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Английский язык

Рекомендовано учебно-методической комиссией направления подготовки 280700.62 «Техносферная безопасность» в качестве электронного учебного пособия

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Целью учебного пособия является обучение студентов направления 280700.62 «Техносферная безопасност»” практическому владению иностранным языком для его активного применения в ситуациях профессионального общения.

Предисловие

Целью учебного пособия является обучение студентов специальности 280700.62 “Техносферная безопасность” практическому владению иностранным языком для его активного применения в ситуациях профессионального общения.

Упражнения и задания, представленные в методических указаниях, направлены на формирование у студентов умений чтения и перевода иноязычных текстов по специальности “Техносферная безопасность” с целью извлечения профессионально-значимой информации, а также базовых умений и навыков профессионального общения на иностранном языке

С целью реализации компетентностного подхода к обучению применяются методические приемы, направленные на формирование компетенций, связанных с извлечением и переводом профессионально-ориентированной информации из иноязычных текстов на основе развиваемой способности каждый раз выбирать виды чтения и перевода, адекватные поставленной задаче.

Для развития навыков практического использования иностранного языка в профессиональной сфере используются такие виды деятельности, как: поиск и реферирование информации на изучаемом языке, составление и презентация докладов и сообщений, составление диалогов и моделирование дискуссий и конференций.

Лексический состав материала соответствует современному состоянию английского языка и включает в себя профессиональную терминологию изучаемой специальности.

GENERAL COURSE

UNIT I
ENVIRONMENTAL PROTECTION

I. Study the following words and word combinations.

for the benefit of	ради чего-либо
restraints	ограничения
awareness	осведомлённость
extent	степень (чего-либо)
due to	из-за
biodiversity	биологическое разнообразие
resulting from	в результате чего-либо
related to	связанный с
interwoven	*зд.* смешанный

II. Read and translate the definitions of the following terms.

Natural environment

encompasses all living and non-living things occurring naturally on Earth or some region thereof. It is an environment that encompasses the interaction of all living species. The concept of the natural environment can be distinguished by components:
- complete ecological units that function as natural systems without massive human intervention, including all vegetation, microorganisms, soil, rocks, atmosphere, and natural phenomena that occur within their boundaries;
- universal natural resources and physical phenomena that lack clear-cut boundaries, such as air, water, and climate, as well as energy, radiation, electric charge, and magnetism, not originating from human activity.

Environmental degradation

is the deterioration of the environment through depletion of resources such as air, water and soil; the destruction of

ecosystems and the extinction of wildlife. It is defined as any change or disturbance to the environment perceived to be deleterious or undesirable.
Environmental degradation is one of the Ten Threats officially cautioned by the High Level Threat Panel of the United Nations.
The United Nations International Strategy for Disaster Reduction defines environmental degradation as "*The reduction of the capacity of the environment to meet social and ecological objectives, and needs*".

III. Read and translate the text given below.

Environmental protection

Environmental protection is a practice of protecting the natural environment on individual, organizational or governmental levels, for the benefit of the natural environment and humans. Due to the pressures of population and technology, the biophysical environment is being degraded, sometimes permanently. This has been recognized, and governments have begun placing restraints on activities that cause environmental degradation. Since the 1960s, activity of environmental movements has created awareness of the various environmental issues. There is no agreement on the extent of the environmental impact of human activity, and protection measures are occasionally criticized.

Academic institutions now offer courses, such as environmental studies, environmental management and environmental engineering, that teach the history and methods of environment protection. Protection of the environment is needed due to various human activities. Waste production, air pollution, and loss of biodiversity (resulting from the introduction of invasive species and species extinction) are some of the issues related to environmental protection.

Environmental protection is influenced by three interwoven factors: environmental legislation, ethics and education. Each of these factors plays its part in influencing national-level environmental decisions and personal-level environmental values and behaviors.

IV. Ask the question to every passage of the text.

V. Retell the text in 8-10 sentences. Use the questions from the exercise IV as a plan. Be ready to answer the questions.

!	**VI. Find the additional information** about environmental impact of human activity and present it in the form of short reports.

VI. Study the following words and word combinations.

voluntary	добровольный
to remedy	исправлять, улучшать
non-compliance	несоблюдение
challenge	*зд.* задача
baseline	базовый, стандартный
inherent	неотъемлемый
adversely	неблагоприятный
interrelationship	взаимоотношение, взаимосвязь
collaborative	совместный
relevant	значимый
vulnerable	уязвимый

VII. Read and translate the definitions of the following terms.

Ecosystem

is a community of living organisms (plants, animals and microbes) in conjunction with the nonliving components of their environment (things like air, water and mineral soil), interacting as a system. These components are regarded as linked together through nutrient cycles and energy flows. As ecosystems are defined by the network of interactions among organisms, and between organisms and their environment, they can come in any size but usually encompass specific, limited spaces (although it is sometimes said that the entire planet is an ecosystem).

Resource management

is the efficient and effective deployment of an organization's resources when they are needed. Such resources may include financial resources, inventory, human skills, production resources, or information technology (IT). In the realm of project management, processes, techniques and philosophies as to the best approach for allocating resources have been developed.

Kyoto Protocol

is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC or FCCC) that set binding obligations on the industrialized countries to reduce their emissions of greenhouse gases. The UNFCCC is an international environmental treaty with the goal of achieving the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system".

Regulation

is a legal provision that creates, limits, or constrains a right, creates or limits a duty, or allocates a responsibility. Regulation can take many forms: legal restrictions promulgated by a government authority, contractual obligations that bind many parties (for example, "insurance regulations" that arise out of contracts between insurers and their insureds), self-regulation by an industry such as through a trade association, social regulation (e.g. norms), co-regulation, or market regulation. One can consider regulation as actions of conduct imposing sanctions, such as a fine, to the extent permitted by the law of the land.

VIII. Read and translate the text given below.

Environmental agreements

In industrialized countries, voluntary environmental agreements often provide a platform for companies to be recognized for moving beyond the minimum regulatory standards and, thus, support the development of best environmental practice. In developing countries, such as throughout Latin America, these agreements are more commonly used to remedy significant levels of non-compliance with mandatory regulation. The challenges that exist with these agreements lie in establishing baseline data, targets, monitoring and reporting. Due to the difficulties inherent in evaluating effectiveness, their use is often questioned and, indeed, the environment may well be adversely affected as a result. The key advantage of their use in developing countries is that their use helps to build environmental management capacity.

An ecosystems approach to resource management and environmental protection aims to consider the complex interrelationships of an entire ecosystem in decision making rather than simply responding to specific issues and challenges. Ideally the decision-making processes under such an approach would be a collaborative approach to planning and decision making that involves a broad range of stakeholders across all relevant governmental departments, as well as representatives of industry, environmental groups and community. This approach ideally supports a better exchange of information, development of conflict-resolution strategies and improved regional conservation.

Many of the earth's resources are especially vulnerable because they are influenced by human impacts across many countries. As a result of this, many attempts are made by countries to develop agreements that are signed by multiple governments to prevent damage or manage the impacts of human activity on natural resources. This can include agreements that impact factors such as climate, oceans, rivers and air pollution. These international environmental agreements are sometimes legally binding documents that have legal implications when they are not followed and, at other times, are more agreements in principle or are for use as codes of conduct. These agreements have a long history with some multinational agreements being in place from as early as 1910 in Europe, America and Africa. Some of the most well-known multinational agreements include: the Kyoto Protocol, Vienna Convention on the Protection of the Ozone Layer and Rio Declaration on Development and Environment.

IX. Ask the question to every passage of the text.

X. Retell the text in 8-10 sentences. Use the questions from the exercise IV as a plan. Be ready to answer the questions.

!	**XI. Make the dialogues** between the governmental representative and the industrialist trying to determine what kind of restrictions should be accepted in order to remedy the regional ecosystem.

UNIT II
AIR POLLUTION

I. Study the following words and word combinations.

combustion	сгорание
emission	выброс
contemporary	современный
felling	рубка леса
to unveil	предстать в истинном свете
widespread	широко распространённый
fertilizer	удобрение
contamination	загрязнённость
to emanate	выделять
refuse	отходы
to discard	выбросить

II. Read and translate the definitions of the following terms.

Pollutant

is substance or energy introduced into the environment that has undesired effects, or adversely affects the usefulness of a resource. A pollutant may cause long- or short-term damage by changing the growth rate of plant or animal species, or by interfering with human amenities, comfort, health, or property values.

Rechargeable battery

is a type of electrical battery. It comprises one or more electrochemical cells, and is a type of energy accumulator. It is known as a secondary cell because its electrochemical reactions are electrically reversible. Rechargeable batteries come in many different shapes and sizes, ranging from button cells to megawatt systems connected to stabilize an electrical distribution network.

Fossil fuels

are fuels formed by natural processes such as anaerobic decomposition of buried dead organisms. The age of the organisms and their resulting fossil fuels is typically millions of years, and sometimes exceeds 650 million years. Fossil fuels contain high percentages of carbon and include coal, petroleum, and natural gas. They range from volatile materials with low carbon: hydrogen ratios like methane, to liquid petroleum to nonvolatile materials composed of almost pure carbon, like anthracite coal.

Polyvinyl chloride,

commonly abbreviated PVC, is the third-most widely produced plastic, after polyethylene and polypropylene. PVC is used in construction because it is cheaper and stronger than more traditional alternatives such as copper or ductile iron. It can be made softer and more flexible by the addition of plasticizers, the most widely used being phthalates. In this form, it is used in clothing and upholstery, electrical cable insulation, inflatable products and many applications in which it replaces rubber.

III. Read and translate the text given below.

Air pollution. Part I.

Air pollution comes from both natural and human-made (anthropogenic) sources. However, globally human-made pollutants from combustion, construction, mining, agriculture and warfare are increasingly significant in the air pollution equation.

Motor vehicle emissions are one of the leading causes of air pollution. China, United States, Russia, Mexico, and Japan are the world leaders in air pollution emissions. Principal stationary pollution sources include chemical plants, coal-fired power plants, oil refineries, petrochemical plants, nuclear waste disposal activity, incinerators, large livestock farms (dairy cows, pigs, poultry, etc.), PVC factories, metals production factories, plastics factories, and other heavy industry. Agricultural air pollution comes from contemporary practices which include clear felling and burning of natural vegetation as well as spraying of pesticides and herbicides.

About 400 million metric tons of hazardous wastes are generated each year. The United States alone produces about 250 million metric tons. Americans constitute less than 5% of the world's population, but produce roughly 25% of the world's CO_2, and generate approximately 30% of world's waste. In 2007, China has overtaken the United States as the world's biggest producer of CO_2, while still far behind based on per capita pollution □ ranked 78th among the world's nations.

In February 2007, a report by the Intergovernmental Panel on Climate Change (IPCC), representing the work of 2,500 scientists, economists, and policymakers from more than 120 countries, said that humans have been the primary cause of global warming since 1950. Humans have ways to cut greenhouse gas emissions and avoid the consequences of global warming, a major climate report concluded. But to change the climate, the transition from fossil fuels like coal and oil needs to occur within decades, according to the final report this year from the UN's Intergovernmental Panel on Climate Change (IPCC).

Some of the more common soil contaminants are chlorinated hydrocarbons (CFH), heavy metals (such as chromium, cadmium –

found in rechargeable batteries, and lead-found in lead paint, aviation fuel and still in some countries, gasoline), MTBE, zinc, arsenic and benzene. In 2001 a series of press reports culminating in a book called "Fateful Harvest" unveiled a widespread practice of recycling industrial byproducts into fertilizer, resulting in the contamination of the soil with various metals. Ordinary municipal landfills are the source of many chemical substances entering the soil environment (and often groundwater), emanating from the wide variety of refuse accepted, especially substances illegally discarded there, or from pre-1970 landfills that may have been subject to little control in the U.S. or EU. There have also been some unusual releases of polychlorinated dibenzodioxins, commonly called "dioxins" for simplicity, such as TCDD.

IV. Ask the question to every passage of the text.

V. Retell the text in 8-10 sentences. Use the questions from the exercise IV as a plan. Be ready to answer the questions.

!	**VI. Find the additional information** harmful industrial pollutants and present it in the form of short reports. Organize conference and choose the best report.

VII. Study the following words and word combinations.

precursor	предшественник
attendant	сопутствующий
viability	жизнеспособность
demise	гибель
extinction	вымирание
untenable	несостоятельный
to supersede	замещать, вытеснять
observable	видимый
crucial	ключевой, решающий
dilution	разжижжение, разбавление

dictum	афоризм
approach	подход
whereby	посредством чего
benign	*зд.* лёгкий
outcome	последствие
infeasible	недопустимый
prominence	известность
to predominate	преобладать
to gauge	измерять
furthermore	к тому же
restriction	ограничение

XIII. Read and translate the definitions of the following terms.

Effluent

is an outflowing of water or gas from a natural body of water, or from a human-made structure. Effluent is defined by the United States Environmental Protection Agency as "wastewater □ treated or untreated □ that flows out of a treatment plant, sewer, or industrial outfall. Generally refers to wastes discharged into surface waters". The Compact Oxford English Dictionary defines effluent as "liquid waste or sewage discharged into a river or the sea".

Diluent

is a diluting agent. One industrial application is the transport of crude oil via pipelines. Heavy crude oil is fluid with high viscosity, especially at low temperatures. The addition of a diluent enables the diluted fluid to meet pipeline specifications in order for it to be efficiently transported. Types of diluents more familiar to the general public include paint thinner and nail polish thinner, both of which improve the consistency and applicability of the products to which they are added.

Emergency management
is the generic name of an interdisciplinary field dealing with the strategic organizational management processes used to protect critical assets of an organization from hazard risks that can cause events like disasters or catastrophes and to ensure the resiliency of the organization within their planned lifetime.

Pollution
is the introduction of contaminants into the natural environment that cause adverse change. Pollution can take the form of chemical substances or energy, such as noise, heat or light. Pollutants, the components of pollution, can be either foreign substances/energies or naturally occurring contaminants.


IX. Read and translate the text given below.

Air pollution. Part II.

The earliest precursor of pollution generated by life forms would have been a natural function of their existence. The attendant consequences on viability and population levels fell within the sphere of natural selection. These would have included the demise of a population locally or ultimately, species extinction. Processes that were untenable would have resulted in a new balance brought about by changes and adaptations. At the extremes, for any form of life, consideration of pollution is superseded by that of survival.

For humankind, the factor of technology is a distinguishing and critical consideration, both as an enabler and an additional source of byproducts. Short of survival, human concerns include the range from quality of life to health hazards. Since science holds experimental demonstration to be definitive, modern treatment of toxicity or environmental harm involves defining a level at which an effect is observable. Common examples of fields where practical measurement is crucial include automobile emissions control, industrial exposure (e.g. Occupational Safety and Health Administration (OSHA) PELs), toxicology (e.g. LD_{50}), and medicine (e.g. medication and radiation doses).

"The solution to pollution is dilution", is a dictum which summarizes a traditional approach to pollution management whereby sufficiently diluted pollution is not harmful. It is well-suited to some other modern, locally scoped applications such as laboratory safety procedure and hazardous material release emergency management. But it assumes that the dilutant is in virtually unlimited supply for the application or that resulting dilutions are acceptable in all cases.

Such simple treatment for environmental pollution on a wider scale might have had greater merit in earlier centuries when physical survival was often the highest imperative, human population and densities were lower, technologies were simpler and their byproducts more benign. But these are often no longer the case. Furthermore, advances have enabled measurement of concentrations not possible before. The use of statistical methods in evaluating outcomes has given currency to the principle of probable harm in cases where assessment is warranted but resorting to deterministic models is impractical or infeasible. In addition, consideration of the environment beyond direct impact on human beings has gained prominence.

Yet in the absence of a superseding principle, this older approach predominates practices throughout the world. It is the basis by which to gauge concentrations of effluent for legal release, exceeding which penalties are assessed or restrictions applied. One such superseding principle is contained in modern hazardous waste laws in developed countries, as the process of diluting hazardous waste to make it non-hazardous is usually a regulated treatment process. Migration from pollution dilution to elimination in many cases can be confronted by challenging economical and technological barriers.

X. Ask the question to every passage of the text.

XI. Retell the text in 8-10 sentences. Use the questions from the exercise X as a plan. Be ready to answer the questions.

!	**XII. Make the dialogues** trying to determine what kind of pollutions – natural or human-made – are more dangerous for us.

XIII. Prepare yourself for the discussion: “Modern industry without harmful pollution – is it possible?”

UNIT III
WASTES AND RECYCLING

I. Study the following words and word combinations.

to pose threat	создавать угрозу
substantial	существенный
treatment	обработка
to define under	определять в соответствии с
to apply to	применять
electroplating	гальванопокрытие
to exhibit	демонстрировать
exterminator	истребитель
oil refinery	нефтеочистительный завод
by-product	побочный продукт

II. Read and translate the definitions of the following terms.

By-product

is a secondary product derived from a manufacturing process or chemical reaction. It is not the primary product or service being produced.

Reactivity

is a somewhat vague concept used in chemistry which appears to embody both thermodynamic factors and kinetic factors i.e. “whether or not a substance reacts and how fast it reacts”. Both factors are actually distinct and both are commonly temperature dependent.

Corrosion

is the gradual destruction of material, usually metals, by chemical reaction with its environment. In the most common use of the word, this means electrochemical oxidation of metals in reaction with an oxidant such as oxygen. Rusting, the formation of iron oxides, is a well-known example of electrochemical corrosion.

Toxicity

is the degree to which a substance can damage an organism. Toxicity can refer to the effect on a whole organism, such as an animal, bacterium, or plant, as well as the effect on a substructure of the organism, such as a cell (cytotoxicity) or an organ such as the liver (hepatotoxicity).

III. Read and translate the text given below.

Hazardous waste

A hazardous waste is waste that poses substantial or potential threats to public health or the environment. In the United States, the treatment, storage and disposal of hazardous waste is regulated under the Resource Conservation and Recovery Act (RCRA). Hazardous wastes are defined under RCRA in 40 CFR 261 where they are divided into two major categories: characteristic wastes and listed wastes.

Characteristic hazardous wastes are materials that are known or tested to exhibit one or more of the following four hazardous traits:

- ignitability (i.e., flammable);
- reactivity;
- corrosivity;
- toxicity;

The requirements of RCRA apply to all the companies that generate hazardous waste as well as those companies that store or dispose of hazardous waste in the United States. Many types of businesses generate hazardous waste. For example, dry cleaners, automobile repair shops, hospitals, exterminators, and photo processing centers may all generate hazardous waste. Some hazardous waste generators are larger companies such as chemical manufacturers, electroplating companies, and oil refineries.

These wastes may be found in different physical states such as gaseous, liquids, or solids. A hazardous waste is a special type of waste because it cannot be disposed of by common means like other by-products of our everyday lives. Depending on the physical state of the waste, treatment and solidification processes might be required.

Worldwide, The United Nations Environmental Programme (UNEP) estimated that more than 400 million tons of hazardous wastes are produced universally each year, mostly by industrialized countries. About 1 percent of this total is shipped across international boundaries, with the majority of the transfers occurring between countries in the Organization for the Economic Cooperation and Development (OECD). Some of the reasons for industrialized countries to ship the hazardous waste to industrializing countries for disposal are the rising cost of disposing hazardous waste in the home country.

IV. Ask the question to every passage of the text.

V. Retell the text in 8-10 sentences. Use the questions from the exercise IV as a plan. Be ready to answer the questions.

!	**VI. Find the additional information** about hazardous wastes and present it in the form of short reports. Organize conference and choose the best report.

VII. Study the following words and word combinations.

recycling	переработка отходов
incineration	сжигание
landfilling	отсыпка грунта
greenhouse gas	парниковые газы
to reuse	повторно использовать

to compost	смешивать
curbside	край тротуара
foamed polystyrene	пенополистирол
salvage	сбор утильсырья
intrinsic value	действительная стоимость
to dispute	оспаривать
bias	предвзятость
to detract	приуменьшать
to outweigh	быть тяжелее
logging	заготовка леса
paper pulp	целлюлозно-бумажный
validity	обоснованность

VIII. Read and translate the definitions of the following terms.

Landfill site

is a site for the disposal of waste materials by burial and is the oldest form of waste treatment. Historically, landfills have been the most common methods of organized waste disposal and remain so in many places around the world. Some landfills are also used for waste management purposes, such as the temporary storage, consolidation and transfer, or processing of waste material (sorting, treatment, or recycling).

Greenhouse gas

is a gas in an atmosphere that absorbs and emits radiation within the thermal infrared range. This process is the fundamental cause of the greenhouse effect. The primary greenhouse gases in the Earth's atmosphere are water vapour, carbon dioxide, methane, nitrous oxide, and ozone.

Waste sorting

is the process by which waste is separated into different elements. Waste sorting can occur manually at the household and collected through curbside collection schemes, or automatically separated in materials recovery facilities or mechanical biological treatment.

Incineration

is a waste treatment process that involves the combustion of organic substances contained in waste materials. Incineration and other high temperature waste treatment systems are described as "thermal treatment". Incineration of waste materials converts the waste into ash, flue gas, and heat.

X. Read and translate the text given below.

Recycling

Recycling is processing used materials (waste) into new products to prevent waste of potentially useful materials, reduce the consumption of fresh raw materials, reduce energy usage, reduce air pollution (from incineration) and water pollution (from landfilling) by reducing the need for "conventional" waste disposal, and lower greenhouse gas emissions as compared to virgin production. Recycling is a key component of modern waste reduction and is the third component of the "Reduce, Reuse, Recycle" waste hierarchy.

There are some ISO standards relating to recycling such as ISO 15270:2008 for plastics waste and ISO 14001:2004 for environmental management control of recycling practice.

Recyclable materials include many kinds of glass, paper, metal, plastic, textiles, and electronics. Although similar in effect, the composting or other reuse of biodegradable waste – such as food or garden waste – is not typically considered recycling. Materials to be recycled are either brought to a collection center or picked up from the curbside, then sorted, cleaned, and reprocessed into new materials bound for manufacturing.

In the strictest sense, recycling of a material would produce a fresh supply of the same material for example, used office paper would be converted into new office paper, or used foamed polystyrene into new polystyrene. However, this is often difficult or too expensive (compared with producing the same product from raw materials or other sources), so "recycling" of many products or materials involves their reuse in producing different materials (e.g., paperboard) instead.

Another form of recycling is the salvage of certain materials from complex products, either due to their intrinsic value (e.g., lead from car batteries, or gold from computer components), or due to their hazardous nature (e.g., removal and reuse of mercury from various items). Critics dispute the net economic and environmental benefits of recycling over its costs, and suggest that proponents of recycling often make matters worse and suffer from confirmation bias.

Specifically, critics argue that the costs and energy used in collection and transportation detract from (and outweigh) the costs and energy saved in the production process; also that the jobs produced by the recycling industry can be a poor trade for the jobs lost in logging, mining, and other industries associated with virgin production; and that materials such as paper pulp can only be recycled a few times before material degradation prevents further recycling. Proponents of recycling dispute each of these claims, and the validity of arguments from both sides has led to enduring controversy.

IX. Ask the question to every passage of the text.

X. Retell the text in 8-10 sentences. Use the questions from the exercise IX as a plan. Be ready to answer the questions.

!	**XI. Find the additional information** about recycling processes and present it in the form of short reports. Organize conference and choose the best report.

XII. Study the following words and word combinations.

cost-effectiveness	экономическая эффективность
ubiquitous	повсеместный
cardboard packaging	картонная упаковка
retail store	розничный магазин
warehouse	товарный склад
to deal in	торговать
niche	ниша
lumber	строевой лес
rubber tires	резиновые шины
stock	сырьё
shift	сдвиг
inherently	по сути
fuel cell	топливный элемент
per capita	на душу населения
to reclaim	утилизировать
superior to	превосходящий
depleted uranium	обеднённый уран
armour-piercing shell	бронебойный снаряд
shielding	экранирование
renewable	возобновляемый
to anticipate	*зд.* приближать

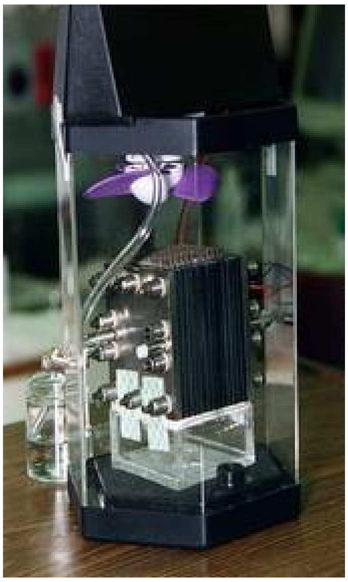
XIII. Read and translate the definitions of the following terms.

Fuel cell
is a device that converts the chemical energy from a fuel into electricity through a chemical reaction with oxygen or another oxidizing agent. Hydrogen is the most common fuel, but hydrocarbons such as natural gas and alcohols like methanol are sometimes used. Fuel cells are different from batteries in that they require a constant source of fuel and oxygen to run, but they can produce electricity continually for as long as these inputs are supplied.

Stock
is the basic material from which a product is manufactured or made, frequently used with an extended meaning. For example, the term is used to denote material that came from nature and is in an unprocessed or minimally processed state. Latex, iron ore, logs, and crude oil, Salt Water would be examples.

Renewable resource
is a natural resource with the ability to reproduce through biological or natural processes and replenished with the passage of time. Renewable resources are part of our natural environment and form our eco-system.

Battery pack
is a set of any number of (preferably) identical batteries or individual battery cells. They may be configured in a series, parallel or a mixture of both to deliver the desired voltage, capacity, or power density. The term battery pack is often used in reference to RC hobby toys and battery electric vehicles.

XIV. Read and translate the text given below.

Industrial waste recycling

Although many government programs are concentrated on recycling at home, a large portion of waste is generated by industry. The focus of many recycling programs done by industry is the cost-effectiveness of recycling. The ubiquitous nature of cardboard packaging makes cardboard a commonly recycled waste product by companies that deal heavily in packaged goods, like retail stores, warehouses, and distributors of goods. Other industries deal in niche or specialized products, depending on the nature of the waste materials that are present.

The glass, lumber, wood pulp, and paper manufacturers all deal directly in commonly recycled materials. However, old rubber tires may be collected and recycled by independent tire dealers for a profit.

Levels of metals recycling are generally low. In 2010, the International Resource Panel, hosted by the United Nations Environment Programme (UNEP) published reports on metal stocks that exist within society and their recycling rates. The Panel reported that the increase in the use of metals during the 20th and into the 21st century has led to a substantial shift in metal stocks from below ground to use in applications within society above ground. For example, the in-use stock of copper in the USA grew from 73 to 238 kg per capita between 1932 and 1999.

The report authors observed that, as metals are inherently recyclable, the metals stocks in society can serve as huge mines above ground. However, they found that the recycling rates of many metals are very low. The report warned that the recycling rates of some rare metals used in applications such as mobile phones, battery packs for hybrid cars and fuel cells, are so low that unless future end-of-life recycling rates are dramatically stepped up these critical metals will become unavailable for use in modern technology.

The military recycles some metals. The U.S. Navy's Ship Disposal Program uses ship breaking to reclaim the steel of old vessels. Ships may also be sunk to create an artificial reef. Uranium is a very dense metal that has qualities superior to lead and titanium for many military and industrial uses. The uranium left over from processing it into nuclear weapons and fuel for nuclear reactors is called depleted uranium, and it is used by all branches of the U.S. military use for armour-piercing shells and shielding.

The construction industry may recycle concrete and old road surface pavement, selling their waste materials for profit.

Some industries, like the renewable energy industry and solar photovoltaic technology in particular, are being proactive in setting up recycling policies even before there is considerable volume to their waste streams, anticipating future demand during their rapid growth.

XV. Ask the question to every passage of the text.

XVI. Retell the text in 8-10 sentences. Use the questions from the exercise XV as a plan. Be ready to answer the questions.

!	**XVII. Find the additional information about renewable resources** and present it in the form of short reports. Organize conference and choose the best report.

XVIII. Prepare yourself for the discussion: "Perspectives industrial use of recycled materials".

UNIT IV
ENVIRONMENTAL ENGINERRING

I. Study the following words and word combinations.

habitation	место обитания
containment	сдерживание
mishap	несчастье, неудача
depletion	сокращение
exhaust	выхлопной газ
to remediate	восстанавливать, улучшать
distinct	особый
to delay	препятствовать, откладывать
dispersion	рассеивание
potable	питьевой
removal	устранение, вывоз
prevalent	общепринятый
outfall	водоотвод

II. Read and translate the definitions of the following terms.

Radiation protection

is the protection of people and the environment from the harmful effects of ionizing radiation, which includes both particle radiation and high energy electromagnetic radiation.
Ionizing radiation is widely used in industry and medicine, and it presents a significant health hazard. It is also present as cosmic rays in outer space, so spacecraft and spacesuits must have appropriate shielding. It causes microscopic damage to living tissue, resulting in skin burns and radiation sickness at high exposures, and statistically elevated risks of cancer at low exposures.

Occupational hygiene

is generally defined as the art and science dedicated to the anticipation, recognition, evaluation, communication and control of environmental stressors in, or arising from, the workplace that may result in injury, illness, impairment, or affect the well being of workers and members of the community. These stressors are divided into the categories biological, chemical, physical, ergonomic and psychosocial.

Sustainability

is the capacity to endure through renewal, maintenance, and sustenance, or nourishment, in contrast to durability, the capacity to endure through unchanging resistance to change. For humans in social systems or ecosystems, sustainability is the long-term maintenance of responsibility, which has environmental, economic, and social dimensions, and encompasses the concept of stewardship, the responsible management of resource use. In ecology, sustainability describes how biological systems remain diverse, robust, and productive over time, a necessary precondition for the well-being of humans and other organisms.

Acid rain

is a rain or any other form of precipitation that is unusually acidic, meaning that it possesses elevated levels of hydrogen ions (low pH). It can have harmful effects on plants, aquatic animals, and infrastructure. Acid rain is caused by emissions of sulfur dioxide and nitrogen oxides, which react with the water molecules in the atmosphere to produce acids.

III. Read and translate the text given below.

Environmental engineering

Environmental engineering is the application of science and engineering principles to improve the natural environment (air, water, and/or land resources), to provide healthy water, air, and land for human habitation (house or home) and for other organisms, and to remediate polluted sites. It involves waste water management and air pollution control, recycling, waste disposal, radiation protection, industrial hygiene, environmental sustainability, and public health issues as well as knowledge of environmental engineering law. It also includes studies on the environmental impact of proposed construction projects.

Environmental engineers conduct hazardous-waste management studies to evaluate the significance of such hazards, advice on treatment and containment, and develop regulations to prevent mishaps. Environmental engineers also design municipal water supply and industrial wastewater treatment systems as well as address local and worldwide environmental issues such as the effects of acid rain, global warming, ozone depletion, water pollution and air pollution from automobile exhausts and industrial sources. At many universities, Environmental Engineering programs follow either the Department of Civil Engineering or The Department of Chemical Engineering at engineering faculties. Environmental "civil" engineers focus on hydrology, water resources management, bioremediation, and water treatment plant design. Environmental "chemical" engineers, on the other hand, focus on environmental chemistry, advanced air and water treatment technologies and separation processes.

Additionally, engineers are more frequently obtaining specialized training in law (J.D.) and are utilizing their technical expertise in the practices of Environmental engineering law. About four percent of environmental engineers go on to obtain Board Certification in their specialty area(s) of environmental engineering (Board Certified Environmental Engineer or BCEE).

IV. Ask the question to every passage of the text.

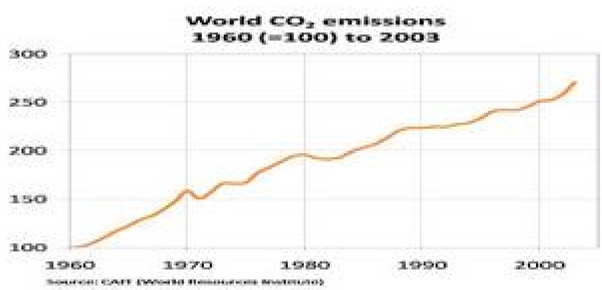
V. Retell the text in 8-10 sentences. Use the questions from the exercise IV as a plan. Be ready to answer the questions.

!	**VI. Find the additional information** about systems engineering and industrial engineering and present it in the form of short reports. Organize conference and choose the best report.

VI. Read and translate the definitions of the following terms.

Watershed, or **drainage basin**
is an extent or an area of land where surface water from rain and melting snow or ice converges to a single point, usually the exit of the basin, where the waters join another waterbody, such as a river, lake, reservoir, estuary, wetland, sea, or ocean.

Sewage treatment
is the process of removing contaminants from wastewater and household sewage, both runoff (effluents) and domestic. It includes physical, chemical, and biological processes to remove physical, chemical and biological contaminants. Its objective is to produce an environmentally safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse (usually as farm fertilizer). Using advanced technology it is now possible to re-use sewage effluent for drinking water, although Singapore is the only country to implement such technology on a production scale in its production of NEWater.



VII. Read and translate the text given below.

Issues in environmental engineering

Solid waste management is the collection, transport, processing or disposal, managing and monitoring of solid waste materials. The term usually relates to materials produced by direct or indirect human activity, and the process is generally undertaken to reduce their effect on health, the environment or aesthetics. Waste management is a distinct practice from resource recovery which focuses on delaying the rate of consumption of natural resources. The management of wastes treats all materials as a single class, whether solid, liquid, gaseous or radioactive substances and the objective is to reduce the harmful environmental impacts of each through different methods.

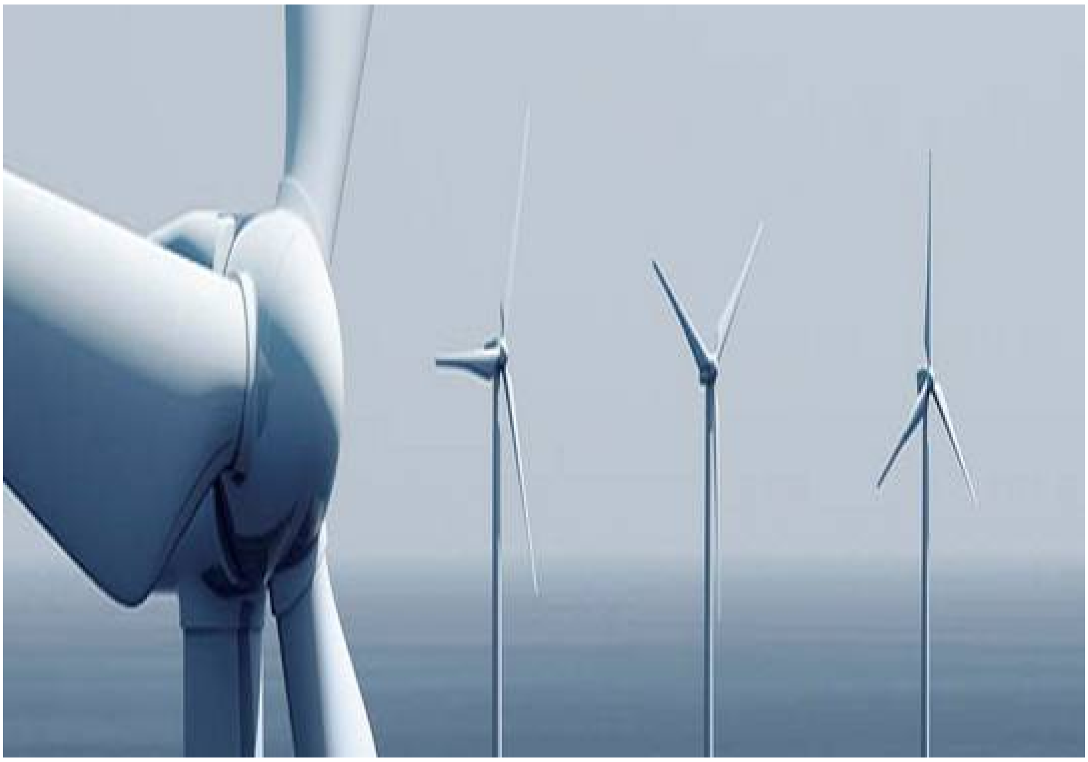
Engineers and scientists work to secure ***water supplies*** for potable and agricultural use. They evaluate the water balance within a watershed and determine the available water supply, the water needed for various needs in that watershed, the seasonal cycles of water movement through the watershed and they develop systems to store, treat, and convey water for various uses. Water is treated to achieve water quality objectives for the end uses. In the case of potable water supply, water is treated to minimize the risk of infectious disease transmission, the risk of non-infectious illness, and to create a palatable water flavor. Water distribution systems are designed and built to provide adequate water pressure and flow rates to meet various end-user needs such as domestic use, fire suppression, and irrigation.

There are numerous ***wastewater treatment*** technologies. A wastewater treatment train can consist of a primary clarifier system to remove solid and floating materials, a secondary treatment system consisting of an aeration basin followed by flocculation and sedimentation or an activated sludge system and a secondary clarifier, a tertiary biological nitrogen removal system, and a final disinfection process. The aeration basin/activated sludge system removes organic material by growing bacteria (activated sludge). The secondary clarifier removes the activated sludge from the water. The tertiary system, although not always included due to costs, is becoming more prevalent to remove nitrogen and phosphorus and to disinfect the water before discharge to a surface water stream or ocean outfall.

VIII. Ask the question to every passage of the text.

IX. Retell the text in 8-10 sentences. Use the questions from the exercise VIII as a plan. Be ready to answer the questions.

!	**IX. Find the additional information** about systems engineering and industrial engineering and present it in the form of short reports. Organize conference and choose the best report.



UNIT V
SAFETY ENGINEERING

I. Study the following words and word combinations.

applied	прикладной
related to	относящийся к
to assure	гарантировать
to behave	вести себя
specifications	технические условия
to assign	назначать, поручать
proactive	упреждающий
subset	подмножество
realm	сфера
extensively	широко
serviceable	прочный
replaceable	заменимый
impending	предстоящий
to bundle	*зд.* объединяться

II. Read and translate the definitions of the following terms.

Fail-safe

device is one that, in the event of failure, responds in a way that will cause no harm, or at least a minimum of harm, to other devices or danger to personnel.

Systems engineering

is an interdisciplinary field of engineering focusing on how complex engineering projects should be designed and managed over their life cycles. Issues such as logistics, the coordination of different teams, and automatic control of machinery become more difficult when dealing with large, complex projects. Systems engineering deals with work-processes and tools to manage risks on such projects, and it overlaps with both technical and human-centered disciplines such as control engineering, industrial engineering, organizational studies, and project management.

Industrial engineering

is a branch of engineering dealing with the optimization of complex processes or systems. It is concerned with the development, improvement, implementation and evaluation of integrated systems of people, money, knowledge, information, equipment, energy, materials, analysis and synthesis, as well as the mathematical, physical and social sciences together with the principles and methods of engineering design to specify, predict, and evaluate the results to be obtained from such systems or processes.

Fault-tolerance

is the property that enables a system (often computer-based) to continue operating properly in the event of the failure of (or one or more faults within) some of its components. If its operating quality decreases at all, the decrease is proportional to the severity of the failure, as compared to a naïvely-designed system in which even a small failure can cause total breakdown. Fault-tolerance is particularly sought-after in high-availability or life-critical systems.

III. Read and translate the text given below.

Safety engineering

Safety engineering is an applied science strongly related to systems engineering/industrial engineering and the subset System Safety Engineering. Safety engineering assures that a life-critical system behaves as needed even when components fail.

Ideally, safety-engineers take an early design of a system, analyze it to find what faults can occur, and then propose safety requirements in design specifications up front and changes to existing systems to make the system safer. In an early design stage, often a fail-safe system can be made acceptably safe with a few sensors and some software to read them. Probabilistic fault-tolerant systems can often be made by using more, but smaller and less-expensive pieces of equipment.

Far too often, rather than actually influencing the design, safety engineers are assigned to prove that an existing, completed design is safe. If a safety engineer then discovers significant safety problems late in the design process, correcting them can be very expensive. This type of error has the potential to waste large sums of money.

The exception to this conventional approach is the way some large government agencies approach safety engineering from a more proactive and proven process perspective, known as “system safety”. The system safety philosophy is to be applied to complex and critical systems, such as commercial airliners, complex weapon systems, spacecraft, rail and transportation systems, air traffic control system and other complex and safety-critical industrial systems. The proven system safety methods and techniques are to prevent, eliminate and control hazards and risks through designed influences by a collaboration of key engineering disciplines and product teams. Software safety is a fast growing field since modern systems functionality are increasingly being put under control of software. The whole concept of system safety and software safety, as a subset of systems engineering, is to influence safety-critical systems designs by conducting several types of hazard analyses to identify risks and to specify design safety features and procedures to strategically mitigate risk to acceptable levels before the system is certified.

Additionally, failure mitigation can go beyond design recommendations, particularly in the area of maintenance. There is an entire realm of safety and reliability engineering known as Reliability Centered Maintenance (RCM), which is a discipline that is a direct result of analyzing potential failures within a system and determining maintenance actions that can mitigate the risk of failure. This methodology is used extensively on aircraft and involves understanding the failure modes of the serviceable replaceable assemblies in addition to the means to detect or predict an impending failure.

For large scale complex systems, hundreds if not thousands of maintenance actions can result from the failure analysis. These maintenance actions are based on conditions (e.g., gauge reading or leaky valve), hard conditions (e.g., a component is known to fail after 100 hrs of operation with 95% certainty), or require inspection to determine the maintenance action (e.g., metal fatigue). The RCM concept then analyzes each individual maintenance item for its risk contribution to safety, mission, operational readiness, or cost to repair if a failure does occur. Then the sum total of all the maintenance actions are bundled into maintenance intervals so that maintenance is not occurring around the clock, but rather, at regular intervals.

IV. Ask the question to every passage of the text.

V. Retell the text in 8-10 sentences. Use the questions from the exercise IV as a plan. Be ready to answer the questions.

!	**VI. Find the additional information** about systems engineering and industrial engineering and present it in the form of short reports. Organize conference and choose the best report.

UNIT VI
FIRE SAFETY

I. Study the following words and word combinations.

precaution	мера предосторожности
likelihood	вероятность
to occur	происходить, случаться
to enable	давать возможность
occupant	жилец, обитатель
to impede	препятствовать
in accordance with	в соответствии с
to exceed	превышать
signage	идентификационный комплект
compliance	соответствие, согласие
accessible	доступный
hazardous	опасный
solvent	растворитель
spray booth	окрасочная кабина
to prohibit	запрещать
flammable	огнеопасный
detection	выявление
warning	предупреждение
inventory of firestops	пожарный инвентарь
to ensure	обеспечивать
awareness	осведомленность
spark	искра
furnace	горн, печь, топка
heater	обогреватель
ignition sources	воспламенение

II. Read and translate the definitions of the following terms.

Fire drill

is a method of practicing the evacuation of a building for a fire or other emergency. Generally, the emergency system (usually the fire alarm) sounds and the building is evacuated as though a real fire had occurred. Usually, the time it takes to evacuate is measured to ensure that it occurs within a reasonable length of time, and problems with the emergency system or evacuation procedures are identified to be remedied.

Combustibility

is a measure of how easily a substance will set on fire, through fire or combustion. This is an important property to consider when a substance is used for construction or is being stored. Substances with low combustibility may be selected for construction where the fire risk needs to be reduced. Fire resistant substances are preferred for building materials and furnishings.

Fire extinguisher

is an active fire protection device used to extinguish or control small fires, often in emergency situations. It is not intended for use on an out-of-control fire, such as one which has reached the ceiling, endangers the user (i.e., no escape route, smoke, explosion hazard, etc.), or otherwise requires the expertise of a fire department. Typically, a fire extinguisher consists of a hand-held cylindrical pressure vessel containing an agent which can be discharged to extinguish a fire.

Operational requirement

is a singular documented physical and functional need that a particular product or service must be or perform. It is a statement that identifies a necessary attribute, capability, characteristic, or quality of a system for it to have value and utility to a user.

Fire alarm system

is designed to detect the unwanted presence of fire by monitoring environmental changes associated with combustion. In general, a fire alarm system is classified as either automatically actuated, manually actuated, or both. Automatic fire alarm systems are intended to notify the building occupants to evacuate in the event of a fire or other emergency, report the event to an off-premises location in order to summon emergency services, and to prepare the structure and associated systems to control the spread of fire and smoke.

Firestop

is a fire protection system made of various components used to seal openings and joints in fire-resistance rated wall and/or floor assemblies. Firestops are designed to restore the fire-resistance ratings of wall and/or floor assemblies by impeding the spread of fire by filling the openings with fire-resistant materials. Unprotected openings in fire separations cancel out the fire-resistance ratings of the fire separations, allowing the spread of fire, usually past the limits of the fire safety plan of a building.

III. Read and translate the text given below.

Fire safety

Fire safety refers to precautions that are taken to prevent or reduce the likelihood of a fire that may result in death, injury, or property damage, alert those in a structure to the presence of an uncontrolled fire in the event one occurs, better enable those threatened by a fire to survive, or to reduce the damage caused by a fire. Fire safety measures include those that are planned during the construction of a building or implemented in structures that are already standing, and those that are taught to occupants of the building.

Threats to fire safety are referred to as fire hazards. A fire hazard may include a situation that increases the likelihood a fire may start or may impede escape in the event a fire occurs.

Fire safety is often a component of building safety. Those who inspect buildings for violations of the Fire Code and go into schools to educate children on Fire Safety topics are fire department members known as fire prevention officers. The Chief Fire Prevention Officer or Chief of Fire Prevention will normally train newcomers to the Fire Prevention Division and may also conduct inspections or make presentations.

There are some key elements of a fire safety policy:

- building a facility in accordance with the version of the local building code;
- maintaining a facility and conducting yourself in accordance with the provisions of the fire code.

Examples of these include:

- not exceeding the maximum occupancy within any part of the building;
- maintaining proper fire exits and proper exit signage (e.g., exit signs pointing to them that can function in a power failure);
- compliance with electrical codes to prevent overheating and ignition from electrical faults or problems such as poor wire insulation or overloading wiring, conductors, or other fixtures with more electric current than they are rated for;

- placing and maintaining the correct type of fire extinguishers in easily accessible places;

- properly storing and using, hazardous materials that may be needed inside the building for storage or operational requirements (such as solvents in spray booths);

- prohibiting flammable materials in certain areas of the facility;

- maintaining fire alarm systems for detection and warning of fire;

- obtaining and maintaining a complete inventory of firestops;

- ensuring that spray fireproofing remains undamaged;

- maintaining a high level of training and awareness of occupants and users of the building to avoid obvious mistakes, such as the propping open of fire doors;

- conduct fire drills at regular intervals throughout the year;

Among common fire hazards are:

- electrical systems that are overloaded, resulting in hot wiring or connections, or failed components;

- combustible storage areas with insufficient protection;

- combustibles near equipment that generates heat, flame, or sparks;

- smoking (cigarettes, cigars, pipes, lighters, etc.);

- equipment that generates heat and utilizes combustible materials;

- flammable liquids;

- cooking appliances stoves, ovens;

- heating appliances wood burning stoves, furnaces, boilers, portable heaters;

- electrical wiring in poor condition;

- batteries;

- personal ignition sources matches, lighters;

- electronic and electrical equipment.

IV. Ask the question to every passage of the text.

V. Retell the text in 8-10 sentences. Use the questions from the exercise IV as a plan. Be ready to answer the questions.

!	**VI. Make the dialogues** between the chief of the enterprise and fire safety manager trying to determine the measures to be undertaken in order to ensure fire safety at the enterprise.

VII. Study the following words and word combinations.

elaborate	сложный
to submit	подписать
approval	*зд.* согласование
to implement	выполнять
in case of	в случае чего-либо
fire emergency	пожарная служба
shut-off valves	запорный клапан
layout	планировка
maintenance	техническое обслуживание
due to	из-за, вследствие

VIII. Find and translate correct definitions of the following terms.

Fire sprinkler system
is an active fire protection measure, consisting of a water supply system, providing adequate pressure and flow rate to a water distribution piping system, onto which fire sprinklers are connected. Although historically only used in factories and large commercial buildings, home and small building systems are now available at a cost-effective price.

Fire resistant material
is one that is designed to resist burning and withstand heat. It is used in the bunker gear worn by firefighters to protect them from the flames in a burning building.

Hazardous materials
are solids, liquids, or gases that can harm people, other living organisms, property, or the environment. They are often subject to chemical regulations. Dangerous goods include materials that are radioactive, flammable, explosive, corrosive, oxidizing, asphyxiating, biohazardous, toxic, pathogenic, or allergenic.

Fire code
is a model code adopted by the state or local jurisdiction and enforced by fire prevention officers within municipal fire departments. It is a set of rules prescribing minimum requirements to prevent fire and explosion hazards arising from storage, handling, or use of dangerous materials, or from other specific hazardous conditions.

IX. Read and translate the text given below.

Fire safety plan

A fire safety plan is required by all North American national, state and provincial fire codes based on building use or occupancy types. Generally, the owner of the building is responsible for the preparation of a fire safety plan. Buildings with elaborate emergency systems may require the assistance of a fire protection consultant. After the plan has been prepared, it must be submitted to the Chief Fire Official or authority having jurisdiction for approval. Once approved, the owner is responsible for implementing the fire safety plan and training all staff in their duties. It is also the owner's responsibility to ensure that all visitors and staff are informed of what to do in case of fire. During a fire emergency, a copy of the approved fire safety plan must be available for the responding fire departments use.

Fire safety plan structure includes:

- Key contact information
- Utility services (including shut-off valves for water, gas and electric)
- Access issues
- Dangerous stored materials
- Location of people with special needs
- Connections to sprinkler system
- Layout, drawing, and site plan of building
- Maintenance schedules for life safety systems
- Personnel training and fire drill procedures

Fire safety plans are a useful tool for fire fighters to have because they allow them to know critical information about a building that they may have to go into. Using this, fire fighters can locate and avoid potential dangers such as hazardous material storage areas and flammable chemicals.

In addition to this, fire safety plans can also provide specialized information that, in the case of a hospital fire, can provide information about the location of things like the nuclear medicine ward. In addition to this, fire safety plans also greatly improve the safety of fire fighters. According to FEMA, 16 percent of all fire fighter deaths in 2002 occurred due to a structural collapse or because the fire fighter got lost. Fire safety plans can outline any possible structural hazards, as well as give the fire fighter knowledge of where he is in the building.

In North America alone, there are around 8 million buildings that legally require a fire safety plan, be it due to provincial or state law. Not having a fire safety plan for buildings which fit the fire code occupancy type can result in a fine, and they are required for all buildings, such as commercial, industrial, assembly, etc.

As previously stated, a copy of the approved fire safety plan shall be available for the responding fire department. This, however, is not always the case. Up until now, all fire plans were stored in paper form in the fire department. The problem with this is that sorting and storing these plans is a challenge, and it is difficult for people to update their fire plans. As a result, only half of the required buildings have fire plans, and of those, only around 10 percent of are up-to-date. This problem has been solved through the introduction of digital fire plans. These fire plans are stored in a database and can be accessed wirelessly on site by firefighters and are much simpler for building owners to update.

X. Ask the question to every passage of the text.

XI. Retell the text in 8-10 sentences. Use the questions from the exercise IV as a plan. Be ready to answer the questions.

!	**XII. Make the dialogues** between fire safety plan developer and the chief of the enterprise discussing the components of fire safety plan.

XIII. Prepare yourself for the discussion: “Fire safety: what should be done in order to eliminate fire risks”.

UNIT VII
JOB SAFETY

I. Study the following words and word combinations.

tool	инструмент
to eliminate	исключать
job performance	коэффициент выполнения норм
reasonably	корректно, достаточно
to adjust	регулировать, приспосабливать
associated with	связанный с
to mitigate	уменьшать, смягчать
to list	перечислять
severity	строгость
to share	делить, делиться
to evaluate	оценивать

II. Read and translate the definitions of the following terms.

ALARP

stands for "as low as reasonably practicable", and is a term often used in the milieu of safety-critical and safety-involved systems. The ALARP principle is that the residual risk shall be as low as reasonably practicable. It has particular connotations as a route to reduce risks SFAIRP (as far as is reasonably practicable) in UK Health and Safety law. For a risk to be ALARP it must be possible to demonstrate that the cost involved in reducing the risk further would be grossly disproportionate to the benefit gained. The ALARP principle arises from the fact that infinite time, effort and money could be spent on the attempt of reducing a risk to zero.

Safety management system

is a term used to refer to a comprehensive business management system designed to manage safety elements in the workplace. A SMS is intended to act as a framework to allow an organization, as a minimum, to meet its legal obligations under occupational health and safety law. The structure of a SMS is not of itself a legal requirement but it is an extremely effective tool to organize the myriad aspects of occupational safety and health (OSH) that can exist within an organization, often to meet standards which exceed the minimum legal requirement.

Reliability engineering

is an engineering field that deals with the study, evaluation, and life-cycle management of reliability: the ability of a system or component to perform its required functions under stated conditions for a specified period of time. Reliability engineering is a sub-discipline within systems engineering. Reliability is often measured as probability of failure, frequency of failures, or in terms of availability, a probability derived from reliability and maintainability. Maintainability and maintenance are often important parts of reliability engineering.

Risk assessment

is a step in a risk management procedure. Risk assessment is the determination of quantitative or qualitative value of risk related to a concrete situation and a recognized threat (also called hazard). Quantitative risk assessment requires calculations of two components of risk (R): the magnitude of the potential loss (L), and the probability (p) that the loss will occur. In all types of engineering of complex systems sophisticated risk assessments are often made within Safety engineering and Reliability engineering when it concerns threats to life, environment or machine functioning.

III. Read and translate the text given below.

Job safety analysis. Part I.

Job safety analysis (JSA), also known as job hazard analysis (JHA), activity hazard analysis (AHA) or risk assessment (RA) is a safety management tool in which the risks or hazards of a specific job in the workplace are identified, and then measures to eliminate or control those hazards are determined and implemented. More specifically, a job safety analysis is a process of systematically evaluating certain jobs, tasks, processes or procedures and eliminating or reducing the risks or hazards to as low as reasonably practical (ALARP) in order to protect workers from injury or illness. The JSA process is documented and the JSA document is used in the workplace or at the job site to guide workers in safe job performance. The JSA document is also a living document that is adjusted as conditions warrant.

The JSA process begins with identification of the potential hazards or risks associated with a particular job. Once the hazards are understood, the consequences of those hazards are then identified, followed by control measures to eliminate or mitigate the hazards. A more detailed JSA can be performed by breaking the job into steps and identifying specific hazards and control measures for each job step, providing the worker with a documented set of safe job procedures. Some JSA processes also include a risk assessment that lists the probability of each hazard occurring and the severity of the consequences, as well as the effectiveness of the control measures.

The US Army Corps of Engineers uses a risk assessment code (RAC) to analyze the level of risk associated with each job step.

The end result of a JSA is an easy to understand document that can be shared with workers as part of pre-job and safety meetings, and/or included as part of worker job descriptions. The JSA process can be used to help refine safe work procedures described in safety manuals or standard operating procedures, and the JSA document can serve as a useful tool in training new employees.

It is important to remember that a JSA is not simply a piece of paper; it is a process. Workers and management need to understand that a piece of paper will not make the job safe. Rather, workers and management must understand the risks and hazards associated with the job and know how to utilize the chosen controls in such a way as to eliminate or mitigate those risks. The JSA documents the decisions of this process.

IV. Ask the question to every passage of the text.

V. Retell the text in 8-10 sentences. Use the questions from the exercise IV as a plan. Be ready to answer the questions.

!	**VI. Find the additional information** about risk and safety management systems and present it in the form of short reports. Organize conference and choose the best report.

VII. Study the following words and word combinations.

harm	вред
injury	травма
to cause	вызывать, причинять
to prevent	предотвращать
impact	воздействие, эффект
substitution	замена
to alter	вносить изменения
sentiment	*зд.* отношение
to echo	отражать
exposure	подвергание
to circumvent	*зд.* предотвращать
feasible	осуществимый
blade	лезвие, лопасть
saw	пила
guard	предохранитель
fume	газы
to interact	взаимодействовать

VIII. Read and translate the definitions of the following terms.

Personal protective equipment (PPE)
refers to protective clothing, helmets, goggles, or other garment or equipment designed to protect the wearer's body from injury. The hazards addressed by protective equipment include physical, electrical, heat, chemicals, biohazards, and airborne particulate matter. Protective equipment may be worn for job-related occupational safety and health purposes. "Protective clothing" is applied to traditional categories of clothing, and "protective gear" applies to items such as pads, guards, shields, or masks, and others.

Circuit breaker

is an automatically operated electrical switch designed to protect an electrical circuit from damage caused by overload or short circuit. Its basic function is to detect a fault condition and, by interrupting continuity, to immediately discontinue electrical flow.

Buddy system

is a procedure in which two people, the "buddies", operate together as a single unit so that they are able to monitor and help each other.

Lockout-tagout

is a safety procedure which is used in industry and research settings to ensure that dangerous machines are properly shut off and not started up again prior to the completion of maintenance or servicing work. It requires that hazardous power sources be "isolated and rendered inoperative" before any repair procedure is started. "Lock and tag" works in conjunction with a lock usually locking the device or the power source with the hasp, and placing it in such a position that no hazardous power sources can be turned on. The procedure requires that a tag be affixed to the locked device indicating that it should not be turned on.

Respirator

is a device designed to protect the wearer from inhaling harmful dusts, fumes, vapors, or gas. Respirators come in a wide range of types and sizes used by the military, private industry, and the public. Respirators range from cheaper, single-use, disposable masks to reusable models with replaceable cartridges. There are two main categories: the air-purifying respirator, which forces contaminated air through a filtering element, and the air-supplied respirator, in which an alternate supply of fresh air is delivered. Within each category, different techniques are employed to reduce or eliminate noxious airborne contents.

IX. Read and translate the text given below.

Hazard control

A hazard is the potential for harm. If left uncontrolled, a hazard could result in injury or harm. A hazard can be a physical object, chemical, noise, radiation, extreme heat or cold, electrical energy or anything else that has the potential to cause harm.

A control is anything that will help to "control" the hazard by either preventing it from occurring or minimizing its impact if it does occur. If a hazard cannot be eliminated, steps should be taken so that the consequences of the hazard are as low as reasonably practical (ALARP).

If a workplace hazard cannot be eliminated or replaced with a non-hazardous substitution, it is necessary to implement hazard controls in order to protect the worker.

Controls can be categorized into three main types: engineering (altering the hazard or access to the hazard), administrative (altering the way in which the job is performed) and personal protective equipment, or PPE (altering the worker and his/her contact with the hazard). The U.S. Occupational Safety and Health Administration (OSHA) echoes the sentiments of many health and safety professionals when it states, "the most effective controls are engineering controls that physically change a machine or work environment to prevent employee exposure to the hazard. The more reliable or less likely a hazard control can be circumvented, the better. If this is not feasible, administrative controls may be appropriate. This may involve changing how employees do their jobs”. The generally accepted hierarchy for controls is engineering controls first, administrative controls second and PPE controls third.

The U.S. National Institute for Occupational Health and Safety (NIOSH), a division of the Centers for Disease Control and Prevention (CDC) describes the use of engineering controls as being to, “remove a hazard or place a barrier between the worker and the hazard”. Examples of engineering controls include machine guards on mechanical blades/saws, ventilation systems to control fumes, wetting systems to control dust, circuit breakers and automatic shutoff switches on tanks and high pressure systems.

If a hazard cannot be eliminated or minimized to an acceptable risk level by using engineering controls, administrative controls should be considered. Administrative controls change how a worker interacts with the hazard by setting out recommended policies and procedures to minimize worker contact with the hazard. Examples of administrative controls include developing a step by step procedure for performing the job safely, altering worker schedules to a time of day when the hazard is less likely to occur and designing policies such as a buddy-system or lockout/tagout system (which then becomes an engineering control once the system is shutdown). Required specialized training and permits are also often included in the “administrative controls” category.

If a hazard cannot be eliminated or minimized to an acceptable risk level by using engineering or administrative controls, steps should be taken to protect the worker as he or she interacts with the hazard by using protective clothing or equipment, also known as PPE. Examples of PPE include steel toed shoes, long pants, hard hat, high visibility reflective safety vest, face shield, respirator and ear plugs.

X. Ask the question to every passage of the text.

XI. Retell the text in 8-10 sentences. Use the questions from the exercise X as a plan. Be ready to answer the questions.

!	**XII. Make up dialogues** between the safe manager and industrial director trying to choose the proper form of protection for their employees.

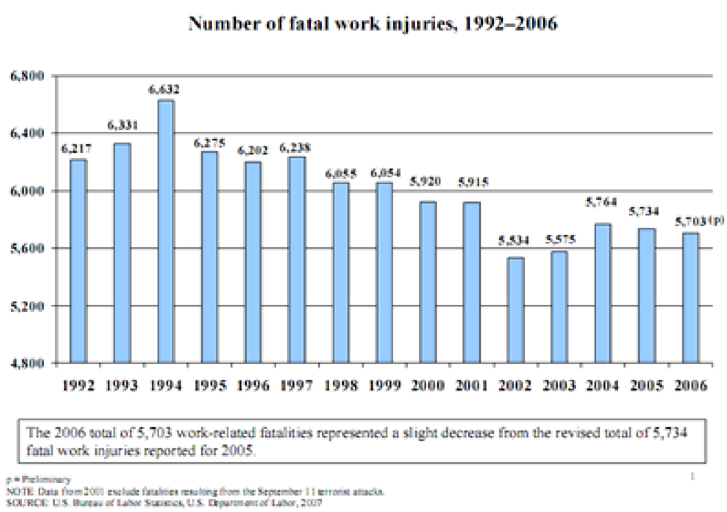
XIII. Study the following words and word combinations.

to discover	обнаружить
invaluable	неоценимый
oversight	упущение
solution	решение
accident	несчастный случай
loss	гибель
to deserve	заслуживать
scrutiny	внимательный осмотр
preliminary	предварительный
brainstorm	мозговой шторм
to pose	*зд.* являться чем-либо
commitment	заинтересованность
unacceptable	неприемлемый
to set priorities	расставить приоритеты
to outline	очертить
breakdown	авария

XIV. Read and translate the definitions of the following terms.

Occupational illness
is any chronic ailment that occurs as a result of work or occupational activity. It is an aspect of occupational safety and health. An occupational disease is typically identified when it is shown that it is more prevalent in a given body of workers than in the general population, or in other worker populations. Occupational hazards that are of a traumatic nature (such as falls by roofers) are not considered to be occupational diseases.

Occupational safety and health (OSH)
is a cross-disciplinary area concerned with protecting the safety, health and welfare of people engaged in work or employment. The goals of occupational safety and health programs include fostering a safe and healthy work environment. OSH may also protect co-workers, family members, employers, customers, and many others who might be affected by the workplace environment.



XV. Read and translate the text given below.

Job safety analysis. Part II.

Often, employers, foremen, supervisors and health and safety professionals conduct job safety analyses, which are then reviewed with and/or by workers performing the job. At other times, workers may discover a task on the job site which does not have a written JSA, and may conduct their own JSA on the job site before beginning the task.

What should you do in order to conduct/create a JSA?

1. Involve your employees. It is very important to involve your employees in the hazard analysis process. They have a unique understanding of the job, and this knowledge is invaluable for finding hazards. Involving employees will help minimize oversights, ensure a quality analysis, and get workers to “buy in” to the solutions because they will share ownership in their safety and health program.

2. Review your accident history. Review with your employees your worksite’s history of accidents and occupational illnesses that needed treatment, losses that required repair or replacement. These events are indicators that the existing hazard controls (if any) may not be adequate and deserve more scrutiny.

3. Conduct a preliminary job review. Discuss with your employees the hazards they know exist in their current work and surroundings. Brainstorm with them for ideas to eliminate or control those hazards. If any hazards exist that pose an immediate danger to a worker’s life or health, take immediate action to protect the worker. Any problems that can be corrected easily should be corrected as soon as possible. Do not wait to complete your job safety analysis. This will demonstrate your commitment to safety and health and enable you to focus on the hazards and jobs that need more study because of their complexity. For those hazards determined to present unacceptable risks, evaluate types of hazard controls.

4. List, rank, and set priorities for hazardous jobs. List jobs with hazards that present unacceptable risks, and rank them based on those most likely to occur and those with the most severe consequences. These jobs should be your first priority for analysis.

5. Outline the steps or tasks. Nearly every job can be broken down into job tasks or steps. When beginning a job safety analysis, watch the employee perform the job and list each step as the employee takes it. Be sure to record enough information to describe each job action without getting overly detailed. Avoid making the breakdown of steps so detailed that it becomes unnecessarily long or so broad that it does not include basic steps. You may find it valuable to get input from other workers who have performed the same job. Later, review the job steps with the employee to make sure you have not omitted something. Point out that you are evaluating the job itself, not the employee's job performance. Include the employee in all phases of the analysis – from reviewing the job steps and procedures to discussing uncontrolled hazards and recommended solutions.

Be sure to document your findings in order to create a written record of your JSA.

XVI. Study the following words and word combinations.

contributing	способствующий
consistent	последовательный
to precipitate	*зд.* дать толчок
trigger	спусковой крючок
to line up	выстраиваться
snag	помеха
to encounter	сталкиваться
pulley	шкив
severe	серьёзный

XVII. Read and translate the text given below.

Job safety analysis. Part III.

A job safety analysis is an exercise in detective work. Your goal is to discover the following:

- What can go wrong?
- What are the consequences?
- How could the hazard arise?
- What are other contributing factors?
- How likely is it that the hazard will occur?

To make your job safety analysis useful, document the answers to these questions in a consistent manner. Describing a hazard in this way helps to ensure that your efforts to eliminate the hazard and implement hazard controls help target the most important contributors to the hazard.

Good hazard scenarios describe:

- Where it is happening (environment),
- To whom or what it is happening (exposure),
- What precipitates the hazard (trigger),
- The outcome that would occur should it happen (consequence),
- Any other contributing factors?

Rarely is a hazard a simple case of one singular cause resulting in one singular effect. More frequently, many contributing factors tend to line up in a certain way to create the hazard. Here is an example of a hazard scenario:

In the metal shop (environment), snags in a machine are periodically encountered and need be cleared (trigger). The worker uses his hand (exposure) to clear the snag from a rotating pulley.

To perform a job safety analysis, you would ask:

- What can go wrong? The worker's hand could come into contact with a rotating object that "catches" it and pulls it into the machine.
- What are the consequences? The worker could receive a severe injury or lose fingers or hand.
- How could it happen? The accident could happen as a result of the worker trying to clear a snag during operations or as part of a

maintenance activity while the pulley is operating. Obviously, this hazard scenario could not occur if the pulley is not rotating.

- What are other contributing factors? Because this hazard occurs very quickly, it does not give the worker much opportunity to recover or prevent it once his hand comes into contact with the pulley. This is an important contributing factor to note, because it helps you determine the severity and likelihood of the accident when selecting appropriate hazard controls.
- How likely is it that the hazard will occur? In the example, the likelihood that the hazard will occur is high because there is no guard preventing contact, and the operation is performed while the machine is running. Other factors to consider include past "near-misses" or actual cases, which show that the likelihood of recurrence is high, and if the pulley is exposed and easily accessible, also contributing to a high likelihood of occurrence. By following the steps in this example, you can organize your hazard analysis activities.
- What can be done to eliminate or minimize the hazard? In the example, we see that the rotating pulley is a hazard to the worker's hand. One way we could "control" this hazard is to install a machine guard to provide a barrier between the worker's hand and the rotating pulley. This is an engineering control. We could also implement an administrative control. Issuing a policy that requires the worker to power off the machine any time there is a snag would be an example of an administrative control. This will prevent the worker's hand from making contact with the pulley while it is rotating.

Our JSA for this scenario would include a description of the job the worker is performing (grinding metal), the types of hazards the worker could encounter (including the example above, as well as any other hazards that could occur) and the different ways in which those potential hazards will be eliminated or minimized.

Practical questions you might ask to help identify potential hazards include:

- Can any body part get caught in or between objects?
- Do tools, machines or equipment present any hazards?
- Can the worker make harmful contact with moving objects?

- Can the worker slip, trip or fall?
- Can the worker suffer strain from lifting, pushing or pulling?
- Is the worker exposed to extreme heat or cold?
- Is excessive noise or vibration a problem?
- Is there a danger from falling objects?
- Is lighting a problem?
- Can weather conditions affect safety?
- Is harmful radiation a possibility?
- Can contact be made with hot, toxic or caustic substances?
- Are there dusts, fumes, mists or vapors in the air?
- Can any foreign object contact the eyes?

XVIII. Ask the question to every passage of the text.

XIX. Retell the text in 8-10 sentences. Use the questions from the exercise XVIII as a plan. Be ready to answer the questions.

!	**XX. Describe** one the possible accidents in your professional area using hazard scenario**.** What measure should be undertaken in order to eliminate hazardous situation?

XXI. Prepare yourself for the discussion: "How can we improve job safety (in mining or chemistry)".

SUPPLEMENTARY READING

UNIT VIII
WATER PURIFICATION

Water purification

Water purification is the process of removing undesirable chemicals, biological contaminants, suspended solids and gases from contaminated water. The goal is to produce water fit for a specific purpose. Most water is purified for human consumption (drinking water), but water purification may also be designed for a variety of other purposes, including meeting the requirements of medical, pharmacological, chemical and industrial applications. In general the methods used include physical processes such as filtration, sedimentation, and distillation, biological processes such as slow sand filters or biologically active carbon, chemical processes such as flocculation and chlorination and the use of electromagnetic radiation such as ultraviolet light.

The purification process of water may reduce the concentration of particulate matter including suspended particles, parasites, bacteria, algae, viruses, fungi; and a range of dissolved and particulate material derived from the surfaces that water may have made contact with after falling as rain.

The standards for drinking water quality are typically set by governments or by international standards. These standards will typically set minimum and maximum concentrations of contaminants for the use that is to be made of the water.

It is not possible to tell whether water is of an appropriate quality by visual examination. Simple procedures such as boiling or the use of a household activated carbon filter are not sufficient for treating all the possible contaminants that may be present in water from an unknown source. Even natural spring water – considered safe for all practical purposes in the 19th century – must now be tested before determining what kind of treatment, if any, is needed. Chemical and microbiological analysis, while expensive, are the only way to obtain the information necessary for deciding on the appropriate method of purification.

According to a 2007 World Health Organization (WHO) report, 1.1 billion people lack access to an improved drinking water supply, 88 percent of the 4 billion annual cases of diarrheal disease are attributed to unsafe water and inadequate sanitation and hygiene, and 1.8 million people die from diarrheal diseases each year. The WHO estimates that 94 percent of these diarrheal cases are preventable through modifications to the environment, including access to safe water. Simple techniques for treating water at home, such as chlorination, filters, and solar disinfection, and storing it in safe containers could save a huge number of lives each year. Reducing deaths from waterborne diseases is a major public health goal in developing countries.

Water purification techniques

The processes below are the ones commonly used in water purification plants. Some or most may not be used depending on the scale of the plant and quality of the raw (source) water.

Pre-treatment techniques

1. Pumping and containment. The majority of water must be pumped from its source or directed into pipes or holding tanks. To avoid adding contaminants to the water, this physical infrastructure must be made from appropriate materials and constructed so that accidental contamination does not occur.

2. Screening. The first step in purifying surface water is to remove large debris such as sticks, leaves, rubbish and other large particles which may interfere with subsequent purification steps. Most deep groundwater does not need screening before other purification steps.

3. Storage. Water from rivers may also be stored in bankside reservoirs for periods between a few days and many months to allow natural biological purification to take place. This is especially important if treatment is by slow sand filters. Storage reservoirs also

provide a buffer against short periods of drought or to allow water supply to be maintained during transitory pollution incidents in the source river.

4. Pre-chlorination. In many plants the incoming water was chlorinated to minimize the growth of fouling organisms on the pipe-work and tanks. Because of the potential adverse quality effects (see chlorine below), this has largely been discontinued.

Widely varied techniques are available to remove the fine solids, micro-organisms and some dissolved inorganic and organic materials. The choice of method will depend on the quality of the water being treated, the cost of the treatment process and the quality standards expected of the processed water.

Treatment techniques

Pure water has a pH close to 7 (neither alkaline nor acidic). Sea water can have pH values that range from 7.5 to 8.4 (moderately alkaline). Fresh water can have widely ranging pH values depending on the geology of the drainage basin or aquifer and the influence of contaminant inputs (acid rain). The water being acidic (lower than 7), lime, soda ash, or sodium hydroxide can be added to raise the pH during water purification processes. Lime addition increases the calcium ion concentration, thus raising the water hardness. For highly acidic waters, forced draft degasifiers can be an effective way to raise the pH, by stripping dissolved carbon dioxide from the water. Making the water alkaline helps coagulation and flocculation processes work effectively and also helps to minimize the risk of lead being dissolved from lead pipes and from lead solder in pipe fittings. Sufficient alkalinity also reduces the corrosiveness of water to iron pipes. Acid (carbonic acid, hydrochloric acid or sulfuric acid) may be added to alkaline waters in some circumstances to lower the pH. Alkaline water (above pH 7.0) does not necessarily mean that lead or copper from the plumbing system will not be dissolved into the water. The ability of water to precipitate calcium carbonate to protect metal surfaces and reduce the likelihood of toxic metals being dissolved in water is a function of pH, mineral content, temperature, alkalinity and calcium concentration.

Sewage treatment

Sewage treatment is the process of removing contaminants from wastewater and household sewage, both runoff (effluents) and domestic. It includes physical, chemical, and biological processes to remove physical, chemical and biological contaminants. Its objective is to produce an environmentally safe fluid waste stream (or treated effluent) and a solid waste (or treated sludge) suitable for disposal or reuse (usually as farm fertilizer). Using advanced technology it is now possible to re-use sewage effluent for drinking water, although Singapore is the only country to implement such technology on a production scale in its production of NEWater.

Sewage is generated by residential, institutional, and commercial and industrial establishments. It includes household waste liquid from toilets, baths, showers, kitchens, sinks and so forth that is disposed of via sewers. In many areas, sewage also includes liquid waste from industry and commerce. The separation and draining of household waste into greywater and blackwater is becoming more common in the developed world, with greywater being permitted to be used for watering plants or recycled for flushing toilets.

Sewage may include stormwater runoff. Sewerage systems capable of handling stormwater are known as combined sewer systems. This design was common when urban sewerage systems were first developed, in the late 19th and early 20th centuries. Combined sewers require much larger and more expensive treatment facilities than sanitary sewers. Heavy volumes of storm runoff may overwhelm the sewage treatment system, causing a spill or overflow. Sanitary sewers are typically much smaller than combined sewers, and they are not designed to transport stormwater. Backups of raw sewage can occur if excessive infiltration/inflow (dilution by stormwater and/or groundwater) is allowed into a sanitary sewer system. Communities that have urbanized in the mid-20th century or later generally have built separate systems for sewage (sanitary sewers) and stormwater, because precipitation causes widely varying flows, reducing sewage treatment plant efficiency.

As rainfall travels over roofs and the ground, it may pick up various contaminants including soil particles and other sediment, heavy metals, organic compounds, animal waste, and oil and grease. Some jurisdictions require stormwater to receive some level of treatment before being discharged directly into waterways. Examples of treatment processes used for stormwater include retention basins, wetlands, buried vaults with various kinds of media filters, and vortex separators (to remove coarse solids).

Sewage can be treated close to where it is created, a decentralised system (in septic tanks, biofilters or aerobic treatment systems), or be collected and transported by a network of pipes and pump stations to a municipal treatment plant, a centralised system (see sewerage and pipes and infrastructure). Sewage collection and treatment is typically subject to local, state and federal regulations and standards. Industrial sources of sewage often require specialized treatment processes (see Industrial wastewater treatment).

Sewage treatment generally involves three stages, called primary, secondary and tertiary treatment.

- *Primary treatment* consists of temporarily holding the sewage in a quiescent basin where heavy solids can settle to the bottom while oil, grease and lighter solids float to the surface. The settled and floating materials are removed and the remaining liquid may be discharged or subjected to secondary treatment.
- *Secondary treatment* removes dissolved and suspended biological matter. Secondary treatment is typically performed by indigenous, water-borne micro-organisms in a managed habitat. Secondary treatment may require a separation process to remove the micro-organisms from the treated water prior to discharge or tertiary treatment.
- *Tertiary treatment* is sometimes defined as anything more than primary and secondary treatment in order to allow rejection into a highly sensitive or fragile ecosystem. Treated water is sometimes disinfected chemically or physically (for example, by lagoons and microfiltration) prior to discharge into a stream, river, bay, lagoon or wetland, or it can be used for the irrigation of a golf course, green way or park. If it is sufficiently clean, it can also be used for groundwater recharge or agricultural purposes.

UNIT IX
ENVIRONMENTAL REMEDIATION

Environmental remediation

Environmental remediation deals with the removal of pollution or contaminants from environmental media such as soil, groundwater, sediment, or surface water for the general protection of human health and the environment or from a brownfield site intended for redevelopment. Remediation is generally subject to an array of regulatory requirements, and also can be based on assessments of human health and ecological risks where no legislated standards exist or where standards are advisory.

Remediation technologies are many and varied but can be categorized into ex-situ and in-situ methods. Ex-situ methods involve excavation of effected soils and subsequent treatment at the surface, In-situ methods seek to treat the contamination without removing the soils.

The more traditional remediation approach (used almost exclusively on contaminated sites from the 1970s to the 1990s) consists primarily of soil excavation and disposal to landfill "dig and dump" and groundwater "pump and treat". In situ technologies include Solidification and Stabilization and have been used extensively in the USA.

Excavation or dredging

Excavation processes can be as simple as hauling the contaminated soil to a regulated landfill, but can also involve aerating the excavated material in the case of volatile organic compounds (VOCs). Recent advancements in bioaugmentation and biostimulation of the excavated material have also proven to be able to remediate semi-volatile organic compounds (SVOCs) onsite. If the contamination affects a river or bay bottom, then dredging of bay mud or other silty clays containing contaminants may be conducted. Recently, ExSitu Chemical oxidation has also been utilized in the remediation of contaminated soil. This process involves the excavation of the contaminated area into large bermed areas where they are treated using chemical oxidation methods.

Surfactant Enhanced Aquifer Remediation

The Surfactant Enhanced Aquifer Remediation process involves the injection of hydrocarbon mitigation agents or specialty surfactants into the subsurface to enhance desorption and recovery of bound up otherwise recalcitrant non aqueous phase liquid (NAPL).

In geologic formations that allow delivery of hydrocarbon mitigation agents or specialty surfactants, this approach provides a cost effective and permanent solution to sites that have been previously unsuccessful utilizing other remedial approaches. This technology is also successful when utilized as the initial step in a multi faceted remedial approach utilizing SEAR then In situ Oxidation, bioremediation enhancement or soil vapor extraction (SVE).

Pump and treat

Pump and treat involves pumping out contaminated groundwater with the use of a submersible or vacuum pump, and allowing the extracted groundwater to be purified by slowly proceeding through a series of vessels that contain materials designed to absorb the contaminants from the groundwater. For petroleum-contaminated sites this material is usually activated carbon in granular form. Chemical reagents such as flocculants followed by sand filters may also be used to decrease the contamination of groundwater. Air stripping is a method that can be effective for volatile pollutants such as BTEX compounds found in gasoline.

For most biodegradable materials like BTEX, MTBE and most hydrocarbons, bioreactors can be used to clean the contaminated water to non-detectable levels. With fluidized bed bioreactors it is possible to achieve very low discharge concentrations which will meet or exceed discharge standards for most pollutants.

Depending on geology and soil type, pump and treat may be a good method to quickly reduce high concentrations of pollutants. It is more difficult to reach sufficiently low concentrations to satisfy remediation standards, due to the equilibrium of absorption (chemistry)/desorption processes in the soil.

Solidification and stabilization

Solidification/stabilization work has a reasonably good track record but also a set off serious deficiencies related to durability of solutions and potential long-term effects. In addition CO_2 emissions due to the use of cement are also becoming a major obstacle to its widespread use in solidification/stabilization projects.

Stabilization/solidification (S/S) is a remediation/treatment technology that relies on the reaction between a binder and soil to stop/prevent or reduce the mobility of contaminants.

Stabilization involves the addition of reagents to a contaminated material (e.g. soil or sludge) to produce more chemically stable constituents. Solidification involves the addition of reagents to a contaminated material to impart physical/dimensional stability to contain contaminants in a solid product and reduce access by external agents (e.g. air, rainfall).

Conventional S/S is an established remediation technology for contaminated soils and treatment technology for hazardous wastes in many countries in the world. However, the uptake of S/S technologies has been relatively modest, and a number of barriers have been identified including:

- the relatively low cost and widespread use of disposal to landfill;
- the lack of authoritative technical guidance on S/S;
- uncertainty over the durability and rate of contaminant release from S/S-treated material;
- experiences of past poor practice in the application of cement stabilization processes used in waste disposal in the 1980s and 1990s (ENDS, 1992); and
- residual liability associated with immobilized contaminants remaining on-site, rather than their removal or destruction.

In situ oxidation

New in situ oxidation technologies have become popular, for remediation of a wide range of soil and groundwater contaminants. Remediation by chemical oxidation involves the injection of strong oxidants such as hydrogen peroxide, ozone gas, potassium permanganate or persulfates.

Oxygen gas or ambient air can also be injected to promote growth of aerobic bacteria which accelerate natural attenuation of organic contaminants. One disadvantage of this approach is the possibility of decreasing anaerobic contaminant destruction natural attenuation where existing conditions enhance anaerobic bacteria which normally live in the soil prefers a reducing environment. In general though, aerobic activity is much faster than anaerobic and overall destruction rates are typically greater when aerobic activity can be successfully promoted.

The injection of gases into the groundwater may also cause contamination to spread faster than normal depending on the site's hydrogeology. In these cases, injections downgradient of groundwater flow may provide adequate microbial destruction of contaminants prior to exposure to surface waters or drinking water supply wells.

Migration of metal contaminants must also be considered whenever modifying subsurface oxidation-reduction potential. Certain metals are more soluble in oxidizing environments while others are more mobile in reducing environments.

UNIT X
DANGERS TO MINERS

Historically, coal mining has been a very dangerous activity and the list of historical coal mining disasters is a long one. In the US alone, more than 100,000 coal miners were killed in accidents over the past century, with more than 3,200 dying in 1907 alone. Open cut hazards are principally mine wall failures and vehicle collisions; underground mining hazards include suffocation, gas poisoning, roof collapse and gas explosions.

Firedamp explosions can trigger the much more dangerous coal dust explosions, which can engulf an entire pit. Most of these risks can be greatly reduced in modern mines, and multiple fatality incidents are now rare in some parts of the developed world. Modern mining in the US results in approximately 30 deaths per year due to mine accidents.

However, in lesser developed countries and some developing countries, many miners continue to die annually, either through direct accidents in coal mines or through adverse health consequences from working under poor conditions. China, in particular, has the highest number of coal mining related deaths in the world, with official statistics claiming that 6,027 deaths occurred in 2004. To compare, 28 deaths were reported in the US in the same year. Coal production in China is twice that in the US, while the number of coal miners is around 50 times that of the US, making deaths in coal mines in China 4 times as common per worker (108 times as common per unit output) as in the US.

In 2006, fatal work injuries among miners in the US doubled from the previous year, totaling 47. These figures can in part be attributed to the Sago Mine disaster of January 2006. The 2007 mine accident in Utah's Crandall Canyon Mine, where nine miners were killed and six entombed, speaks to the increase in occupational risks faced by US miners. More recently, the Upper Big Branch Mine disaster in West Virginia killed 29 miners in April 2010.

Chronic lung diseases, such as pneumoconiosis (black lung) were once common in miners, leading to reduced life expectancy. In some mining countries black lung is still common, with 4,000 new cases of black lung every year in the US (4 percent of workers annually) and 10,000 new cases every year in China (0.2 percent of workers). Rates may be higher than reported in some regions.

Build-ups of a hazardous gas are known as damps, possibly from the German word “Dampf” which means steam or vapor:

- Black damp: a mixture of carbon dioxide and nitrogen in a mine can cause suffocation, and is formed as a result of corrosion in enclosed spaces so removing oxygen from the atmosphere.
- After damp: similar to black damp, after damp consists of carbon monoxide, carbon dioxide and nitrogen and forms after a mine explosion.
- Fire damp: consists of mostly methane, a highly flammable gas that explodes between 5% and 15% ⍰ at 25% it causes asphyxiation.
- Stink damp: so named for the rotten egg smell of the hydrogen sulphide gas, stink damp can explode and is also very toxic.
- White damp: air containing carbon monoxide which is toxic, even at low concentrations

Improvements in mining methods (e.g. longwall mining), hazardous gas monitoring (such as safety-lamps or more modern electronic gas monitors), gas drainage, electrical equipment, and ventilation have reduced many of the risks of rock falls, explosions, and unhealthy air quality. Statistical analyses performed by the US Department of Labor’s Mine Safety and Health Administration (MSHA) show that between 1990 and 2004, the industry cut the rate of injuries by more than half and fatalities by two-thirds. However, according to the Bureau of Labor Statistics, mining remains the second most dangerous occupation in America.

New braces called Atlas Cribs contain a mix of hardwoods and a main lateral element that make these braces stronger than other braces used in the past. The new cribbing system takes up 41 percent less area than existing ones and may be up to 50 percent more efficient in terms of airflow.

The improved safety features in Australian mining has dramatically increased the forecasted improvement in the deficit to average life expectancy of the working male. It is envisioned that within 17 years, life expectancy of mine workers will be on par with the average male Australian.

The environmental impact of the coal industry

The environmental impact of the coal industry includes the consideration of issues such as land use, waste management, and water and air pollution caused by the coal mining, processing and the use of its products. In addition to atmospheric pollution, coal burning produces hundreds of millions of tons of solid waste products annually, including fly ash, bottom ash, and flue-gas desulfurization sludge that contain mercury, uranium, thorium, arsenic, and other heavy metals.

There are severe health effects caused by burning coal. According to the reports issued by the World Health Organization in 2008 and by environmental groups and 2004, coal particulates pollution are estimated to shorten approximately 1,000,000 lives annually worldwide, including nearly 24,000 lives a year in the United States. Coal mining generates significant additional independent adverse environmental health impacts, among them the polluted water flowing from mountaintop removal mining.

A major EU funded research study known as ExternE, or Externalities of Energy, undertaken over the period of 1995 to 2005 found that the cost of producing electricity from coal would double over its present value, if external costs such as damage to the environment and to human health, from the airborne particulate matter, nitrogen oxides, chromium VI and arsenic emissions produced by coal, were taken into account. It was estimated in the study that external, downstream, fossil fuel costs amount up to 1%-2% of the EU's entire Gross Domestic Product (GDP), with coal the main fossil fuel accountable for this, and this was before the external cost of global warming from these sources was even included. The study also found that the environmental and health costs of coal alone were €0.06/kWh, or 6 cents/kWh, with the energy sources of the lowest external costs associated with them being nuclear power €0.0019/kWh, and wind power at €0.0009/kWh.

Strip mining severely alters the landscape, which reduces the value of the natural environment in the surrounding land. The land surface is dedicated to mining activities until it can be reshaped and reclaimed. If mining is allowed, resident human populations must be resettled off the mine site; economic activities, such as agriculture or hunting and gathering food and medicinal plants are interrupted. What becomes of the land surface after mining is determined by the manner in which the mining is conducted. Usually reclamation of disturbed lands to a land use condition is not equal to the original use. Existing land uses (such as livestock grazing, crop and timber production) are temporarily eliminated from the mining area. High-value, intensive-land-use areas like urban and transportation systems are not usually affected by mining operations. If mineral values are sufficient, these improvements may be removed to an adjacent area.

Strip mining eliminates existing vegetation, destroys the genetic soil profile, displaces or destroys wildlife and habitat, alters current land uses, and to some extent permanently changes the general topography of the area mined. Adverse impacts on geological features of human interest may occur in a coal strip mine. Geomorphic and geophysical features and outstanding scenic resources may be sacrificed by indiscriminate mining. Paleontological, cultural, and other historic values may be endangered due to the disruptive activities of blasting, ripping, and excavating coal. Stripping of overburden eliminates and destroys archeological and historic features, unless they are removed beforehand.

The removal of vegetative cover and activities associated with the construction of haul roads, stockpiling of topsoil, displacement of overburden and hauling of soil and coal increase the quantity of dust around mining operations. Dust degrades air quality in the immediate area, has an adverse impact on vegetative life, and constitutes health and safety hazards for mine workers and nearby residents.

Surface mining disrupts virtually all aesthetic elements of the landscape. Alteration of landforms often imposes unfamiliar and discontinuous configurations. New linear patterns appear as material is extracted and waste piles are developed. Different colors and textures are exposed as vegetative cover is removed and overburden dumped to the side. Dust, vibration, and diesel exhaust odors are created (affecting sight, sound, and smell). Residents of local communities often find such impacts disturbing or unpleasant. In case of mountaintop removal, tops are removed from mountains or hills to expose thick coal seams underneath. The soil and rock removed is deposited in nearby valleys, hollows and depressions, resulting in blocked (and contaminated) waterways.

Removal of soil and rock overburden covering the coal resource may cause burial and loss of topsoil, exposes parent material, and creates large infertile wastelands. Soil disturbance and associated compaction result in conditions conducive to erosion. Soil removal from the area to be surface-mined alters or destroys many natural soil characteristics, and reduces its biodiversity and productivity for agriculture. Soil structure may be disturbed by pulverization or aggregate breakdown.

Mine collapses (or mine subsidences) have the potential to produce major effects above ground, which are especially devastating in developed areas. German underground coal-mining (especially in North Rhine-Westphalia) has damaged thousands of houses, and the coal-mining industries have set aside large sums in funding for future subsidence damages as part of their insurance and state-subsidy schemes. In a particularly spectacular case in the German Saar region (another historical coal-mining area), a suspected mine collapse in 2008 created an earthquake measuring 4.0 on the Richter magnitude scale, causing some damage to houses. Previously, smaller earthquakes had become increasingly common and coal mining was temporarily suspended in the area.

In response to negative land effects of coal mining and the abundance of abandoned mines in the US the federal government enacted the Surface Mining Control and Reclamation Act of 1977, which requires reclamation plans for future coal mining sites. These plans must be approved by federal or state authorities before mining begins. As of 2003, over 2 million acres (8,000 km^2) of previously mined lands have been reclaimed in the United States.

Coal and coal waste products (including fly ash, bottom ash and boiler slag) releases approximately 20 toxic-release chemicals, including arsenic, lead, mercury, nickel, vanadium, beryllium, cadmium, barium, chromium, copper, molybdenum, zinc, selenium and radium, which are dangerous if released into the environment. While these substances are trace impurities, enough coal is burned that significant amounts of these substances are released.

During combustion, the reaction between coal and the air produces oxides of carbon, including carbon dioxide (CO_2 (an important greenhouse gas)), oxides of sulfur (mainly sulfur dioxide) (SO_2), and various oxides of nitrogen (NO_x). Because of the hydrogenous and nitrogenous components of coal, hydrides and nitrides of carbon and sulfur are also produced during the combustion of coal in air. These include hydrogen cyanide (HCN), sulfur nitrate (SNO_3) and other toxic substances.

Further, acid rain may occur when sulfur dioxide produced by the combustion of coal reacts with oxygen to form sulfur trioxide (SO_3); this reacts with water molecules in the atmosphere to form sulfuric acid. The sulfuric acid (H_2SO_4) returns to earth as acid rain. Flue-gas desulfurization scrubbing systems, which use lime to remove sulfur dioxide, can reduce the likelihood of acid rain.

However, another form of acid rain is due to carbon dioxide emissions of a coal plant. When released into the atmosphere, the carbon dioxide molecules react with water molecules, to slowly produce carbonic acid (H_2CO_3). This, in turn, returns to the earth as a corrosive substance. This cannot be prevented as easily as sulfur-dioxide emissions.

Fires sometimes occur in coal beds underground. When coal beds are exposed, the fire risk is increased. Weathered coal can also increase ground temperatures if it is left on the surface. Almost all fires in solid coal are ignited by surface fires caused by people or lightning. Spontaneous combustion is caused when coal oxidizes and airflow is insufficient to dissipate heat; this more commonly occurs in stockpiles and waste piles, rarely in bedded coal underground. Where coal fires occur, there is attendant air pollution from emission of smoke and noxious fumes into the atmosphere. Coal seam fires may burn underground for decades, threatening destruction of forests, homes, roadways and other valuable infrastructure. The best-known coal-seam fire may be the one which led to the permanent evacuation of Centralia, Pennsylvania, United States.

Содержание