarifiers or thickeners. If the main purpose of the operation is to produce an effluent stream with low suspended solids, the vessel is usually called a clarifier. If the major concern is the production of a concentrated suspension, the vessel is normally called a thickener. The terms clarifier and thickener are often used interchangeably in describing settling tanks for effluent streams from activated sludge reactors. Since both clarification and thickening occur in any sedimentation basin, both functions should be considered in the design.

In water treatment plants, sedimentation is used to remove readily settleable particles, flocculated or coagulated impurities, and precipitated impurities from softening operations. In wastewater treatment plants, sedimentation is applied to a variety of organic and inorganic solids from raw or treated wastes. Primary settling tanks are used to remove solids from the waste stream entering the plant. Secondary settling tanks handle the solids in the effluent from a biological reactor. Proper design of the secondary settling tank is especially critical in conventional waste treatment plants. The performance of a biological reactor depends upon the concentration of active biological solids in the reactor. Most of these solids are usually provided by recycle underflow from the sedimentation vessel. A recycle stream with a high concentration of settled solids enhances the efficiency of the reactor.

Classifications of settling

The settling characteristics of suspended particles depend upon the nature of the particles, their concentration, and the conditions in the settling device. Settling behavior is often classified into four separate categories. In class 1 clarification, the suspension is dilute and the particles have little or no tendency to adhere upon collision. Each discrete particle has a constant settling rate that is independent of the other particles. A grit chamber for heavy granular materials may approach this type of clarification. In class 2 clarification, the suspension is again dilute but some of the particles coalesce or flocculate during the settling period. Since the larger particles formed

by agglomeration have higher settling velocities, the rate of settling changes with time. The wastes entering primary settling basins frequently exhibit class 2 behavior.

With cohesive particles at higher solids concentration, class 3 settling is observed in which the suspension settles as a mass with a distinct interface between sludge and clarified liquor. Forces between particles are sufficiently strong to maintain roughly the same relative position of particles as they settle. Since the particles in the structure have little tendency to move past one another, a clear line of demarcation is established between solids and clear fluid. Secondary settling tanks usually operate in this zone settling regime. In practice, some solids always escape in the clarified effluent because of hydrodynamic factors.

As the floc structure builds up from the bottom of the vessel, each layer of solids provides a degree of mechanical support to the layers above. Since the weight of the solids is no longer supported by hydraulic forces alone, the solids are objected to a compressive stress which compacts the floc structure. When the floc provides support, it is in a compression regime (class 4). The solids concentration in the compression zone is related to the sludge depth and solids detention time in this zone.

Lesson 7

SLUDGE TREATMENT PROCESSES

I. **Translate the pairs of words, paying special attention to the prefixes with *negative meaning:***

a) adequate – inadequate;
direct – indirect;
correct – incorrect;
dependent – independent;
effective – ineffective;
efficient – inefficient;

b) proper – improper;
purity – impurity;

c) rational – irrational;

d) continue – discontinue;
charge – discharge;
equilibrium – disequilibrium;
infection – disinfection;

e) biodegradable – nonbiodegradable;
decomposable – nondecomposable;

polluting – nonpolluting;

settling – nonsettling;

regenerability – nonregenerability;

f) diluted – undiluted;

favorable – unfavorable;

usual – unusual;

treated – untreated;

common – uncommon;

finished – unfinished;

acceptable – unacceptable.

II. Translate the words having the same root. Pay attention to the suffixes, prefixes and other determiners:

soft – softly –soften – softening – softener –when softening – will be softened;

thick – thicken – thickening – thickness – thickened;

enhance – enhancement – enhanced –while enhancing;

settle – settlement – settleability – while settling – settleable - -settler – settled residue;

incinerate – incineration – incinerator – incinerated;

accumulate – accumulation – accumulator – while accumulating;

purify – purification – purifier – purity –impurities – pure – when purifying – by purifying;

availability – available – unavailable – be available;

common – commonly – uncommon – uncommonly;

suit - suitability – suitable – suitably – unsuitable – unsuited;

vary – variety – variation – various – variable – invariable – variability – invariability;

to use – the use – useful – useless – misuse – usable – using the substance – used – unused.

III. Form "attribute chains" instead of word combinations with the preposition "of" and translate them.

Model: Selection of treatment process – treatment process selection:

the nature of the sludge, the sequence of operations, the field of mass transfer, the principles of mass transfer, significant quantity of sludge, selection of a treatment sequence, the rate of dewatering, the water content of sludges, the length of the reactor, point of influent at the beginning of the tank.

IV. Find the pairs of words with similar meaning:

apply; remove;

concern v; velocity;
vary; process;
significant; use;
sequence; operate;
reduction; worry;
rate; unpleasant;
ultimate; approximately;
dispose; important;
run; selection;
roughly; decrease;
alternative; change;
offensive; final.

V. Translate the following word combinations:

a) anaerobic
anaerobic sludge digestion
bacterial
thermophilic

b) dry
low-temperature
sludge processing
waste
wet

c) feasible plan
reaction
situation
for cultivation

d) land
wastewater
final
radioactive waste disposal
underground
refuse (отбросы, отходы)
ocean

e) carry out an experiment, a trial
a plan

		a job
		a promise (обещание)
f)	acceptable	time
		conditions of work
		offer (предложение)
		plan
g)	ultimate	selection
		result
		offer
		purpose
		decision (решение)
		treatment

VI. Mind the translation of "unlike" - в отличие от. Translate:

unlike many other trials;
the previous available data;
the traditional approach to treating these gases;
thermal incineration of air contaminants (загрязняющие вещества в атмосфере);
from kraft mills (сульфатный целлюлозный завод).

Unlike oxygen, hydrogen peroxide is also effective in enhancing the second extraction stage.

Unlike thermal incineration of TRS (total reduced sulfur) in kraft mills, the chemical oxidation is the cheaper option, since a plastic scrubber (скруббер, газоочиститель) is less expensive than the equipment of any incineration option.

VII. Mind the translation of "in terms of" - с точки зрения, исходя из, в виде, через, в единицах, в значениях:

1. These catalysts tend to be highly specific in terms of both the reactions they catalyze and the physical conditions under which they operate effectively.
2. The result of washing (промывка) was dirtier pulp in terms of sodium, COD, and TOC.
3. The comparisons between these schemes were done in terms of inorganic recovery.
4. The remaining chromophores become increasingly resistant to peroxide in terms of their reactivity and accessibility.
5. These best performing mills in terms of BOD_5 and TSS (tertiary suspended solids – взвешенные вещества в стоках после глубокой доочистки) respectively, do not use chemically assisted clarification.

6. The document focuses on magnesium sulphite pulping (варка) because of its importance in terms of capacity and numbers of mills running in Europe.
7. An example of the raw (необработанные) data, in terms of dissolved oxygen as a function of time, is shown in Fig.1.
8. In addition, the objective of bleaching, in terms of target brightness (плановая белизна), cleanliness and strength differ among products and mills.
9. The supplier recommended specific operating conditions in terms of pH, residence time, temperature, and application rate.
10. The ecological plans offer the best way to manage their forests in terms of both timber (лесоматериал) production and conservation.
11. Stated in terms of mass, 1 kg of calcium hydroxide can remove 1.73 kg of sulphur dioxide.
12. One conclusion to be drawn is that the amount of AOX in terms of the consumption of elemental chlorine, varies between 11 and 13 %.
13. The comparisons between these schemes were done in terms of inorganic recovery.
14. In terms of annual operating costs (эксплуатационные затраты), chemical oxidation is shown to be more cost-efficient in this case.

VIII. Define the determiners of Subjunctive Mood and translate them:

1. An increase of this magnitude would have been noticed.
2. If the sludge were degraded to soluble BOD and released as such, then the increase in effluent BOD would also have been significant.
3. The enhancement (повышение) might be attributed to the presence of the hemicellulase (полуцеллюлаза) in the enzyme preparation.
4. However, if the conventional chemical control were used for comparison, the enzyme trials would be less toxic than the conventional trial, as we have observed previously.
5. This provision (положение) could be applied to sources adjacent to (находящийся рядом с) international boundary (граница) or it could be applied to sources that contribute to global air pollution.
6. It would not be economically feasible to install such a tertiary treatment process for removal of COD.
7. Although it is theoretically possible to have a ratio less than one, such a ratio would indicate a high conversion of BOD to biomass instead of to CO_2.
8. Should a low-cost material be available, adsorption could become a very attractive option for odor control.

9. Lignin cannot be the principal component involved in the degradation, otherwise the bleached (отбеленный) and brown fibers would have behaved differently.
10. It is not possible to predict what guidelines will be derived but subjects (темы) which could be dealt with include conservation of rare species, preservation of unique ecosystems, the size of clean-cuts (вырубка сплошной рубкой (леса)), etc.
11. The nanotechnology approach to water purification could help prevent many diseases and poisoning for millions of people.
12. A higher pH would remove hydrogen sulphide but carbon dioxide would be absorbed which would quickly neutralize the alkali.
13. Increased recycling of paper and paperboard in Canada could help displace the amount of waste paper (макулатура) which is imported into Canada for recycling purposes.
14. The other quick alternative would be expensive equipment addition.

IX. Find in the text and translate:

a) three adjectives in comparative degree;
b) three adjectives in superlative degree;
c) three sentences with infinitive of purpose;
d) two sentences with the verb in subjunctive mood;
e) two sentences with present participle as adverbial modifier.

X. Words and word combinations to be remembered:

acceptable - приемлемый;
according to - в соответствии с;
anaerobic digestion - анаэробное дигерирование, анаэробное сбраживание;
ash - зола, шлак;
average - средний;
carry out – проводить;
charge *n, v* - нагрузка; нагружать;
conditioning - доведение до необходимого состояния;
consideration - рассмотрение, обсуждение;
degradability - способность к химическому или биологическому разложению;
digestion - гниение, сбраживание осадка сточных вод в анаэробных условиях;
dispose - обезвреживать, удалять;
dry *a, v* - сухой; сушить, обезвоживать;
drying - обезвоживание, засушивание;
feasible - осуществимый, экономически выгодный;

feed *n* – подача;

improve - улучшать, совершенствовать;

in terms of - в условиях, в соответствии с;

influent - втекающий, входящий (поток);

land disposal - захоронение отходов в землю;

loading – нагрузка;

offensive - неприятный, агрессивный;

pathogen - патогенный фактор, болезнетворный микроорганизм или вещество;

processing – обработка;

sand bed - песчаное дно, русло;

sequence – последовательность;

sludge drying - обезвоживание осадка;

step aeration - многоступенчатая аэрация;

transfer *n* - передача;

transfer *v* - передавать, переносить;

ultimate – конечный;

uniform - единообразный, единый;

unlike - в отличие от;

water disposal - удаление воды.

XI. Read and translate the text:

Sludge Treatment Processes

Since direct land or water disposal of raw wastewater sludges is rarely feasible or acceptable, sludge treatment is usually necessary to reduce its volume and to make it less offensive. The most common sludge processing methods have been grouped in several categories according to function and the categories are presented in the usual sequence found in treatment plants.

Selection of treatment processes for sludges depends upon the nature of the sludge, environmental factors, and ultimate disposal options. The various alternatives should be examined to select the most economical sequence of operations for a given location. The major processes are concentration, stabilization, conditioning, and dewatering.

Aeration and mass transfer

Mass transfer is an important consideration in many wastewater treatment systems. In order to carry out chemical or biological reactions, it is necessary to transfer substances into or out of the wastewater, as well as to move them adequately within the water to control concentration differences. The material transferred can be as diverse as gases, liquids, ions,

charged colloids, or suspended solids. However, the rate at which these substances are transferred is the important consideration and is the primary concern of the field of mass transfer. The principles of mass transfer do not vary with each treatment process.

Sludge disposal

Wastewater treatment processes generate significant quantities of sludge from suspended solids in the feed biomass generated by biological operations and precipitates from added chemicals. Selection of a treatment sequence for sludges depends upon the nature of the sludge, environmental factors, and ultimate disposal options.

Concentration operations, such as gravity or flotation thickeners, increase the solids concentration and achieve a significant reduction in sludge volume. Stabilization operations, such as anaerobic digestion, convert sludges into a less offensive form in terms of odor, degradability, and pathogen content.

Sludge conditioning by chemicals or heat improves rates of dewatering. In dewatering operations, the water content of sludges is reduced to a level where they can be handled as damp solids. Vacuum filtration centrifugation and sand beds are the most common dewatering methods. Thermal processes, such as heat drying and incineration, are used to either dry the sludge or to oxidize its organic content. Residual sludge and ash from sludge treatment processes must be disposed of in the ocean or on land. Some of the options for ultimate disposal on land are landfill, land reclamation, and crop fertilization.

Step aeration

Unlike the conventional plant, the step aeration system introduces the feed wastewater at several points along the aeration tank. This feed method, which might be more properly called step loading, keeps the process loading factor U, and the oxygen demand in the tank more uniform than the conventional process. Step aeration plants are usually designed for the same solids loadings but higher volumetric loadings than the conventional plant, because of the increased biological efficiency made possible by a more uniform waste concentration.

In the conventional process the solids concentration is nearly constant along the length of the reactor. In the step aeration process, it decreases sharply after each point of influent. Assume for example that a step aeration plant is running with a recycle solids concentration of 10,000 mg/l, a return sludge rate R, equal to 25 %, and influent feed locations at the beginning of the tank and at the middle. The solids concentration in the first half of the tank would be 3333 mg/l while in the second half it would be 2000 mg/l, giving an average tank concentration of 2667 mg/l. Although the average solids concentration in the reactor is higher, the effluent solids concentration is the same as the conventional system allowing the conventional final clarifiers to be used.

Lesson 8

CONCLUSIONS AND RECOMMENDATIONS

I. Read and translate the following international words paying special attention to the pronunciation:

population *n*, degradation *n*,
microbial *a*, biodegradation *n*,
aromatic hydrocarbon *n*, catalyze *v*,
alcohol *n*, adsorption *n*,
anionic *a*, energy *n*,
molecule *n*, molecular *a*,
protein *n*, catalytic *a*,
metabolic *a*, control *n, v*,
physical *a*, maximize *v*,
carbohydrate *n*, mechanism *n*,
adsorb *v*, cation *n*,
nitrite *n*, nitrate *n*,
nitrogen *n*, phosphate *n*,
toxic *a*, biotic *a.*

II. Read and translate the following "false friends" using the dictionary. Try to remember their meaning:

typically, formulate.

III. Name the verbs from which the following nouns were formed. Translate all the words:

degradation, population, mixture, reaction, processing, modification, operation, description, stabilization, inhibition, information, application, coagulation, alteration, equalization, movement, filtration, extraction, decomposition, addition, digestion, composting, destruction, recommendation.

IV. Pronounce the following verbs, paying attention to the suffixes. Translate the verbs:

optimize, minimize, catalize, modify, stabilize, formulate, incorporate, precipitate, activate, acclimatize, equalize.

V. Find in the text the words with similar meaning:

a) mixture;
condition;
influence *v;*

(e)special;

Normally;

form *v;*

requirement;

depend on;

change *v;*

b) carry out;

increase *v;*

incorporate;

necessary;

very small amount;

use *n;*

acclimatize;

usable;

demand *v;*

c) suppose;

can;

sufficient;

economical;

goal;

appropriate;

performance;

support, help *v;*

installation;

d) conventional;

be known for;

because;

take place;

take part;

obtain, get;

have a tendency;

use *v;*

accomplish;

velocity.

VI. Match the words with opposite meaning:

increase *v;*	more;
simple;	solid;
organics;	completely;
include;	decrease;
less;	macro-;
partially;	complex;
slowly;	effluent;
liquid;	high;
influent;	short;
long;	exclude;
micro-;	inorganics;
low;	fast.

VII. Translate the following word combinations:

1) common
   depleted
   exotic
   protected
   rare species
   out-of-danger
   wildlife
   restored
2) aquatic
   human
   natural habitat
   wildlife
3) water
   ecological
   gaseous
   suspended state
   wet
   steady
   state of environment
   rest
   health

	sanitary state of	forest
		soil
		water
4)	waste water	
	weather	
	sanitary	
	favorable	
	habitat	conditions
	living	
	adverse	
	ambient	
	discharge	
	under certain	difficult, favorable … conditions
5)	avoid	danger
		fires
		accidents
		oil spill
		flooding
		catching cold
6)	high	
	low	
	permissible	salinity
	soil	
	water	

VIII. Translate the word combinations with modal verbs:

may	
might	
can	
could	
must	
should	
have to	vary (perform, formulate, incorporate)
had to	
are to	
were to	

will have to

is able to

were able to

are unable to

IX. Translate the following word combinations with verbs in passive voice:

the organic compounds are decomposed, natural degradation is enhanced, simple and complex organics can be decomposed, concentrations should be kept low, activity is not inhibited, trace concentrations of inorganics may be removed, anionic species…are not affected by biological treatment, enzyme treatment is included in the list, enzymes are normally formulated from…, the enzymes are used apart from the cells from which they are derived, the systems are affected by physical factors of habitat…, metals are absorbed, …may be treated, can be converted to…, phosphorus can be concentrated, suspended solids are precipitated, filtration is used, the treatment is applied.

X. Find in the text and translate:

a) three sentences with gerund;
b) six sentences with infinitive of purpose;
c) two sentences with the construction “there be”;
d) two sentences with verbs in subjunctive mood;
e) one sentence with “these” which is used instead of a noun.

XI. Words and word combinations to be remembered. You should remember that one can memorize the words only while reading and translating the text several times:

accomplish - выполнять, завершать;

add – добавлять;

addition - добавка, дополнение;

aerated lagoon - аэрируемый накопитель;

alteration - изменение, перестройка;

alternative *n* - альтернативный, другой возможный, запасной;

amenable - пригодный, поддающийся, склонный к;

applicable – применимый;

appropriate - соответствующий, надлежащий;

aqueous - водяной, водосодержащий;

be able to – способный;

(cation) exchange - катионный обмен;

cell - ячейка, отсек на мусорной свалке;

chain – цепь;

coating - слой, покрытие, нанесение покрытия;

conclusion – вывод;

cost-effective - рентабельный, малозатратный, экономичный;

decomposition - распад, разложение;

destroy – разрушать;

enhance - увеличивать, улучшать, совершенствовать;

ensure гарантировать, обеспечивать, ручаться;

enzymatic - энзимный, ферментативный;

enzyme - энзим;

equalization - уравнивание, компенсация;

essential - существенный, жизненно важный;

habitat - естественная среда, зона обитания;

inhibition - торможение, ингибирование, угнетение, замедление;

lime – известь;

movement – движение;

net negative charge - чистый отрицательный заряд;

preliminary (treatment) - предварительная (обработка);

release *v* - выпускать, освобождать;

residual *n, a* - остаток, остаточный;

residuals - остаточные примеси (продукты);

salinity - минерализация воды; засоленность почвы, солёность;

sedimentation vessel - отстойный резервуар;

solution - раствор;

solvent - растворяющий;

species – виды;

steady - стабильный, постоянный;

trace *n* – след;

waste stabilization pond - стабилизационный пруд (для очистки сточных вод).

XII. Read and translate the text:

Conclusions and Recommendations

Biological treatment processes involve placing a waste stream in contact with a mixture of microorganisms, so that the organic compounds in the waste stream are decomposed. Typically the microorganisms used in the process are present in the influent waste stream. The process optimizes the microbial environment, so that natural degradation in enhanced. Methods

for optimizing biological degradation include controlling the dissolved oxygen level, adding nutrients, increasing the concentration of microorganisms, and slowly increasing influent waste concentrations so that an acclaimed microbial population develops within the process.

Biological treatment is applicable to aqueous streams with organic contaminants. The organics may be either solvent or solid in the influent waste stream to be amenable to biodegradation. Water is essential in the waste stream. The microorganisms rely on enzymes require water to remain active. In aerobic biological treatment processes, both simple and complex organics can eventually be decomposed to carbon to carbon dioxide and water. Oxygen is essential to the decomposition of long chain and aromatic hydrocarbons. In anaerobic biological treatment processes, only simple organics such as carbohydrates, proteins, alcohols, and acids can be decomposed.

Biological treatment processes do not alter or destroy inorganics. In fact, concentrations of soluble inorganics should be kept low so that enzymatic activity is not inhibited. Trace concentrations of inorganics may be partially removed from the liquid waste stream during the biological treatment because of adsorption onto the microbial cell coating. Typically microorganisms have a net negative charge and are therefore able to perform cation exchange with metal ions in solution. Anionic species, such as chlorides and sulfates, are not affected by biological treatment.

With a property acclimatized microbial population and adequate equalization preliminary treatment to ensure a uniform hydraulic flow and organic concentration, biological treatment is applicable to industrial wastes. For the treatment of organics in an aqueous medium, it is probably the most cost-effective treatment. Energy and chemical demands are low compared to other processes; however, land requirements are greater. As might be expected, biological treatment processes increase their energy demand as specific modifications require less land.

Biological waste treatment processes

The purpose of biological waste treatment is to convert complex molecules into simple products and biomass by using a mixture of microorganisms. Since successful waste treatment depends upon suitable biological activity, it is necessary to operate the system to encourage microbial activity, it is necessary to operate the system to encourage microbial growth. Although the physical units containing the microorganisms may vary widely, there are several common parameters which have been used in their design and operation.

Process description:

There are several biological treatment processes, the most well-known are the following:

Enzyme treatment

Activated sludge

Trickling filter

Aerated lagoon

Waste stabilization pond anaerobic digestion, and composting

All of the above treatment processes, except enzyme treatment, depend on the natural functions of living microorganisms. Enzyme treatment is included in the list because enzymes are normally formulated from living cells. In the strict sense, however, they are chemical compounds whose molecule consists of specific proteins. Enzymes are noted for their catalytic behavior. Since microorganisms are essentially "bags of enzymes", enzymes participate in all metabolic processes, enhancing and controlling the course of these processes. Enzyme treatment, however, stands alone: the enzymes are used apart from the cells from which they are derived.

Because the biological systems (excluding enzyme treatment) listed above contain living organisms, they require specific ratios of carbon, macro-nutrients and micro-nutrients. Water is a necessary component of all living organisms and must, therefore, be a vital part of the biological waste treatment systems. The systems are affected by physical factors of habitat, temperature, light and movement; by chemical factors of pH, oxygen, salinity and metals: and by biotic factors involving the mix and interrelations of the organisms present. In summary, the microorganisms thrive best in a steady state of environmental conditions that ensures their growth and maximizes the biological decomposition of wastes. Alterations to their environment can occur, but these must occur at such a rate that organisms are allowed to acclimate.

Peculiarities of biological treatment

Biological treatment is applicable to aqueous waste streams with organic contaminants. Aerobic biological treatment systems can destroy all types of organics, while anaerobic biological treatment can perform only on simple organics such as carbohydrates, proteins, alcohols, and acids. Destruction of long chain and aromatic hydrocarbons requires incorporating molecular oxygen into the organic compound, and anaerobic organisms do not have the appropriate enzymes or environment to accomplish this oxidation mechanism.

Biological treatment does not decompose metal compounds. To some degree, metals are adsorbed onto the microbial population. Since the microorganisms tend to have a net negative charge, they provide cation exchange capacity for trace amounts of certain metal species. However, the concentration of soluble metals must remain low (generally less than a few milligrams per liter) to avoid inhibition of microbial growth.

Certain inorganic compounds may be treated using microorganisms, although the information on application is limited. Ammonia can be converted to nitrite and nitrate, and then to nitrogen gas through a controlled sequence of aerobic and anaerobic biological treatment

steps. Phosphorus can be concentrated in microorganisms under aerobic conditions, then released under anaerobic conditions.

Physical-chemical treatment

Physical-chemical treatment processes are alternatives to the biological processes. In a physical-chemical plant, the main processes are chemical coagulation, carbon adsorption and filtration. Suspended solids and phosphates are precipitated together in a sedimentation vessel after addition of suitable chemicals, such as alum, ferric chloride, or lime. Adsorption on granular activated carbon extracts the remaining soluble organics and filtration is used to remove residual suspended solids. The granular carbon column may serve the dual function of adsorbing organics and filtering out solids.

Physical-chemical treatment is usually applied to wastes containing toxic or non-biodegradable compounds that are not amenable to biological processes.

Notes:

stand alone – отличаться;

ferric chloride – хлорид железа;

granular carbon column – колонна, заполненная гранулированным углем.

Unit 2

WATER POLLUTION ABATEMENT

Lesson 1

Introduction

I. Translate the "false friends": fibre, legal.

II. Pronounce and translate the following pairs of nouns and verbs.

Note that nouns are pronounced with the stress on the first syllable while verbs have the stress on the second syllable.

Nouns:	*Verbs:*
transfer;	transfer;
project;	project;
impact;	impact;
subject;	subject;
import;	import;
permit;	permit.

III. Name the verbs from which the following nouns and adjectives were formed. Use the dictionary and translate all the words:

abatement, generation, consideration, operation, inhabitant, implementation, detrimental, beneficial, utilization, foaming, deposition, population, troublesome, definition.

IV. Translate the following adjectives with the prefix *non-:*

nonpolluting, nonerodable, nonresistant, nontoxic, nonsettling, nonbiodegradable.

V. Translate the following word combinations:

a) flood
   smoke
   noise — abatement
   pollution
   water pollution

b) detrimental to — health
   nature
   aquatic life
   wildlife

c) the origin of — species
   the world
   life
   noise

d) future
   older
   new — generation
   the postwar

e) impair — the environment
   the water potability
   the water quality
   the conditions
   one's health

f) deposition of — silt
   sediments

VI. Find the pairs of words having similar meaning:

goal;	harmful;
frequently;	determine;
implement;	through;
conserve;	useful;
define;	influence;
detrimental;	aim;
beneficial;	state *n;*
due to;	carry out;
impact;	preserve;
condition;	often.

VII. Translate the sentences paying attention to the verb "be':

a) An important consideration of modern pulp and paper mill design and operation is to minimize losses.

b) The goal is to preserve environmental quality…

VIII. Translate:

must be	treated
	preserved
	assessed
	removed
	defined
can't be	reduced
	determined
	impaired
	accepted

IX. Select any nouns that can be used with the following adjectives and translate

Model: a troublesome situation – ситуация, вызывающая беспокойство:

detrimental;

beneficial;

capital-intensive;

expensive;

significant;

specific;

troublesome.

X. Name the above-mentioned adjectives in the comparative and superlative degree.

XI. Words and word combinations to be remembered. Transcribe them before pronouncing. Try to learn the words while reading and translating the text several times:

abatement - борьба с загрязнением;

accept - принимать;

beneficial - благоприятный, полезный;

benefit, *n, v* - преимущество, польза, приносить пользу, извлечь пользу, помочь;

capital-intensive - капиталоёмкий, фондоёмкий;

consideration - рассмотрение, обсуждение;

customer - получатель, покупатель, заказчик;

define – определять;

definition – определение;

deposition - осаждение, оседание частиц, покрытие;

detrimental - вредоносный, разрушительный;

domestic sewage - коммунально-бытовые сточные воды;

foaming - вспенивание;

for the benefit of - в пользу чего-либо, кого-либо;

generation - производство, генерация;

impact *v*, - влиять, воздействовать;

impair - ослаблять, умалять, ухудшать;

implementation - воплощение, реализация, внедрение;

inhabitant – обитатель;

loss, impact *n* - потеря, ущерб, урон; воздействие, влияние;

pollution abatement - борьба с загрязнением;

preserve - предохранять, сохранять, оберегать, хранить;

significance - значимость, значении;

viability - живучесть, жизненность, целесообразность;

water potability - пригодность воды для питья.

XII. Read and translate the text:

Water pollution abatement

1. Introduction

An important consideration of modern pulp and paper mill design and operation is to minimize losses from the process and to treat mill effluents so that their impact on the

environment is minimal and essentially non-polluting. The goal is to preserve environmental quality for the benefit of present inhabitants and future generations. The implementation of pollution abatement programs within the pulp and paper industry is generally capital-intensive and causes significant operating costs. The incremental cost attributed to pollution abatement is now accepted as a cost of operation and is usually passed along to the customer in the form of higher-priced products. While abatement programs are expensive, the typical mill enjoys some benefits of reduced raw material usage and better overall energy utilization.

Definition of pollution

Water pollution can best be defined as a change in the condition of water which is detrimental to some beneficial use. In any situation, the beneficial uses of the water and the conditions affecting these uses must first be determined. Then, the significance of any changes (i.e., degree of pollution) can be assessed.

In human terms, the highest water use is for drinking purposes. Pollution from domestic sewage will impair water potability due to bacterial infection. Substances of industrial origin may adversely affect the taste and odor of drinking water. Other problems such as foaming, radio-activity, toxic substances, or heavy metal ion contamination have been encountered in specific situations.

Fish habitats are most often affected by a reduction of dissolved oxygen or by toxic substances in the water. Deposition of solid particles can also affect the viability of fish populations.

Water utilization for industrial purposes depends on the specific requirements. Some industries need high quality water relatively free of suspended solids, organic substances, or high concentrations of inorganic salts. Although incoming raw water is frequently treated to remove suspended material, other types of pollution may be more troublesome. For example, dissolved organic substances (especially colored compounds) can adversely affect a wide range of industrial uses.

Lesson 2

CHARACTERISTICS OF RECEIVING WATERS

I. Read and translate the following international words paying special attention to the pronunciation:

assimilate *v*, assimilation *n*,
period *n*, photosynthesis *n*,
tannin *n*, lignin *n*.

II. Read and translate the "false friends" consulting the dictionary. Try to remember their meaning:

characteristic n, principal(ly), agitation, degrade, structure.

III. Find in the text the words with opposite meaning:

a) slow(ly), simple, fresh water

b) dissimilation, undetectable, inability, incomplete.

IV. Match the words with similar meaning:

take place;	assimilation;
generally;	define;
uptake *n;*	necessary;
attribute *n;*	commonly;
specify;	occur;
essential;	characteristic.

V. Name the verbs from which the following nouns and adjectives were formed and translate all the words:

detectable, floatable, population, survival, assimilation, action, agitation, saturation, absorption, decomposition, biodegradable.

VI. Form adjectives of the following adverbs and translate them:

slowly, rapidly, virtually, ultimately, generally, relatively.

VII. Translate the "attribute chains":

effluent discharge, nutrient concentration, surface agitation, surface water, waste assimilation, air/water interface, mill effluents, lignin derivatives.

VIII. Pay attention to different meanings of:

the number of – 1) число, количество 2) номер;

a number of – ряд, некоторое количество.

Models: 1) the number of the sentence – номер предложения;

2) the number of substances – количество веществ;

3) a number of equations – ряд уравнений;

Translate:

a) the number of compounds
derivatives
suspended solids
characteristics
complex structures
attributes

b) a number of compounds

derivatives
suspended solids
characteristics
complex structures
attributes
methods

IX. Try to remember the meaning of "*with respect to*" - в отношении, что касается. Translate:

1. With respect to surface area, the AST systems are smaller.
2. The evaluation (анализ, оценка) was undertaken with respect to ten mutually (взаимно) independent criteria.
3. Much interest is focused on methods that improve the situation with respect to COD.
4. The new challenge (первоочередная задача) is to make recycled fiber interchangeable with respect to product quality and economics.
5. The comments on the efficiency of the different components of a waste incineration plant (мусоросжигательная установка или завод) indicated already the high standards with respect to minimizing any impact to the environment.

X. Revise the English tenses. Analyse the tenses in Active and Passive Voice and translate:

a) saturation
- rises;
- rose;
- will rise;
- has risen;
- is rising;
- was rising;

b) …sugars and alcohols
- are consumed rapidly;
- will be consumed…
- are being consumed…
- have been consumed…
- had been consumed…
- were being consumed.

c) is
was

were

has been responsible for

have been

will be

The resin (смоляные) acids are responsible for a large part of the softwood pulping (варка хвойной древесины) effluent toxicity to aquatic organisms.

XI. Use the tenses given in brackets and translate the following sentences:

1. Each molecule of sugar required six molecules of oxygen (Present Simple, Present Perfect).
2. Pollution will impair water potability (Present Simple, Past Simple).
3. The level of dissolved oxygen represents the equilibrium… (Past Simple, Future Simple).
4. Natural waters become deficient in dissolved oxygen (Past Simple, Present Perfect).
5. The ability of water to dissolve the oxygen was affected by salinity (Present Simple, Present Perfect).
6. Fish habitats are affected by a reduction of dissolved oxygen (Past Somple, Future Simple).

XII. Translate the following sentences and word combinations paying special attention to the underlined words.

a. *The further* the concentration is away from saturation, *the higher* is the driving force for absorption…
b. *More complex* structures
c. Organic suspended solids are *slow to degrade*
d. *No* change in these characteristics will be detectable
e. The oxygen demand of organic waste *while being assimilated…*
f. All naturally - *occurring* organic materials.

XIII. What words of the same root do you know:

a) in English b) in Russian

saline, detectable, productivity, inversely, deficient, initial, respiration, equilibrium, generation, intensive, deposition.

XIV. Words and word combinations to be remembered:

(become, be) deficient - (становиться, быть) несовершенным, дефектным;

(oxygen) uptake - потребление, поглощение (кислорода);

a number of - несколько, некоторое количество;

ability – способность;

agitation - смятение, беспокойство, побуждение;

ambient - относящийся к окружающей среде, внешний, наружный;

be responsible for - быть ответственным за;

breakdown - поломка, перебои в работе;

characteristic *n* - характеристика, свойство, параметр;

detectable - обнаружимый, различимый, определяемый;

driving force - движущая сила;

equilibrium - равновесие, устойчивость, сбалансированность;

estuary - устье реки, морской рукав;

floatable solids - плавучие твердые вещества;

foam – пена;

foul-smelling - зловонный, дурно пахнущий;

fungus-fungi - грибок, грибки;

initial – первоначальный;

ppm - мг/м^3;

productivity – производительность;

respiration - дыхание;

saline - соляной солевой;

saturation - насыщение, газирование;

smell – запах;

specify - обуславливать, детализировать, предусматривать;

survival – выживание;

troublesome - причиняющий затруднения;

waste assimilation - ассимиляция отходов;

with respect to - что касается, в отношении к.

XV. Read and translate the text:

Characteristics of Receiving Waters

The major characterizing of a typical receiving water (e.g., river, lake, estuary, etc.) are listed in Table 1. It is commonly specified that little or no change in these characteristics will be detectable as a result of effluent discharges.

Table 1. Characteristics of Receiving Waters.

- dissolved oxygen
- pH
- toxicity

- suspended solids
- temperature
- floatable solids
- foam
- taste
- odor
- nutrient concentration
- productivity (population of microorganisms)

Dissolved oxygen is essential to the survival of fish and all other useful organisms in the water, including those responsible for waste assimilation. When natural waters become seriously deficient in dissolved oxygen, their ability to support life is impaired and they can become foul-smelling due to the action of anaerobic organisms.

Under conditions of ambient pressure and temperature of 20°C, natural waters can contain up to 8.9 ppm of dissolved oxygen. The ability of water to dissolve oxygen is inversely related to temperature, (as illustrated in Table 2) and is also affected by salinity, with less oxygen uptake as salinity rises. Oxygen enters solution in water principally through the air/water interface; the rate of transfer depends on such factors as surface agitation and initial oxygen concentration. The further the concentration is away from saturation, the higher is the driving force for absorption.

Table 2. Concentration of dissolved oxygen in water at saturation as a function of temperature (for fresh water and moderately saline water).

Temperature, °C	Oxygen concentration, ppm	
	Fresh Water	Saline Water
0	14.6	13.8
5	12.8	12.1
10	11.3	10.7
15	10.2	9.7
20	9.2	8.7
25	8.4	8.0
30	7.6	7.3

The level of dissolved oxygen in water at any time represents the equilibrium between a number of factors, such as absorption, respiration, photosynthesis, and decomposition of organic compounds. The oxygen demand of organic waste while being “assimilated” by bacteria and fungi is of primary concern with respect to the discharge of mill effluents into receiving waters.

Virtually all naturally occurring organic materials are “biodegradable” by organisms which occur in surface waters. Ultimately, these compounds will be reduced to carbon dioxide and water. The chemical equation for the biological breakdown of a “simple compound” like sugar shows that each molecule of sugar requires six molecules of oxygen for its complete assimilation:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$$

Biological assimilation takes place over a period of days and weeks, the rate of which is primarily dependent on the nature of the waste, the water temperature, and the concentration of oxygen. Relatively simple, soluble compounds such as sugars and alcohols are consumed quite rapidly, while more complex structures such as tannin and lignin derivatives are broken down very slowly. Generally, organic suspended solids are relatively slow to degrade.

Lesson 3

MEASUREMENT OF POLLUTION

Types of Treatment-Overview

I. Read and translate the following international words, paying attention to the pronunciation:

category *n;*
toxicity *n;*
accumulation *n;*
methane *n;*
incubation *n;*
identify *v;*
chlorinated phenolics *n;*
lethal *a;*
mutagenic *a;*
carcinogenic *a.*

II. Translate the “false friends”:

focus (on) n, resin acid, dramatic a, effect n.

III. Pronounce the following verbs with the suffixes: -ate, -(i)fy, -ize. Translate them:

estimate, regulate, eliminate, chlorinate, facilitate, identify, accumulate, contaminate, utilize, illustrate, assimilate, specify, segregate.

IV. Name the verbs from which the following nouns were formed and translate all these words. Consult the dictionary:

measurement, penetration, accumulation, concentration, indication, reproduction, elimination, removal, limitation, difference, depletion, oxidation, application, action, aeration, survival, coagulations, reduction.

V. Form adjectives from the following adverbs and translate these pairs of words:

generally, fortunately, weakly, usually, essentially, sufficiently, especially, rapidly, appropriately, normally, traditionally, dramatically, universally.

VI. Translate the following "attribute chains":

effluent solids, abatement efforts, mill wastes, dilution factor, light penetration, plant growth, gill tissue (of fish), bottom accumulation, life forms, end product, effluent stream, oxygen concentration, oxygen depletion, oxygen balance, BOD data, pulp and paper mill effluents, survival rate, time period, toxicity testing, fiber retention, in-plant utilization, raw material cost, in-plant losses, treatment step, treatment requirements, clarification stage, effluent color.

VII. Match the words with similar meaning:

a) abatement; perform;
normally; expensive;
demand *n* ; enough;
essentially; use;
sufficiently evaluate;
estimate; reduction;
apply; as;
costly; preserve;
since; result;
retain; generally;
carry out; requirement;
effect *n;* mainly;

b) stress *v;* decrease;
application; component;
eliminate; remove;
constituent; single;
reduce; before;
dramatically; influence;
prior to; stage;
the only; emphasize;

objectionable; greatly;

step; utilization;

impact *n;* undesirable.

VIII. Find in the text the words with opposite meaning: strong(ly), toxic, slow(ly), saturated.

IX. Translate the word combinations:

most efforts, most mill wastes, much more, most effluents, lower cost, the most effective, most of the BOD and color, the most dramatic in-plant reduction in BOD discharge, most widely used tests, to be much more concerned with.

X. Translate paying attention to the word "following":

following biological treatment, a sample following incubation, a stage following secondary treatment, recycle of this water following screening (скрининг, улавливание загрязнений на решетках), and clarification.

XI. Translate the following sentence and explain what grammar difficulties it contains:

If properly carried out, the five-day BOD test gives a good indication of the effect an effluent is likely to have on the oxygen balance of any natural receiving water.

XII. Explain the functions of the infinitive in the following sentences and translate them.

a) Light penetration is affected sufficiently to have an impact on plant growth.
b) Knowledge of the behavior of the receiving water is necessary to predict the impact of the effluent.
c) The single most effective way for reducing in-plant losses has been to recycle and reuse mill process waters.
d) External treatment is usually by means of sedimentation to remove suspended solids and biological oxidation to remove BOD.
e) The classical method is to determine oxygen concentration.

XIII. Find in the text and translate:

a) a sentence with an absolute participle construction;
b) two sentences with gerund.

XIV. Revise the material referring to complex sentences. Pay special attention to the sentences in which the words "that" or "which" are omitted. What are the determiners showing the end of one clause and the beginning of the next one? When translating into Russian, use the Russian equivalents for the omitted words.

Model: Further investigation showed | bacterial growth was causing slime formation in many lines – Дальнейшие исследования показали, *что* рост бактерий вызывает образование ила (грязи) в трубопроводе.

Translate:

1. We suppose the sludge reduction observed in the field occurs from initial degradation of the fibrous sludge into smaller fragments that are slowly mineralized.
2. This chemical difference could account for (объяснять) the role magnesium plays in such coagulation processes.
3. Some industry authorities say unique new effluent treatment techniques (метод, методика) have to be developed in combination with maximum wastewater reuse programs.
4. These results indicate pH adjustment (регулирование) of E-stage effluents is unnecessary and should be avoided to prevent precipitation (осаждение) of chlorolignin.
5. An important problem to be considered in effecting any change in a manufacturing system is the impact this change will have on product characteristics.
6. Current trends indicate this goal will be met.
7. Results showed increased ink (типографская краска) removal is achieved at low level of a commercially available enzyme preparation in a combination with a surfactant (ПАВ).
8. This means the air-liquid mixture has to reverse direction.
9. The way we view (рассматривать, оценивать) environmental problems and our level of accountability (ответственность) has changed dramatically in recent years.
10. Every form of energy we use has an environmental impact that must be assessed in some detail.
11. The first parameter we studied was the charge of hydrogen peroxide.
12. This proves there was no permanent adsorption on the membrane surface.

XV. Words and word combinations to be remembered:

accumulation - накопление, аккумуляция;

appropriate - подходящий, соответствующий;

be affected - (если после него нет дополнения) подвергаться влиянию, воздействию, измениться;

bioassay - биологическая проба, биоанализ;

bubble – пузырь;

buildup - наслоение, построение, увеличение;

constituent - составной, существенный, составная часть;

costly - дорогостоящий, затратный;

dilution - разжижение, разбавление;

dilution factor - коэффициент разбавления;

duplicate sample двойная выборка;

effect *n* - результат, влияние, воздействие;

exceed - превышать, превосходить;

external – внешний;

facilitate - способствовать, облегчить, содействовать;

focus *v* - сконцентрировать усилия;

identify - устанавливать, идентифицировать, опознавать;

initial sample - исходная проба, исходный образец;

lethal - летальный, смертоносный;

measurement – измерение;

objectionable - нежелательный, бракованный;

oxygen depletion - кислородное обеднение, кислородное истощение;

penetration - проникновение, внедрение;

pollution load - концентрация загрязнений, уровень загрязнений;

predict - предвидеть, предсказать;

raw material - сырьё, сырой материал;

reproduction – воспроизводство, размножение;

survival rate - коэффициент выживаемости;

retain - удерживать;

stagnant - застойный;

stress v – напрягать, нагнетать, стресс (сущ.);

(the) oxygen demand - Потребность в кислороде;

(un)saturated – (не)насыщенный;

weak(ly) – слабый (слабо).

XVI. Read and translate the texts:

Measurement of pollution

The major categories of water pollution which are of concern to the pulp and paper industry are solids, oxygen demand, toxicity and color. Most abatement efforts generally focus on the removal of solids and oxygen demand. Fortunately, most mill wastes are only weakly toxic, and are usually essentially non-toxic following conventional biological treatment. Color is

of critical concern only when the dilution factor in the receiving water is low and light penetration is affected, thereby having an impact on plant growth in the water system.

Settleable organic solids are especially objectionable in natural waters because of their tendency to settle out in stagnant areas. These accumulations of organic material rapidly become depleted in oxygen, and the aerobic organisms die off. Anaerobic bacteria take over and continue biological action; however, the end products are now methane and hydrogen sulfide which are released into the atmosphere as bubbles of gas.

The oxygen demand of an effluent stream may be measured or estimated by a number of methods. The most widely used test is the five-day Biochemical Oxygen Demand (BOD_5), in which a sample of effluent is allowed to consume oxygen by the action of microorganisms. The classical method is to determine oxygen concentration on both an initial sample and on a duplicate sample following incubation at 20° C over a period of five days, the difference in oxygen concentration being taken as the BOD. Since the initial sample can only retain about 9 ppm of oxygen, the effluent must be appropriately diluted so that oxygen depletion during the test does not exceed much more than 7 ppm (i.e., about 70-75 % depletion).

Biochemical oxidation is a slow process, and complete breakdown may take up to 100 days. However, for most effluents, it has been shown that 60 to 70 % of the oxidation takes place in the first five days. If properly carried out, the five-day BOD test gives a good indication of the effect an effluent is likely to have on the oxygen balance of any natural receiving water. However, it must be stressed that the application of BOD data is not simple, and knowledge of the behavior of the receiving (e.g., temperature or degree of natural aeration) is necessary to predict the impact of the effluent.

Severe toxicity is normally not a problem for pulp and paper mill effluents. However, a number of pulp effluent constituents have been identified as toxic (e.g., resin acids, unsaturated fatty acids, chlorinated phenolics) and periodic testing is required to ensure that the treated effluent meets minimum requirements prior to discharge. For this purpose, bioassays are commonly performed where fingerling fish (or other suitable aquatic animals) are exposed to a known concentration of effluent and the survival rate is measured after a specified time period (usually 96 hours).

The main limitation with conventional toxicity testing is that only acute lethal effects are found. Sub-lethal cumulative effects over long periods on growth and reproduction are usually not considered, nor are the potential mutagenic/carcinogenic properties. It now appears that governmental regulations are much more concerned with sub-lethal effects, and future emphasis will be on the removal of specific contaminants.

Types of Treatment-Overview

The most effective means of reducing and controlling mill discharges is better in-plant utilization of raw materials. Fiber, soda, and dissolved lignin are contaminants in the effluent, but these constituents also represent a costly loss to the mill. Therefore, all actions taken to "tighten up" the process will have the dual benefits of more efficient utilization and reduced pollution load.

Perhaps the most effective way to reduce losses is greater reuse or recycling of mill process water. In recent years, there has been a dramatic reduction in the amount of water consumed by pulp and paper mills. Although this trend will continue, there are usually practical limitations on the degree of "closure" caused by buildups of temperature and impurities. In addition to reducing the quantity of contaminants, a reduced volume of effluent also facilitates subsequent external treatment steps.

External treatment is usually by means of sedimentation to remove suspended solids ("primary treatment") and biological oxidation to remove BOD ("secondary treatment"). Prior to leaving the mill, the various effluent streams are segregated according to treatment requirements. Some effluents need only primary treatment; others require only secondary treatment, while a few streams must have both primary and secondary treatment before discharge.

Any treatment beyond primary and secondary treatment is usually termed "tertiary treatment". Sometimes a clarification stage following secondary treatment is called a tertiary stage, but this terminology is not universally applied. Perhaps the only valid tertiary treatment now being undertaken in a few mills is for the removal of effluent color.

Lesson 4

ENVIRONMENTAL MONITORING

I. Write out from the text the international words.

II. Read and translate the following "false friends". Consult the dictionary. Try to remember their meaning:

data, examine, examination, accurate, selection, department, individual a, accuracy.

III. Translate the word combinations paying attention to the degrees of comparison:

more obvious – the most obvious – much more obvious; more accurate – the most accurate – most accurate – much more accurate – less accurate – the least accurate; more complete – the most complete – much more complete – less complete

more significant – less significant – the least significant – the most significant – most significant – much more significant.

IV. Translate the "attribute chains":

a mill environmental monitoring program, performance check, treatment stages, process control, data collection effort, flow measurement, sampling program, sewer flow, mill site, effluent concentration, the inlet loading of suspended solids.

V. Translate the following words having the same root, but first state the part of speech of the words by their suffixes and other determiners:

to vary – variability – variable – variation – variety – various;

fluctuate – fluctuation – fluctuating prices;

to locate – location – local (library);

sensitivity – to sense – sensitive – insensitive;

install a sampler – gas cleaning installation – by installing a heating system – the installed; heating system – they installed;

saturate – saturation – saturated steam – unsaturated;

analyze – analysis; analyses were – analytical – analyser – analytic chemistry;

include in the program – were included – including the new installation;

air sample – have to sample – sampler – river sampling;

accurate data – accurately – accuracy – inaccurate;

will affect – the result was affected – the temperature affected the result – unaffected;

examine the benefits – examination of Baikal Lake water – examiner – by examining – the results being examined;

can rely on – reliability – reliable man;

assess the local situation – assessment- when assessing the damage;

binary number – decimal numeral – numerous installations – number the pages of the article;

represent our country at the conference – a representative of our country – a representative species of;

the works of art from the Russian Museum – artificial satellite.

VI. In what meaning is the word *"one"* used in the sentence:

"…while the least accurate part and the one most frequently ignored is the sampling?" **Translate the sentence.**

VII. Translate the combinations with Participle I and Participle II:

1) the data collected;
2) the information required for…;
3) the corresponding levels following treatment;
4) field studies involving sampling…;
5) a grid of sampling stations radiating from… .

VIII. Find in the text and translate:

1) two sentences with gerund;
2) one sentence with an absolute participle construction;
3) one sentence with subjective infinitive construction (complex subject).

IX. Words and word combinations to be remembered:

accuracy – точность;

accurate – точный;

artificial – искусственный;

assess - оценивать;

assessment - оценка;

check *n, v* - проверка, проверять;

downstream – вниз по течению, выходной поток, переработка и сбыт;

effort - усилие;

field studies – полевые исследования;

fluctuation - колебание, уклонение;

grid (of sampling stations) - ;

individual - индивидуальный, отдельный ;

inlet - вход;

installation - установка;

involve – вовлекать, включать;

locate - разместить;

location - расположение;

marine *a* - морской*;*

neglect - пренебрегать;

numerous - многочисленный;

point *n* - точка*;*

reliability - надежность;

representative (sample) - репрезентативный образец;

sampler - пробоотборник;

sampling - выборка;

sampling device - пробоотборное устройство;

sensitivity - чувствительность;

sewer - сточная труба;

short-term - короткий срок;

site - сайт;

tolerance - толерантность;

treatment facilities - очистные сооружения;

unaffected (area) - без изменений (площадь);

upstream - против течения;

value - значение;

variability - изменчивость;

various - различный;

vary, variety - различаться, разнообразие.

X. Read and translate the text:

Environmental Monitoring

Compliance with government standards is the most obvious and immediate priority of a mill environmental monitoring program. Other purposes include performance checks of the various treatment stages, determining the impact of effluent discharge on the receiving water, and gathering information for process control. Monitoring usually includes the entire data collection effort, with sampling, flow measurement, testing and analyses.

The most accurate part of any monitoring operation is usually the analytical laboratory, while the least accurate part (and the one most frequently neglected) is the sampling. In general, the ability of a sampling device to collect a representative sample from a waste stream should be carefully assessed. The amount of variability obtained between samplers and sampling methods has been shown to vary up to 30 % depending on the fluctuations in concentration and flow. Attention to proper selection and installation of the sampler, and careful planning of the sampling program will significantly increase the reliability and accuracy of the data collected.

The minimum information required for mill effluents includes water usage in each department, individual sewer flows, and analysis of each sewer effluent for suspended solids, dissolved solids, BOD, pH, and toxic effects. For the treatment facilities, it is necessary to know the inlet loading of suspended solids and BOD, and the corresponding values following treatment. And, of course, the combined effluent at the point of discharge must be carefully monitored with respect to all relevant properties.

The effect of the mill effluent on the receiving water must be determined by field studies involving sampling near the point of discharge and at various locations distant from the mill site. In a lake or marine situation, a grid of sampling stations is established radiating from the effluent discharge points, with control stations are located at intervals downstream from the mill with control areas upstream from the mill site.

Although conventional testing (i.e. solids, BOD, toxicity) is usually carried out on receiving water samples, these chemical methods provide only transitory, short-term data. To acquire knowledge of long-term effects, biological monitoring is necessary. Examination of a representative aquatic community provides an accurate assessment of the quality of the environment and the effects due to mill effluents.

Biological monitoring can be accomplished in a variety of ways. In one method, artificial substrates are placed along the bottom of a river bed or water body in several locations, dictated by changes in habitat or effluent concentration. In unpolluted waters, these substrates will become quickly populated by numerous benthic organisms (i.e. bottom-dwelling invertebrates). In the presence of toxic substances, species are progressively eliminated in relation to their sensitivity or tolerance to the pollutants. By examining the communities present on various substrates, a biologist can monitor changes in the environment and assess effects on the entire water body.

Lesson 5

PRIMARY TREATMENT

I. Translate the following "false friends" and try to remember their meaning:

accompany *v*, objective *n*, principal *a*.

II. Find in the text the words having similar meaning:

use *n*, stage *n*, main, goal, eliminate, utilize.

III. Translate the following word combinations:

1) the maintenance of
   - the equipment;
   - the treatment facilities;
   - numerous installations;
2) principal
   - objective;
   - achievement;
   - examination of…;
3) sludge
   wastewater
   large suspended particles
   - screening;
4) according to the
   - latest data;
   - accurate assessment;
   - acquired information;
   - results of feed studies;
5) means
   - of reducing the plugging action of mill solid waste;

of improving clarifier efficiency;
to get maximum results from a flotation unit;
to better understand this phenomenon;

What do you think is the principal means to acquire deep knowledge of a foreign language?

6) relatively insensitive;
accurate;
complete;
efficient;
inexpensive;

7) preliminary treatment;
conclusion;
examination;
calculation;
usage.

I. Don't confuse the words *later* and *(the) latter:*

Later – позже, (the) latter – последний (из упомянутых выше).

Model: 1. This process will be considered *later* – Этот процесс будет рассмотрен позже.

2. The efficiency of a treatment depends primarily on the biological activity. *The latter* measures itself by many variables of which the most important are the following. – Эффективность очистки в основном зависит от биологической активности. Последняя (т.е. биологическая) активность определяется многими переменными величинами, из которых самыми важными являются следующие.

Translate:

1. They consist mainly of compounds containing sulphur, e.g. sulphur dioxide and malodorous (зловонный) reduced sulphur compounds such as methyl mercaptan, dimethyl sulphide and hydrogen sulphide. The latter compounds are commonly referred to as total reduced sulphur (TRS) (общая восстановленная сера).
2. The latter is particularly important because the AST (activated sludge treatment) system is more prone (подверженный) to spill (разлив) upsets thus requiring stricter internal and external mill control.
3. For the compound examined in this study, the latter drawback (недостаток) is only significant for chloroform.
4. The latter usually strongly depend on the local conditions.

5. However, during the course of our investigation it was found out that the manufacture of the latter model was discontinued.
6. The latter organism is widely used in a standard test.
7. Figure 5 illustrates the BOD discharges from bleached kraft (беленая крафт-целлюлоза) mills in North America and the Nordic (скандинавские) countries. Since BOD in the latter is measured over a seven-day period, the discharges from these countries have been multiplied by a factor of 0.85 to enable a comparison (сравнение).

II. Words and word combinations to be remembered:

(in)sensitive - (не)чувствительный;

(the) latter - последний;

accompany - сопровождать;

according to - в соответствии с;

blinding – ослепление, затемнение, закупорка;

dissolved-air flotation - флотация растворенного воздуха;

employ - использовать;

gravity sedimentation - гравитационная седиментация;

maintenance - поддержка;

objective *n* - цель;

plugging - закупоривание;

preliminary - предварительный;

primary treatment –первичная обработка;

principal – важный, главный;

relative(ly) - относительный (но);

return *n,v* - возврат, возвращать;

screening - сортировка;

secondary treatment - вторичная обработка;

sedimentation - осаждение;

settling - оседание;

usage - использование.

III. While reading and translating the text try to find the answers the following questions:

1. What is primary treatment used for?
2. What is solids removal accompanied by in the Pulp and Paper industry?
3. By what process must these latter pollutants be reduced?
4. Does biological treatment differ from secondary one?

5. What is screening used for?
6. Why isn't complete removal of suspended solids practical?
7. What are the two principal methods for clarifying effluent in the Pulp and Paper industry?
8. What are the advantages of sedimentation or gravity settling?
9. What is the disadvantage of flotation processes?
10. What processes are more efficient?

IV. Read and translate the texts:

Text 1

Primary treatment

Primary treatment refers to any means of removing suspended solids from mill effluents. In the Pulp and Paper Industry, solids removal is always accompanied by some reduction in BOD and toxicity; but these latter pollutants usually must be further reduced by biological treatment (i.e., secondary treatment).

Screening is often used as a preliminary step to remove relatively large floating or suspended particles. Sometimes, the objective is to salvage fiber from selected effluents for return to the process, at the same time reducing the loading to the main clarification stage. Complete removal of suspended solids is not practical because of the blinding or plugging action of most pulp and paper mill solid waste.

The two principal methods employed in the Pulp and Paper Industry for clarifying effluent are gravity sedimentation and dissolved-air flotation. Sedimentation or gravity settling is by far the most common process used because it is relatively insensitive to variations in flow and solids concentration and requires little attention and maintenance. Flotation processes are generally more efficient in removal of solids, but are more expensive to operate.

Text 2

Sedimentation

I. Revise the international words, paying special attention to their pronunciation:

period, mechanically, center, function, functional, zone, concentrate, diameter, minimum, recommend, base v, experimental, factor, optimize, standard, theory, coagulant, flocculant, flocculation tube, hydraulic, convection.

II. While translating the text pay attention to the "false friends":

press *n, v*, typical, tank, actual, operation, principle.

III. Name the verbs from which the following nouns and adjectives were formed. Translate all the words:

clarifier, settleable, characteristic, disposal, incineration, operation, action, loading, experimental, coagulant, flocculant, increase, removal.

IV. Translate the following verbs:

utilize, thicken, press, dispose, divide, stress, perform, recommend, base, add, achieve, install, eliminate, provide, mount, pump, pass, incinerate, clarify.

V. Revise the forms and functions of Participle I and Participle II and translate:

a) Participle I as an attribute:

utilizing, thickening, pressing, disposing, dividing, stressing, performing, recommending, basing, adding, achieving, installing, eliminating, providing, mounting, pumping, passing, incinerating, clarifying

b) translate the same participles as adverbial modifiers;

c) translate Participle II as an attribute:

utilized, thickened, pressed, disposed, divided, stressed, performed, recommended, based, added, achieved, installed, eliminated, provided, mounted, pumped, passed, incinerated, clarified.

VI. Read and translate the text:

Sedimentation

Sedimentation can be carried out in any holding pond or impounding chamber that provides sufficient retention for settling. More often, circular, mechanically cleaned clarifiers are used. In all cases, the sedimentation unit must provide a sufficient period of quiescent flow to enable the specified percentage of settleable solids to drop to the bottom. In the mechanically cleaned units, the solids are generally raked toward a center sump, utilizing a center-mounted sludge scraper. Depending on the characteristics of the solids, the underflow may be pumped anywhere between 1.5 and 6 % solids. The solids are then thickened and sometimes pressed before disposal by incineration or landfill.

Clarifiers can be divided into four functional zones with respect to design and operation.

It must be stressed that a gravity clarifier performs two functions: it clarifies the liquid passing through it, and it concentrates the solids. The clarifying action is primarily a function of clarifier diameter; surface loadings of 800 to 1000 gal/day/ft² are typical. The thickening action is more a function of clarifier depth; a minimum depth of 11 ft. is generally recommended for clarifiers ranging from 30 to 65 ft. diameter, while a minimum depth of 15 ft. is recommended for tanks over 200 ft. A floor slope toward the center of 1 to 12 is usually used to help move the sludge to the sump.

The design of a clarifier cannot be based on theoretical principles alone. Actual experimental data on settling rates are necessary. Nonetheless, some understanding of the factors that affect settling can help to optimize the operation of a clarifier. According to standard theory, settling is primarily affected by particle density, particle shape and particle size. Therefore, where required, coagulants or flocculants may be added to the influent stream to increase particle size and thereby increase the rate of settling. Since nonsettleable solids can also be made settleable through flocculation, much higher efficiencies of suspended solids removal are possible.

Improved clarifier efficiency or increased capacity can also be achieved by means of inclined tubes installed in the settling zone. These auxiliary devices serve to effectively increase the hydraulic path at the same time that convection currents are virtually eliminated.

VII. Choose the Russian equivalents for the English words:

a)	1) operation	эффективность, КПД;
	2) quiescent flow	глубина;
	3) sump	илоскреб;
	4) efficiency	осаждающиеся вещества;
	5) sludge scraper	конвективный поток;
	6) depth	любой отстойный пруд;
	7) tank	проектирование;
	8) convection current	работа, действие;
	9) settleable solids	скорость осаждения;
	10) any holding pond	резервуар, емкость;
	11) rate of settling	поток в спокойном состоянии;
	12) design	поглощающий (отстойный) колодец;
b)	1) surface load(ing)	удержание;
	2) density	сжигание;
	3) landfill	сточная вода, поступающая на очистку;
	4) capacity	наклон;
	5) inflow	осветлитель, очиститель;
	6) shape	размер;
	7) slope	нагрузка на единицу площади;
	8) clarifier	производительность, мощность;
	9) sedimentation	форма;
	10) incineration	плотность;
	11) retention	осаждение, отстаивание;

12) size — захоронение отходов;

c) 1) by means of — главным образом;
2) generally — в зависимости от;
3) according to — что касается;
4) depending on — фактически;
5) with respect to — так как;
6) primarily — обычно;
7) since — при помощи;
8) virtually — согласно (чему-либо).

V. Give English equivalents for the Russian words:

последний (из вышеназванных);
предварительный;
возвращение (возвращаться);
сопровождать;
относительно (сравнительно);
согласно (чему-либо);
плавающий (на поверхности);
главный/основной (2 words);
гравитационное осаждение;
содержание (уход);
(не)чувствительный;
самый распространенный процесс;
флотация растворенным воздухом;
процеживание через решетку (сито);
закупоривание (2 words);
внимание;
любое средство (способ);
более эффективный.

VI. Words and word combinations to be memorized:

capacity - мощность;
case – кожух, дело, случай;
clarifier; clarify – очиститель, осветлитель, очищать, осветлять;
coagulant - коагулянт;
convection current - конвекционный ток;
depth - глубина;

design –конструкция, разработка, дизайн;

efficiency - эффективность;

eliminate – устранять, ликвидировать;

enable - давать возможность;

flocculant - флокулянт;

holding pond –удерживающий пруд;

incline – наклон, изгиб;

impounding chamber - ;

improve - улучшать;

incineration - сжигание;

install - устанавливать;

landfill *n* - свалки;

pass *v* - проходить*;*

press - нажимать;

pump *n,v* - насос, на(вы)качивать;

quiescent flow - медленный, стоящий поток;

rake *v* - сгрести, выгребать*;*

range *v* -классифицировать*;*

retention - удержание;

settleable solids - твердые вещества, способные осаждаться;

settling rate – скорость оседания;

shape – форма, формировать;

slope - склон;

sludge scraper - илоскреб;

sump - отстойник;

surface load(ing) - поверхностная нагрузка;

tank - бак ;

thicken – thickening - сгустить – сгущать .

VII. Look through the text once more and answer the questions:

1. Where can sedimentation be carried out?
2. What is necessary for any holding pond to carry out sedimentation?
3. What type of clarifier is more often used?
4. Why must a sedimentation unit provide a sufficient period of quiescent flow?
5. Where are the solids raked to in the mechanically cleaned units?
6. What is used for this purpose?

7. What takes place with the solids before disposal by incineration or landfill?
8. How many functional zones are there in a clarifier?
9. What are the functions of a gravity clarifier?
10. What does the clarifying action of a clarifier depend on?
11. What are typical parameters?
12. What does the thickening action depend on?
13. What is a floor slope toward the center used for?
14. What is actually necessary for the design of a clarifier?
15. What is settling primarily affected by?
16. What is the objective of adding coagulants or flocculants to the influent stream?
17. In what way can nonsettleable solids be made settleable?
18. How can improved clarifier efficiency be achieved?
19. What is the function of inclined tubes?

Text 3

Flotation clarifiers

I. Words and word combinations to be memorized:

along with - вместе с;

alum - квасцы;

attach (to) - прикрепить (к);

compact *v* – уплотнять, прессовать, сжимать*;*

dissolved air flotation - флотация растворенного воздуха;

entrap - поймать в ловушку;

except - кроме;

exert (force, influence, pressure …) - приложить (усилие, влияние, давление …);

fine air bubbles - тонкие воздушные пузыри;

floating layer - плавающий слой;

flocculant aid – флоккулирующее средство, коагулирующее вещество;

flotation clarifier - флотационный осветлитель;

flotation unit - флотационная установка;

power – электроэнергия, , мощность, сила;

pressurized - герметичный;

release *v* – выпускать, высвобождать*;*

space - пространство;

unit - блок.

II. Read and translate the text:

Flotation clarifiers

Dissolved air flotation is a solids removal process that attaches fine air bubbles to the suspended solids, thereby reducing the density of individual particles and causing them to float to the surface. The separated solids then form a floating layer that is a mixture of solids and air bubbles. The buoyant force exerted by the entrapped air also acts to compact the solids into a smaller volume before the floating layer is skimmed off.

Air is usually introduced to the inflowing effluent in a pressurized mixing chamber. When the effluent enters the nonpressurized flotation unit, the supersaturated solution releases the air in the force of very fine air bubbles which then become attached to the suspended particles. To get maximum results from a flotation unit, a flocculant aid such as alum must be added along with the air. Flotation methods can achieve very high rates of suspended solids removal (i.e., up to 98 %). However, the relatively high operating costs (for compressor power and flocculating chemicals) have mitigated against wide utilization of flotation clarification except where space is limited. The most common application is for use as a white water save all.

III. Translate word combinations with participles:

1) the process removing solids,
2) fine air bubbles attached to the suspended solids,
3) the process attaching fine air bubbles to the suspended solids,
4) thereby reducing the density and causing them to float to the surface,
5) the reduced density of individual particles,
6) the separated solids,
7) a floating layer,
8) the force exerted by the entrapped air,
9) the force …acting to compact the solids into a smaller volume,
10) the solids compacted into a smaller volume,
11) mixed solids and air bubbles,
12) the floating layer skimmed off,
13) the air introduced to the inflowing effluent,
14) the effluent entering the flotation unit,
15) the air released by the supersaturated solution,
16) a flocculant aid added along with the air,
17) adding alum to get maximum results,
18) flotation methods achieving very high rates of suspended solids removal,

19) very high rates achieved by means of flotation methods,
20) limited space,
21) limiting the space,
22) separating the solids,
23) achieving very high rates of suspended solids removal by flotation methods.

Lesson 6

SECONDARY TREATMENT

I. Transcribe the international words and memorize their pronunciation:

A. bacteria, sanitary (waste), methane, ammonia, bioconversion, carbon dioxide, phase, endogenous;
B. approximately, aerator, diffuser, type, typical, tolerant;
C. microbial, suspension, character;
D. contact *n*, porous.

II. Pay attention to the following "false friends" while reading the text:

portion, balance, technique, medium, passage, alternatively, (in) series.

III. Pronounce the following verbs paying attention to the suffixes:

utilize, mitigate, stimulate, cultivate, *but exception*! – solubilize.

IV. Name adjectives from which the following adverbs were formed and translate all the words:

rarely, frequently, essentially, generally, specially, finally, rapidly, typically, approximately, relatively, usually, normally, carefully, primarily, eventually, closely, alternatively.

V. Translate the "attribute chains":

nature's own purification process, rapid growth phase, cell mass, food supply, substantial BOD reduction, 90% BOD removal, aeration action, load variations, the activated sludge system, high floc density, activated sludge process, space limitation, nutrient requirements, outflow water, a mill shut down, the manpower requirements, the skill requirements, cell tissue, clarification step, effluent variability, rotary disc design.

VI. Fill in the blanks with the correct preposition and translate:

1) … aerobic conditions, micro-organisms consume oxygen to convert wastes … carbon dioxide and water;
2) Secondary treatment is carried out ….accelerated rates;
3) to prevent anaerobic conditions … developing;
4) a closed space devoid … molecular oxygen;
5) reduced forms such … methane, ammonia and hydrogen sulfide;

6) the high sulfur content … pulp mill wastes;
7) anaerobic biological oxidation can be accomplished … various means;
8) a process used … the treatment … sanitary waste;
9) the area available … external treatment;
10) each method depends … sustaining a viable population … adapted microorganisms;
11) a large portion … the soluble BOD;
12) Bioconversion is capable … converting 30 to 70% of the BOD … insoluble material;
13) … the declining growth phase, the rate … bioconversion shows down;
14) extended treatments remove BOD …more complete oxidation;
15) Aside …higher capital and operating costs the process has a number of disadvantages.

VII. Define the function of the infinitive and translate:

1) Microorganisms consume oxygen to convert wastes into end products.
2) Sufficient aeration and mixing are provided to prevent anaerobic conditions from developing.
3) The cell mass first undergoes auto-oxidation to stay alive.
4) … effluent to be treated
5) These systems have proven to be noncompetitive with respect to BOD removal.
6) An area of biological growth is alternatively submerged to absorb food.
7) A certain portion of the sludge solids is usually recirculated to provide a high floc density.

VIII. When reading and translating the text "Secondary treatment", be ready to answer the questions preceding each part of the text. Pay attention to the words and word combinations to be memorized. Words and word combinations to be memorized:

A

accelerate - ускоряться;
adapt - адаптировать;
anaerobic digestion - анаэробное сбраживание;
at rate – при скорости, по ставкам ;
auto-oxidation – само (авто)окисление ;
balance *n* – баланс, равновесие*;*
be capable of + *Gerund* - быть способным + *герундий;*
byproduct - побочный продукт;
devoid of - лишенный;
end product - конечный продукт;

fungi *pl* - грибки*;*

portion - доля;

prevent from - предотвратить от;

purification - очистка;

sanitary waste - бытовые отходы;

slow down - замедлиться;

sustain – поддерживать, подкреплять, выдерживать;

viable population - жизнеспособная популяция;

B

aeration lagoon – пруд-отстойник, аэрационная лагуна;

aerator - аэратор ;

diffuse - распылять;

diffuser - диффузор;

maintain - поддерживать;

oxidation lagoon –биологический пруд;

residual *a* - остаточный*;*

retention time - время удержания ;

shallow (basin) - мелкий (бассейн);

skill – умение, навык;

solubilize – растворять, разбавлять;

tolerant – способный выдержать, терпимый;

C

advantage - преимущество;

aerated chamber - аэрированная камера;

aside from - помимо;

disadvantage - недостаток;

ensure - обеспечивать;

feed *v* - подавать*;*

manpower – кадры, человеческие ресурсы, сотрудники;

mixing chamber - смесительная камера;

multiply - умножать;

separation - разделение;

shutdown – выключение, приостановление работ;

suspension - раствор;

D

(in)stability – (не) устойчивость;

(non)competitive - неконкурентный;

alternatively - альтернативно;

bed – слой, залежи ;

biological filter system - биологическая система фильтра;

in series - последовательно;

medium - средний;

promising - многообещающий;

rotary disk - вращающийся диск;

rotate shaft - вращать вал;

submerge – погружать в воду, затоплять;

technique – метод, технология;

tissue - ткань.

IX. Answer the following questions:

A

1. What is secondary or biological treatment?
2. What is its difference from nature's own purification?
3. Under what conditions do micro-organisms consume oxygen?
4. What is this consumption of oxygen needed for?
5. Why are sufficient aeration and mixing necessary?
6. Do anaerobic digestion frequently used in the Pulp and Paper industry?Why?
7. What does the way of accomplishing aerobic biological oxidation depend on?
8. What should be done to sustain a viable population of specially adapted microorganisms?
9. What is a large proportion of soluble BOD converted to? Give some details.
10. How is BOD removed?

B

1. What is the simplest form of aerobic treatment?
2. What does this system use?
3. What are advantages and disadvantages of this system?
4. What retention time is required for 85-90 % BOD removal?
5. What about the area of a lagoon to treat each million gallons of effluent per day?
6. What equipment does an aeration lagoon utilize?
7. What else can you say about aeration lagoons?

8. How can you compare the area required for an aeration lagoon with that of an oxidation lagoon?
9. Where and why is the aeration lagoon the preferred method of biological oxidation?
10. What can you say about capital and operating costs as far as an aeration lagoon concerns?

C

1. Why is the activated sludge system considered to be the most popular high rate method of treatment?
2. What are the disadvantages of this method?
3. In what case is it mostly utilized?
4. Why is adequate planning necessary in case of a mill shutdown?

D

1. What is a biological filter system needed for?
2. What is the mechanism of the conventional trickling filter operation in this system?
3. Have numerous modifications of the biological filter system been competitive with respect to BOD removal over the past 20 years?
4. What design of the biological filter system has been successful?
5. How does this new system function? You may give the description of the process in Russian.

X. Read and translate the text:

Secondary treatment

Secondary or biological treatment is nothing more than a duplication of nature's own purification process except that it is carried out under contained and controlled conditions, and usually at accelerated rates.

Under aerobic conditions, micro-organisms (mostly bacteria and fungi) consume oxygen to convert wastes into the ultimate end products of carbon dioxide and water. An important consideration of most biological processes is that sufficient aeration and mixing are provided to prevent anaerobic conditions from developing. (*Anaerobic digestion* is a process frequently used for the treatment of sanitary waste, but is rarely used in the Pulp and Paper Industry. Anaerobic organisms utilize chemically bound oxygen in a closed space essentially devoid of molecular oxygen. The end products of anaerobic treatment are reduced forms such as methane, ammonia, and hydrogen sulfide. The high sulfur content of pulp mill wastes mitigates against anaerobic treatment.)

Aerobic biological oxidation can be accomplished by various means, depending on the characteristics of the effluent, the area available for external treatment, and the required degree of BOD removal. Each method depends on sustaining a viable population of specially adapted

microorganisms. In most cases, it is necessary to add nutrient chemicals (nitrogen and phosphorous) to stimulate metabolic activity.

During the rapid growth phase, a large portion of the soluble BOD is converted to "biomass" (i.e., to micro-organisms and their metabolic byproducts.) "Bioconversion" is capable of converting 30 to 70 % of the BOD into insoluble material, depending on the respiration of the particular micro-organisms present. The balance of BOD is converted to carbon dioxide and water. In the declining growth phase, the rate of bioconversion slows down. In the endogenous phase, the cell mass first undergoes auto-oxidation to stay alive. Finally, as the food supply is rapidly depleted, the organisms feed on themselves; this is the phase of most complete oxidation where biological solids are at a minimum. Generally, "high rate" biological processes remove BOD utilizing bioconversion and subsequent removal of biomass. Extended treatments remove BOD by more complete oxidation.

The simplest form of aerobic treatment is the *oxidation lagoon,* which depends on natural means to diffuse air into the effluent. This system used shallow basins that cover very large areas. If depth exceeds 3 to 4 ft., anaerobic micro-organisms will become active in the lowest levels. Substantial BOD reductions are achieved by this method with little operating skill or attention required, but long retention times are necessary and few mills can afford to utilize such large areas of land. Typically, a 30-day retention is required for 85 to 90 % BOD removal. Approximately 20 acres of lagoon must be used for each million gallons per day of effluent to be treated.

The aeration lagoon utilizes continuous aerators or diffusors of various types to solubilize large amounts of oxygen into the effluent. Since a significant concentration of oxygen is maintained in the effluent (at least 0.5 ppm), the biological activity is relatively high, and retention times of 3 to 5 days are typical. Since the aeration action provides continuous mixing, the depth of the lagoon can also be increased to 25 ft. or more. Therefore, the area required for an aeration lagoon is far less than for a simple oxidation lagoon.

Where space is available, the aeration lagoon is the preferred method of biological oxidation because it is tolerant of load variations and usually produces a low level of residual biological floc. Capital and operating costs are generally about one half that required for the activated sludge system.

The activated sludge system is the most popular high rate method of treatment. The essential feature is the development of a microbial floc held in suspension in an aeration or mixing chamber. As waste is fed to this chamber, the activated sludge solids multiply as the waste is metabolized. Following a prescribed retention time (usually 3 to 8 h.), the effluent from the sludge unit is drawn off to a clarification unit for separation of solids from waste water. A

certain portion of the sludge solids is usually recirculated to provide a high floc density, while the remainder is concentrated and disposed of by landfill or incineration.

Aside from higher capital and operating costs, the activated sludge process has a number of disadvantages, and is normally utilized only when space limitations dictate. The process is very sensitive to changes in the character of the waste and pH must be carefully controlled. The nutrient requirements are higher, and settling aids are usually required for proper clarification of the outflow water before discharge. If a mill shutdown is necessary, there must be adequate planning for feeding the system during curtailment to ensure a healthy population of organisms upon resuming operations. In general, the manpower requirements of the activated sludge system are relatively high, as are the skill requirements for operation.

Another type of high rate treatment is provided by a *biological filter system.* Biological filtration is a technique for promoting contact between a free-flowing liquid waste and a stationary growth of micro-organisms in the presence of atmospheric air. The system does not depend on filtering in the usual sense for its effect.

In the conventional trickling filter, the micro-organisms are cultivated on such porous media as crushed rock or plastic modules. The effluent is trickled down through the bed and passes over the layer of micro-organisms (zoogloeal film) that has formed on the filter medium. The entire system is maintained in an aerobic condition by free passage of air through the unit. The micro-organisms consume the organic constituents of the effluent, primarily for the production of new cell tissues (biomass). Eventually, the cell tissue is sloughed off and is carried with the outgoing flow into a subsequent clarification step.

A number of modifications of the trickling filter have been developed and applied to pulp and paper mill wastes over the past twenty years. Generally, these systems have proven to be noncompetitive with respect to BOD removal, and have exhibited even greater instability to effluent variability than activated sludge systems.

However, the more recent *rotary disc* design of biological filter systems has been successful on a number of effluents, and appears promising with respect to future applications. In this system a series of closely spaced corrugated plastic discs are anchored to a rotating shaft and supported above a trough through which the waste effluent to be treated is channeled. The lower 30 to 40 % of each disc extends into the waste, while the upper portion is exposed to the air. Thus, an area of biological growth is alternatively submerged to absorb food and then exposed to air for oxidation. As few or as many stages in series can be used to achieve the desired degree of BOD removal.

Lesson 7

LAND DISPOSAL

I. Translate the "attribute chains":

a sludge solids content, proper solid waste management, higher solids level, transport costs, the only ultimate disposal system, volume-reducing step, landfill site, permafrost areas.

II. In what meanings are the words "end" (toward this end) **"critical" (**critical habitats) **and "adequate"** (a sludge solids content of 20% might have seemed adequate …) **used?**

III. What are the functions of the pronoun "it" in the sentences: "**It** must be realized that …" **and** "Although incineration is usually worthwhile **it** should be considered primarily as a volume-reducing step"?

IV. Define the function of "it" and translate:

1. It is clear that the best results are obtained when the Mn content is below 1 ppm in the P-stage.
2. Until recently it was impractical to carry out such studies by the conventional fish bioassay tests.
3. For the treatment of organics in an aqueous medium, it is probably the most cost-effective (рентабельный) treatment.
4. This means that it is very easy to reduce the content of chlorinated dioxins and furans in pulp and paper products.
5. This makes it difficult to translate a TOCL value to an AOX value.
6. It must be noted that the technology-based approach (подход) toward setting limits on emissions and discharges has achieved a remarkable improvement in the quality of our nation's environment.
7. It was necessary to outline (наметить) the vendor's (поставщик) and the owner's responsibilities clearly, to ensure (гарантировать) good organizational control of the project.
8. This makes it desirable to oxidize both the noncondensate gases (неконденсирующиеся газы) and the condensate.
9. It is usually difficult to make companies and industries pay attention to theoretical business challenges (проблемы).
10. This type of filter press (фильтр под давлением) is rapidly gaining in popularity because it dewaters low solids sludge to high solids content in one continuous operation.

V. Words and word combinations to be memorized while reading and translating the text:

acceptable - приемлемый;

be worthwhile – быть ст*о*ящим;

burn - сжигать;

flood plain - пойма;

ground water - грунтовая вода;

guidelines - руководящие принципы, основные положения;

heat value - теплотворная способность;

infiltration - инфильтрация;

land disposal – захоронение отходов в землю;

permafrost - вечная мерзлота ;

prohibit – запрещать;

realize - понимать;

regulation - регулирование;

regulations - положения (закона), регламент;

silt - осадок;

soil - почва;

steam-generating capacity – мощность производства пара, паропроизводительность;

surface water - поверхностная вода;

volume - объем;

wetland - болото.

VI. While reading the text try to answer the following questions:

1. What has greater concern about proper solid waste management dictated? Why?
2. What are potential benefits of sludge higher solids percent (level)?
3. Why is landfill more preferable for waste sludge than incineration?
4. What about heat value from burning the sludge?
5. What is land disposal of solid waste controlled by?
6. What is the primary objective of land disposal?
7. What do the guidelines specify?
8. What should be limited?
9. In what areas is land disposal prohibited?

VII. Read and translate the text:

Land disposal

In the past, a sludge solids content of 20% might have seemed adequate for landfill. However, greater concern about proper solid waste management has dictated toward higher solids levels. There are a number of potential benefits: 1) reduced volume and transport costs;

2) easier handlings; 3) reduced environmental impact when landfilling; 4) improved heat value when incinerating.

It must be realized that landfill is the only ultimate disposal system for waste sludges. Although incineration is usually worthwhile, it should be considered primarily as a volume-reducing step. Generally, little heat value is realized from burning the sludge, and the addition of sludge to hogged fuel has a negative impact on steam-generating capacity.

Land disposal of solid waste is, of course, controlled by governmental regulation. The primary objective is to minimize potential contact with ground and surface waters. Toward this end, guidelines specify that the soils at the landfill site contain sufficient silt or fine material to limit infiltration to an acceptable level. Disposal in such areas as wetlands, flood plains, permafrost areas, water sheds, and critical habitats, is usually prohibited.

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Учебное издание

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АНГЛИЙСКИЙ ЯЗЫК
“In search of new ways to work in harmony with the environment”

Учебно-методическое пособие

по чтению английской научно-технической литературы

для студентов, обучающихся по направлениям:

20.03.01 «Техносферная безопасность»,

18.03.02 «Энерго- и ресурсосберегающие процессы в химической технологии, нефтехимии и биотехнологии»

Редактор и корректор В. А. Басова

Техн. редактор Л.Я.Титова

Темплан 2017 г., поз. 74

Подп. к печати 05.06.2017. Формат 60х84/16. Бумага тип. №1.

Печать офсетная. Печ. л. 7,25. Уч.-изд. л. 7,25; Тираж 200 экз.

Изд. № 74. Цена “С”. Заказ

Ризограф Высшей школы технологии и энергетики Санкт-Петербургского государственного университета промышленных технологий и дизайна,

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