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АЛМАТИНСКИЙ УНИВЕРСИТЕТ ЭНЕРГЕТИКИ И СВЯЗИ

Кафедра иностранных языков

ПРОФЕССИОНАЛЬНО-ОРИЕНТИРОВАННЫЙ АНГЛИЙСКИЙ ЯЗЫК

Методические указания для развития навыков перевода

профессионально-ориентированных текстов для студентов специальности 5В071700 – Теплоэнергетика

Алматы, 2014

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Данные методические указания предназначены для развития умений чтения и перевода технических текстов в области теплоэнергетики.

Методические указания включают в себя профессионально-ориентированный текстовый материал, упражнения и задания для усвоения терминов по данной специальности.

Материал может найти применение, как на аудиторных занятиях, так и в практике самостоятельной работы с целью формирования иноязычной профессиональной компетенции студентов – бакалавров специальности 5В071700.

Рецензент: канд. фил. наук, доц. В.С. Козлов

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Unit 1

Memorize the words

to convert – превращать, преобразовать;
condensate – конденсат, конденсировать, превращать пар в воду, сгущать, сжимать;
vapour prime mover – паровой двигатель, паровая турбина;
furnace – топка, печь, корпус (многокорпусного котлоагрегата), котел центрального парового отопления.
boiler – котел, котельный агрегат, парогенератор, бойлер, подогреватель;
heater – подогреватель; калорифер;
heat exchanger – теплообменник;
drum – барабан, цилиндр;
boiling tube – кипятильные трубы котла;
coil – обмотка, катушка;
pump – насос, помпа; качать, накачивать, откачивать;
dust collector – коллектор пылеуловитель, пылевая камера, пылесборник;
duct –труба; трубопровод; канал, проход; туннель; короб, проходить, течь по каналу или трубе;
storage – запас, накопление, сборник, емкость;
pulverizer – распылитель, мельница для тонкого разлома;
feeder – питатель; подающий механизм, фидер;
fun – вентилятор;
suspension – взвесь; взвешенное состояние;
burner – горелка, форсунка;
hotwell – сборник конденсата; сборник горячей воды;
psi (pound per square inch) – фунтов на квадратный дюйм.

Text 1. The steam power plant

Do the following tasks:

1) Match English words and word combination with their Russian equivalents.

To convert, to discharge, prime mover, condenser, to generate, furnace, super heater, economizer, drum, to evaporate, feed water, chimney, pump, boiler, heat exchanger, combustion, dust collector, induced draft fan, forced-draft fan, pulverizer.

Конденсатор, газоохладитель; превращать; вырабатывать; разгружать, выпускать, выбрасывать; первичный двигатель, источник энергии; печь; цилиндр; пароперегреватель; питательная вода; подогреватель; испарять; дымовая труба, дымоход; теплообменник; искусственная вентиляция; насос; сгорание, воспламенение, возгорание; котел; пылевая камера, пылесборник; принудительная вентиляция; распылитель, мельница для тонкого размола.

2) Make up 10 questions about the text and let your neighbour answer them, then change parts.

3) Retell each part of the text separately.

4) Give a written translation of the text into Russian.

The steam power plant

The function of a steam power plant is to convert the energy in nuclear reactions or in coal, oil or gas into mechanical or electric energy through the expansion of steam from a high pressure to a low pressure in a suitable prime mover such as a turbine or engine. A non-condensing plant discharges the steam from the prime mover at an exhaust pressure equal to or greater than atmospheric pressure.

In general, central-station plants are condensing plants since their sole outputs is electric energy and a reduction in the exhaust pressure at the prime mover decrease the amount of steam required to produce a given quantity of electric energy. Industrial plants are frequently non-condensing plants because large quantities of low pressure steam are required for manufacturing operations. The power required for operation of a manufacturing plant may often be obtained as a by-product by generating steam at high pressure and expanding this steam in a prime mover to the back pressure at which the steam is needed for manufacturing processes.

The steam generating unit consists of a furnace in which the fuel is burnt, a boiler, super heater, and economizer, in which high pressure steam is generated, and an air heater in which the loss of the energy due to combustion of the fuel is reduced to a minimum. The boiler is composed of a drum, in which a water level is maintained at about the mid-point so as to permit water to circulate from the drum through the tubes and back to the drum. The hot products of combustions from the furnace flow across the boiler tubes and evaporate part of the water in the tubes. The furnace walls are composed of tubes which are also connected to the boiler drum to form very effective steam-generating surfaces. The steam which is separated from the water in the boiler drum then flows through a super heater which is in effect a coil of tubing surrounded by the hot products of combustion. The temperature of the steam is increased in the super heater to perhaps 800° to 1100° F, at which temperature the high-pressure superheated steam flows through suitable piping to the turbine.

Since the gaseous products of combustion leaving the boiler tube bank are at a relatively high temperature and their discharge to the chimney would result in a large loss in energy, an economizer may be used to recover part of the energy in these gases. The economizer is a bank of tubes through which the boiler feed water is pumped on its way to the boiler drum.

A reduction in gas temperature may be made by passing the products of combustion through an air heater which is a heat exchanger cooled by the air required for combustion. This air is supplied to the air heater at normal room temperature and may leave the air heater at 400° to 600° F, thus returning to the furnace energy that would otherwise be wasted up the chimney. The products of combustion are usually cooled in an air heater to an exit temperature of 275° to 400° F, after which they may be passed through a dust collector which will remove objectionable dust and hence through an induced-draft fan to the chimney. The function of the induced-draft fan is to pull the gases through the heat-transfer surfaces of the boiler, super heater, economizer and air heater and to maintain a pressure in the furnace that is slightly less that atmospheric pressure. A forced-draft fan forces the combustion air to flow through the air heater, duct work, and burner into the furnace.

Coal is delivered to the plant in railroad cars or barges which are unloaded by machinery. The coal may be placed in storage or may be crushed and elevated to the overhead raw-coal bunker in the boiler room.

The coal flows by gravity from the overhead bunker to the pulverizer or mill through a feeder which automatically maintains the correct amount of coal in the mill. In the mill the coal is ground to a fine dust. Some of the hot air from the air heater is forced through the mill to dry the coal and to pick up the finely pulverized particles and carry them in suspension to the burner where they are mixed with the air required for their combustion and discharged into the furnace at high velocity to promote good combustion.

The high-pressure, high-temperature steam is expanded in a steam turbine which is generally connected to an electric generator. From 3 to 5 percent of the output of the generator is needed to light the plant and to operate many motors required for fans, pumps, etc., in the plant. the rest of the generator output is available for distribution outside the plant.

The condensed steam, which is normally at a temperature of 70° to 100° F, is pumped out of the condenser by means of a hot-well pump and is discharged through several feed-water heaters to a boiler feed pumps that delivers the water to the economizer.

Most steam power plants of large size are now being built for operation at steam pressures of 1500 to 2400 psi, and in some plants pressures up to 5000 psi are being used. Steam temperatures of 1000° to 1100° F are in general use. Turbine generator capacities of 250,000 kw (1kilowatt =1.34 horsepower) are common, and units of 500,000 kw are in operation. Steam-generating units capable of delivering 3,000.000 1b of steam per hr are now in operation. Overall efficiency of the plant from raw coal supplied to electric energy delivered to the transmission line depends upon size, steam pressure, temperature, and other factors, and 40 percent is now being realized on the basis of a full year of operation.

Text 2. Thermal power station

Do the following tasks:

1) Make up a list of new terms you can find in the text. Translate them into Russian.
2) Read the text. Translate it into Russian.

3) Make up a detailed plan of each part of the text:

a) divide the text into several parts;

b) give each part a heading. Retell each part of the text separately.

4) Write an abstract to the text before doing the writing task read this to help you.

There are two types of abstracts informational and descriptive.

Informational abstracts:

- communicate contents of reports
- include purpose, methods, scope, results, conclusions and recommendations.
- highlight essential points.
- are short – from a paragraph to a page or two, depending upon the length of the report (10% or less of the report)
- allow readers to decide whether they want to read the report.

Descriptive abstracts:

- tell what the report contains
- include purpose, methods, scope, but not results, conclusions and recommendations
- are always very short – usually under 100 words.
- Introduce subject to readers, who must then read the report to learn study results.

Thermal power station

A thermal power station is a power plant in which the prime mover is steam driven. Water is heated, turns into steam and spins a steam turbine which drives an electrical generator. After it passes through the turbine, the steam is condensed in a condenser and recycled to where it was heated; this is known as a Rankine cycle. The greatest variation in the design of thermal power stations is due to the different fossil fuel resources generally used to heat the water. Some prefer to use the term energy center because such facilities convert forms of heat energy into electrical energy. Certain thermal power plants also are designed to produce heat energy for industrial purposes of district heating, or desalination of water, in addition to generating electrical power. Globally, fossil fueled thermal power plants produce a large part of man-made CO_2 emissions to the atmosphere, and efforts to reduce these are varied and widespread.

Almost all coal, nuclear, geothermal, solar thermal electric, and waste incineration plants, as well as many natural gas power plants are thermal. Natural gas is frequently combusted in gas turbines as well as boilers. The waste heat from a gas turbine can be used to raise steam, in a combined cycle plant that improves overall efficiency. Power plants burning coal, fuel oil, or natural gas are often called fossil-fuel power plants. Some biomass-fueled thermal power plants have appeared also. Non-nuclear thermal power plants, particularly fossil-fueled plants, which do not use co-generation are sometimes referred to as conventional power plants.

Commercial electric utility power stations are usually constructed on a large scale and designed for continuous operation. Electric power plants typically use three-phase electrical generators to produce alternating current (AC) electric power at a frequency of 50 Hz or 60 Hz. Large companies or institutions may have their own power plants to supply heating or electricity to their facilities, especially if steam is created anyway for other purposes. Steam-driven power plants have been used in various large ships, but are now usually used in large naval ships. Shipboard power plants usually directly couple the turbine to the ship's propellers through gearboxes. Power plants in such ships also provide steam to smaller turbines driving electric generators to supply electricity. Shipboard steam power plants can be either fossil fuel or nuclear. Nuclear marine propulsion is, with few exceptions, used only in naval vessels. There have been perhaps about a dozen turbo-electric ships in which a steam-driven turbine drives an electric generator which powers an electric motor for propulsion.

Combined heat and power plants (CH&P plants), often called co-generation plants, produce both electric power and heat for process heat or space heating. Steam and hot water lose energy when piped over substantial distance, so carrying heat energy by steam or hot water is often only worthwhile within a local area, such as a ship, industrial plant, or district heating of nearby buildings.

Text 3. Классификация паротурбинных электрических станции

Do the following tasks:

1) Read the text. Translate the underlined terms into English.

2) Make up sentences of your own with the terms used in the text. Let your neighbour translate their Russian versions into English, then change parts.

3) Find in the text following abbreviations and give their full version: HEPGS, SPP, CPS.

Классификация паротурбинных электрических станции

Паровые турбины составляют основное оборудование ТЭС. Кроме этих агрегатов, на электростанциях используются разнообразные машины и механизмы. Среди этих машин большой интерес в отношении *преобразования энергии* представляют машины, предназначенные для *перемещения жидкостей по трубопроводам.* К ним в основном относятся *насосы, вентиляторы* и *компрессоры.* В противоположность тепловым двигателям в этих машинах происходит не преобразование тепловой энергии в механическую, а наоборот – механическая (электрическая) энергия превращается в тепло.

Промышленные и коммунально-бытовые предприятия используют в основном энергию двух видов: электрическую и тепловую. Выработка этих двух видов энергии может производится раздельно, в двух технологических процессах, или совместно – в одном технологическом процессе. Таким образом *паротурбинная электрическая станция* классифицируется на КЭС и ТЭЦ. КЭС – конденсационные электрические станции вырабатывают только электрическую энергию. ТЭЦ – теплоэлектроцентраль вырабатывает тепловую и электрическую энергию одновременно.

Text 4. Теплоэлектроцентрали

Do the following tasks:

1) Read the text and find sentences where the following terms are used. Translate them: вентиляция, очистка, канализация, паропреобразователь, примеси, конденсат.

2) Look through the text. What information did you get about the heat and electric power generating station?

Теплоэлектроцентрали

Источниками тепла в системах централизованного теплоснабжения являются теплоэлектроцентрали (ТЭЦ). Теплоэлектроцентрали вырабатывают два вида продукции: электрическую и тепловую энергию. Теплоэлектроцентрали отпускают тепло двум основным потребителям: промышленным – в виде пара и горячей воды; коммунальным – в виде горячей воды для отопления, вентиляции, горячего водоснабжения. На теплоэлектроцентрали для целей теплофикации используется пар, частично отработавший в турбине.

Если потребителю отпускается тепло в виде пара, то потребитель может возвращать на ТЭЦ конденсат отработавшего пара с помощью насоса обратного конденсата. Доля возвращаемого на ТЭЦ конденсата колеблется от 0 до 1. Если конденсат не загрязнен различными примесями, то возвращается в тепловую схему, в противном случае конденсат проходит очистку или сбрасывается в канализацию.

ТЭЦ отпускает внешнему потребителю тепло в виде:

- пара непосредственно из отбора или вторичного пара, полученного в специальном испарителе, называемом паропреобразователем;
- горячей воды, нагретой в теплообменниках, называемых сетевыми подогревателями или бойлерами.

Unit 2

Memorize the words

grate – колосниковая решетка

stoker – механическая топка, стокер

mesh – отверстие, ячейка; сеть, сетка; меш (число отверстие или ячеек по один линейный дюйм)

suspension – взвесь, взвешенное состояние

ashpit – зольник, поддувало

plunger – скальчатый поршень

fuse – плавить(ся); сплавлять(ся), расплавлять

heat transfer – теплопередача

turbulence – турбулентность, беспорядок

spall – дробить, разбивать, обтесывать

to fluctuate – быть неустойчивым, меняться, колебаться, колыхаться

to erode – разъедать, разрушать, вытравлять, выветривать, размывать, эродировать;

to adhere – прилипать, приставать, приклеиваться, прирастать, придерживаться;

slag – выгарки, окалина, шлаг

adjunct – принадлежности

char – легковоспламеняемый остаток ректификации угля; древесный уголь, обжечься, обуглиться, сгореть

sieve- решетчатый фильтр, сетчатый фильтр; просеивающая машина, просеивать, грохот

refinery – очистительный завод.

Text 1. Burning equipment

Do the following the tasks:

1) Think of questions to the following sentences.

a) There are two general methods of firing fuel commonly employed

b) Coals may be broadly classified into 4 groups

c) A fuel of this group is satisfactorily burned on traveling gate or chain – gate stoker

d) A few coals of this class have a low ash-fusion temperature with a resulting tendency to fuse and jam the operating parts of the stoker

e) They have a tendency to disintegrate on the grate

2) Speak with your group mates about the types of fuel, their use, the operation of the burning equipment. Have a talk with your group mates.

Burning equipment

There are two general methods of firing fuel commonly employed: 1) on stationary grates, or 2) on stokers. Also coal may be pulverized to the consistency of

70 percent through a 200-mesh screen and burned in suspension. The types of solid fuel encountered in various parts of the world and the general conditions under which they must be burned are so variable that it is impossible to design one type of grate or stoker that is exactly suited to all fuels. The problem becomes one rather of suiting the equipment to the type of fuel to be handled.

To a certain extent, the design of the furnace must be considered coincidentally with the selection of fuel burning equipment, so that satisfactory ignition and heat release may be ensured. The choice of equipment for a given set of conditions is limited, and, although any stoker will burn any fuel only one design as a rule will give satisfactory results. Coals may be broadly classified as follows:

Group 1. This group includes the anthracites and semi-anthracites. Which should be burned without agitation of the fuel bed.

A fuel of this class is satisfactorily burned on traveling gate or chain-gate stokers, on which the coal is fed in a comparatively thin, uniform layer. As combustion progresses, the ash covers the surface of the stoker and acts as a protective blanket, the fuel being supplied with combustion air as it travels toward the ashpit.

Group 2. This group includes the bituminous coals of the caking type which require agitation of the fuel bed to break up the mass of coke as it forms as well as to resist the tendency of this fuel into a mat, or cake, that resists the passage of air and retards the process of combustion. Underfeed stokers of the multiple-retort type are designed to burn coals of this class, for the plungers have a characteristic forward and upward motion. By breaking up the surface of the fuel bed, more air passages are created, with a tendency to increase combustion rate. A few coals of this class have a low ash-fusion temperature with a resulting tendency to fuse and jam the operating parts of the stoker. These coals, particularly if high in sulphur, should be avoided as stoker fuels.

Group 3. This group includes Midwestern coals and most of the western bituminous coals. These do not tend to soften but form masses of coke, they require no agitation of the fuel bed and are burned to best advantages on chain-grate stokers.

Group 4. This group consist of most of sub bituminous coals and lignites which do not fuse when heated and do not require agitation. They have a tendency to disintegrate or slack on the grate as well as drift and sift through if disturbed. They have a tendency to avalanche on inclined grates and are most satisfactorily burned on chain or traveling grate stokers.

Text 2. Furnaces

Do the following tasks:

1) Make up 10 questions about the text and let your neighbour answer them, then change parts.

2) Make up a detailed plan of each part of the text: a) divide the text into several parts; b) give each part a heading. Retell each part of the text separately.

3) Give a written translation of the text into Russian.

Furnaces

A furnace is a fairly gas tight and well insulated space in which gas, oil, pulverized coal, of the combustible gases from solid fuel beds may be burned with a minimum amount of excess air and with reasonably complete combustion. Near the exit from the furnace at which place most of the fuel has been burned, the furnace gases will consist of inert gases such as CO_2, N_2 and H_2O vapor, together with some O_2 and some combustible gases such as CO, H_2, hydrocarbons, and particles of free carbon (soot). If combustion is to be complete, the combustible gases must be brought into intimate contact with the residual oxygen in a furnace atmosphere composed principally of inert gases. Also, the oxygen must be kept to a minimum if the loss due to heating the excess air from room temperature to chimney –gas temperature is to be low. Consequently, the major function of the furnace is to provide space in which the fuel may be burned with a minimum amount of excess air and with a minimum loss due to the escape of unburned fuel.

For each particular fossil fuel, there is a minimum temperature, known as the ignition temperature, below which the combustion of that fuel in the correct amount of air will not take place.

The ignition temperature of a fuel in air as reported by various investigators depend somewhat upon the methods used to determine it and, for some common gases, is as follows:

Hydrogen (H_2)	1075-1995˚ F
Carbon monoxide (CO)	1190-1215˚ F
Methane (CH_4)	1200-1380˚ F
Ethane (C_2H_6)	970-1165˚ F

If the combustion gases are cooled below the ignition temperature, they will not burn, regardless of the amount of oxygen present. A furnace must therefore be large enough and be maintained at a high enough temperature to permit the combustible gases to burn before they are cooled below ignition temperature. In other words, the relatively cool heat transfer surface must be so located that they do not cool the furnace gases below the ignition temperature until after combustion is reasonably complete.

Turbulence is essential if combustion is to be complete in a furnace of economized size. Violent mixing of oxygen with the combustible gases in a furnace increases the rate of combustion, shortens the flame, reduces the required furnace volume, and decreases the chance that combustible gases will escape from the furnace without coming into contact with the oxygen necessary for their combustion. The amount of excess oxygen or air required for combustion is decreased by effective mixing. Turbulence is obtained, in the case of oil, gas, and powdered coal, by using burners which introduce the fuel –air mixture into the furnace with a violent whirling action.

Since combustion is not instantaneous, time must be provided for the oxygen to find and react with the combustible gases in the furnace. In burning fuels such as gas, oil, or pulverized coal, the incoming fuel-air mixture must be heated above the ignition temperature by radiation from the flame or hot walls of the furnace. Since gaseous fuels are composed of molecules, they burn very rapidly when thoroughly mixed with oxygen at a temperature above the ignition temperature. However, the individual particles of pulverized coal or atomized oil are very large in comparison with the size of molecules, and many molecules of oxygen are necessary to burn one particle of coal or droplet of oil. Time is required for the oxygen molecules to diffuse through the blanket of inert products of combustion which surround a partially burned particle of fuel and to react with the unburned fuel. Consequently, oil and pulverized coal burn with a longer flame than gaseous fuels.

The required furnace volume is dependent, therefore, upon the kind of fuel burned, the method of burning the fuel, the quantity of excess air in the furnace, and the effectiveness of furnace turbulence. The shape of the furnace depends upon the kind of fuel burned, the equipment employed to burn the fuel, and the type of boiler used to absorb the energy if the fuel is burned for steam generation.

Industrial furnaces in which the objective is to create and maintain a region at a high temperature and the furnaces of small steam boilers are constructed of fire brick, a brick that has been developed to withstand high temperatures without softening, to resist the erosive effect of furnace atmosphere and particles of ash, and to resist spalling when subjected to fluctuating temperatures. Low vertical walls may be constructed of fire brick in the conventional manner. High walls which are subject to considerable expansion, may be tied to and sectionally supported by an external steel frame.

When a boiler furnace is operated at high capacity, the temperature may be high enough to melt or fuse the ash which is carried in suspension by the furnace gases. Molten ash will chemically attack and erode the fire brick with which it comes into contact. Also, if the ash particles are not cooled below the temperature at which they are plastic or sticky before they are carried into the convection tube banks of the boiler, they will adhere to these surface, obstruct the gas passages, and force a shutdown of the unit. Moreover, the function of a boiler is to generate steam, and the most effective heat transfer surface is that which can see the high temperature flame and absorb radiant energy.

Text 3. Cyclone Furnace (Crushed Coal)

Do the following tasks:

1) Write out specific terms used in the texts and translate them into Russian.
2) Speak about the types of furnaces.

Cyclone Furnace (Crushed Coal)

The cyclone furnace is a water-cooled horizontal cylinder (5 to 10 ft in diameter) into which coal is introduced.

As the coal moves from front to rear, combustion air is introduced tangentially at high velocity and about 35-in water gage pressure. This causes a whirling or centrifugal action, with the solid fuel particles moving to the periphery of the combustion chamber where their movement is retarded by molten slag that covers its walls. Although the finer fuel particles burn in suspension, the cyclone method of combustion is primarily a surface-burning process. The solid fuel particles in the liquid ash coating on the walls are scrubbed by the incoming air stream, providing intimate coal and air mixing. Combustion in the cyclone furnace is complete and has practically no carbon loss.

The cyclone furnace is water-cooled as an adjunct to the boiler circulation system. It is attached to the steam generating unit, which may have either of two types of secondary furnace: 1) the water screen type, in which a water screen of tubes divides the furnace into lower and upper section; and 2) the open furnace type. In the water screen furnace, the fly-ash loading of the flue gases will be about 10 percent of the total ash fired. In the open furnace, the loading will be about 15 percent. This refuse may be collected and returned for reinjection.

Some stations find the cyclone furnace advantageous and there are definite sales trends in its favour. As it is not necessary to pulverize the coal, a considerable saving is obtained in both initial investment and also in operating expense.

This furnace has been proved to be suitable for a wide range of coals and for firing gas or oil either in combination with coal or as stand-by or substitute fuel. The cyclone furnace is also capable of burning waste or by-product fuels such as wood, chars, and cokes.

Text 4. Pulverized coal furnace

Do the following tasks:

1) Write out specific terms used in the texts and translate them into Russian.
2) Describe the operational principle of the pulverized coal furnace.
3) Make up questions to each paragraph of the text.
4) Give the Russian variant of the following expressions: steam generators, coal-fired boilers, ash-fusion temperature, ultimate design, flame shape, furnace height, tangential firing, tube wastage, excess air.
5) Make up the sentences with the words above.

Pulverized coal furnace

Coal may be fired as a finely powdered fuel that is injected into the furnace. The coal is pulverized to a fineness of 70 percent or more through a 200 mesh sieve. It is then transported by hot primary air (which also dries the coal) to the furnace.

The majority of all central steam generators operating at 200,000-lb steam per hr and over are fired by pulverized coal. The number of pulverizers are determined by pulverizer capacity and stand-by requirements. Larger installations have two, three or four pulverizers. Provision for three pulverizers, one for each row of burners plus one for stand-by is not unusual. Pulverized coal-fired boilers may be either the dry bottom or slag-tap type. Vertical, horizontal, opposed, or tangential firing methods may be employed.

The size of the unit, its pressure and temperature, available space, fuel characteristics, ash-fusion temperature, type of burner, and ash removal method determine the volume of the furnace, the extent of water cooling, and the ultimate design of the entire steam-generating unit.

Pulverized coal furnaces are usually convertible to firing with oil or gas. Units near oil refineries may utilize fluid coke. Pulverized coal firing removes a limitation on the amount of fuel that can be burned in a boiler (with stoker firing there is a definite limit).

The type and multiplicity of burners, their arrangement and the flame shape will determine the furnace width and depth dimensions. The furnace height is a function of the required furnace volume. The exit temperature of the gases should be below the ash-fusion temperature of the lowest quality fuel to be used. Thus, coal with a large percentage of low-fusion ash will require larger waterwall surfaces, which in turn make a larger furnace volume necessary.

All pulverized coal-fired furnaces constructed to-day are partially or completely water-cooled. If tangential firing is used, the furnace must be completely water-cooled, because there is considerable flame impingement. It is desirable to eliminate, as much as possible, blasting of flames against the furnace walls. Molten ash particles stick to and dissolve most refractories. Heat and high sulphur content may induce a slow attack or tube wastage of the water-cooled walls. Flame length varies with coal particle size (the length is by uniformly fine puliverization), the percentage and composition of the volatile constituent, turbulence, furnace temperature, and excess air.

Text 4. Pulverized coal furnace

Do the following task:

1) Give a written translation of the text into English.

Печи

На современном крупном промышленном предприятии используются высокотемпературные теплотехнологические установки, которые можно разделить на следующие группы:

а) обжиговые печи, в которых термическая обработка исходного материала, связанная с физико-химическим его преобразованием, происходит без изменения его агрегатного состояния;

б) плавильные печи, в которых процессы предварительного нагрева и обжига исходного материала сочетаются с процессами плавления, восстановления или окисления перерабатываемого расплава (то есть сопровождаются изменением агрегатного состояния материала);

в) чисто нагревательные печи, в которых осуществляется только тепловая обработка материала.

Unit 3

Memorize the words

transfer-передача; перенос, перемещение
fluid-жидкость, жидкий, текучий
steam-пар; подвергать действию пара, пропаривать
fan- вентилятор
blower- воздуходувка; компрессор; продувочный
viscosity-вязкость; тягучесть; липкость; клейкость; внутреннее трение
piston pump-поршневой насос
centrifugal-центробежный
impellent-движущаяся сила, побуждающий, двигающий
impeller-рабочее колесо, крыльчатка
impeller rim-обод рабочего колеса
shaft-стол; вал, стержень; ось; рукоятка, ручка
vane-лопатка; лопасть; крыло (вентилятора), лопастный, крыльчатый
radial-радиальный; лучевой, звездообразный двигатель, двигатель с радиально расположенными цилиндрами
volute casing-спиральная турбинная камера, улитка
adiabatic-адиабатическая, теплонепроницаемая

Text 1. Pumps and compressors

Do the following tasks:

1) Read and translate the text.
2) Describe the operational principle of the pumps and compressors.

Pumps and compressors

One of the most important problems of the engineer is the efficient and controlled transfer of fluids from one point to another. This transfer may be opposed by friction. Under certain conditions the gravitational force and other forces may act to aid the transfer, but friction always exists as a force opposing motion. The engineer attempts to reduce the effect of friction and at the same time takes advantage of useful force to produce a motion of the fluids under conditions that can be controlled.

As previously defined, a fluid is a substance in a liquid, gaseous, or vapor state which offers little resistance to deformation. Common examples of the three states of a fluid are water as a liquid, air as a gas, and steam as a vapor. All these types of fluids have a tendency to move because of natural forces. Acting on them. A city may be supplied with water flowing by gravity from high ground. Air may circulate in an auditorium because of its own temperature difference. Steam rises through the water in a boiler owing to the difference in density or specific weight of steam and water. In many cases, however, the circulation is inadequate, and mechanical equipment must be built to supplement the natural circulation. Often mechanical circulation is the only means of obtaining the desired fluid flow. The equipment for producing this fluid flow is divided into two major classes: pumps for handling liquids, and fans, blowers, and compressors for handling gases or vapors.

Both classes of equipment in various forms may be found in the modern stationary power plant or small mobile power plants such as the aircraft engine, Diesel locomotive, or automobile engine.

Text 2. Pump types

Do the following tasks:

1) Read and translated the text.
2) Answer the questions:
a) What are the conditions to select the type of pump?
b) What are the basic types of pumps?

Pump types

The conditions under which liquids are to be transported vary widely and require a careful analysis before the proper selection of a pump can be made. Generally, the engineer purchasing a pump consults with pump manufacturers to obtain the best type-for a particular job. However, a fundamental knowledge of the basic types of pumps that are available and a realization that there is a wide variety of the basic types are of great value to the prospective purchaser.

The conditions that will influence the selection of the type of pump are: 1) the type of liquid to be handled: that is, its viscosity, cleanliness, temperature, and so on; 2) the amount of liquid to be handled; 3) the total pressure against which the liquid is to be moved; 4) the type of power to be used to drive the pump.

Pumps may be divided into four major classifications:

1) Piston pumps or reciprocating pumps driven by engines or electric motors.
2) Centrifugal pumps driven by steam turbines or electric motors.
3) Rotary steam pumps driven by turbines or electric motors.
4) Fluid-impellent pumps which are not mechanically operated but are fluid-pressure-operated.

Text 3. Centrifugal pumps

Do the following tasks:

1) Describe the operational principle of centrifugal pump.

2) Make up questions to each paragraph of the text and let your neighbour answer them, then change parts.

Centrifugal pumps

The centrifugal pump consists of an impeller or rotating section to produce the flow and a casing to enclose the liquid and to direct it properly as it leaves the impeller. The liquid enters the impeller at its center or "eye" and parallel to the shaft. By centrifugal force the liquid passes to the impeller rim through the space between the backward curved blades. The velocity of the liquid with respect to the impeller is in a direction opposite to the impeller motion. The impeller blades are curved backward-to permit the liquid to flow, to the rim of the impeller with a minimum of friction. As the liquid leaves the impeller, it is thrown in a spiral motion forward with a certain velocity.

The water is guided away from the impeller by two basic types of casing: the volute, and the turbine or diffuser. Liquid enters the impeller at the "eye", is thrown to the outside, and leaves the pump through the expanding, spiral or volute casing. The casing has the volute shape to permit flow with a minimum of friction and to convert a part of the velocity head into static head. The static head is the head that overcomes resistance to flow.

The turbine or diffuser pump has the same type of impeller as the volute pump. The casing has a circular shape, and within the casing is a diffuser ring on which are placed vanes. The vanes direct the flow of liquid and a decrease in the velocity of the liquid occurs because of an increase in the area through which the liquid flows. Thus, part of the velocity head is converted into static head as in the volute pump. For a multistage pump, the diffuser pump has a more compact casing than the volute pump. The diffuser-pump design is adaptable to differences in flow conditions since the same casing can be used with various arrangements of diffuser vanes. In the volute pump a variation in the requirements of the volute casing demands alternations in the casing itself. Generally, the volute pump will be used for low-head high- capacity flow requirements and the diffuser pump for high- head requirements.

Both volume and diffuser pumps, are classified by the type of impeller, the number of stages, and the type of suction or intake used. A pump having two "eyes" on the impeller is called a double-suction pump. The double suction, one "eye" located on each side of the impeller, permits forces acting on the impeller to be balanced, thus reducing the axial thrust on the shaft. .Also, the double-suction pump is used for handling hot water where there is danger of water flashing into steam at points of low pressure. The double suction offers,, little resistance to flow; thus, low-pressure areas are less apt to occur. The double-suction pump is used also for large capacities.

When two or more impellers are mounted on the same shaft and act in series, the pump is called a multistage pump, the number of stages corresponding to the number of impellers. A boiler-feed pump is capable of delivering 415,000 lb of water per hr against a pressure of 1500 psi. Multistage produces better performance, higher pump efficiency, and smaller impeller diameters for high-pressure heads. Usually each stage produces the same head, and the total head developed is the number of stages times the head produced per stage.

The types of impellers installed in centrifugal pumps are as numerous as the uses to which the pumps are put. Classification, however, can be made by designating the direction of flow of the fluid leaving the impeller. All pumps have the intake parallel to the impeller shaft. The discharge, however, may be radial, partially radial and axial, or axial. In the radial-type impeller the suction and discharge are at -light angles. The radial impeller may be of the closed or the open type. The term closed or open refers to the fluid passage within the impeller. The open impeller has one side of the flow path open to the pump casing or housing. The closed impeller has both sides of the flow path enclosed by the sides of the impeller. The partially radial impeller discharges at an angle greater than 90 degrees with intake and is of the open-impeller design.

The axial-flow impeller discharges at an angle of approximately 180 degrees with the intake and is generally of the propeller type.

Each of the impeller types has a specific purpose. The axial-flow type is used to pump large quantities of fluid against a relatively small static head.

It is not a true centrifugal pump but is designed on the principles of airfoil shapes. The radial pump is used for handling smaller quantities of fluid against a high head, because the centrifugal force is high but the flow path is small and restrictive. The open impeller is designed to handle dirty liquids such as sewage, where the flow path must be less restrictive. The partially radial impeller covers intermediate pumping conditions.

Text 4. Centrifugal compressors

Do the following tasks:

1) Give the written translation of the text.
2) Name the advantages of centrifugal compressors.

Centrifugal compressors

Multistage centrifugal blowers when capable of handling gases against pressures greater than 35 psig are generally classed as compressors. They resemble multistage centrifugal pumps, and many of the problems encountered in their design are similar to those encountered in pump design. The impellers of a complete centrifugal compressor unit are of the single-suction type, and passages lead the air or gas from the discharge of one impeller to the suction side of the next impeller.

Because of an increase in temperature of the gas or air as the pressure is increased, cooling is generally necessary. If the pressures are not high, cooling water circulated in labyrinths between impellers may be sufficient. When high pressures are encountered, the gas may be cooled in inter stage coolers. The reason for maintaining the gas at a low temperature is to permit an increase in the mass rate of flow with a corresponding reduction in size and horsepower.

Axial-flow compressors are designed on the principles of the airfoil section, and the blade shapes will be similar to the axial-flow fan.

These compressors are an essential part of the gas-turbine cycle. The gas is not cooled between stage, because a portion of the additional work necessary to compress the gas adiabatically over the work necessary to compress it isothermally will be recovered in the gas turbine. The advantages of centrifugal and axial-flow blowers and compressor are: 1) non-pulsating discharge of the gas, 2) no possibility of building up excessive discharge pressures, 3) a minimum of parts subject to mechanical wear, 4) no valve necessary, 5) a minimum of vibration and noise, 6) high speed, low cost, and small size or high capacity.

Text 5. Pumps and compressors

Do the following tasks:

1) Give a written translation of the text into English.
2) Retell the text.

Насосы – машины для перемещения капельных жидкостей. Поршневые насосы в теплоэнергетике используются для питания водой котлов небольшой производительности; главным же образом используются турбонасосы, центробежные и аксиальные насосы. Назначение насоса состоит в преодолении сопротивлений, возникающих при перемещении жидкости.

Компрессоры – машины, предназначенные для перемещения и сжатия упругих (сжимаемых) жидкостей (газов). Компрессоры на тепловых электрических станциях в основном применяют в качестве вспомогательной машины газотурбинных установок.

Машины для перемещения и сжатия воздуха называют вентиляторами. Назначение вентилятора в котельных установках – нагнетать воздух в топку, то есть, осуществлять дутье, и поэтому его называют дутьевым вентилятором.

Unit 4

Memorize the words

shell-кожух, обшивка; корпус; оболочка; вкладыш
tubular- трубчатый
vessel- сосуд, резервуар, бак, баллон
combustion-горение; сгорание, окисление
waterline-ватерлиния, контур водоёма
inclination-наклонение; уклон; наклон; откос, скат
shape-форма; очертание; вид, образец
header-головная часть, водяная камера; водяной коллектор (водотрубного котла); водосборник
row-ряд

connection-соединение; разъём, труба; трубопровод; секция

Text 1. Boilers

Do the following tasks:

1) Do a translation of the text into Russian.
2) Make up 10 questions about the text and let your neighbor answer them, then change parts.

Boilers

Fire-tube boilers. These are boilers with straight tubes that are surrounded by water and through which the products of combustion pass. The tubes are usually installed within the lower portion of a single drum or shell below the waterline.

Water-tube boilers. These are boilers I which the tubes themselves contain steam or water, the heat being applied to the outside surface. The tubes are usually connected to two or more drums set parallel to, or across, the centerline. The drums are usually set horizontally.

Tube shape and position. The tubular heating surface may be classified: 1) by form – either straight, bent, or sinuous or 2) by inclination – horizontal, inclined, or vertical.

Firing. The boiler may be either a fired or an unfired pressure vessel. In fired boilers the heat applied is a product of fuel combustion. A non-fired boiler has a heat source other than combustion.

Circulation. The majority of boilers operate with natural circulation. Some utilize positive circulation in which the operative fluid may be forced "once through" or controlled with partial recirculation.

Furnace position. The boiler is an external combustion device in that the combustion takes place outside the region of boiling water. All heat must be transferred through the heating surface to reach the water. The relative location of the furnace to the boiler is indicated by the description of the furnace as being internally or externally fired: 1) the furnace is internally fired if the furnace region is completely surrounded by water-cooled surfaces; 2) the furnace is externally fired if the furnace is auxiliary to the boiler or built under the boiler.

General shape. During the evolution of the boiler as a heat producer many new shapes and designs have appeared. Some of these boilers have become popular and are widely recognized in the trade, including the following:

1) Fire-tube boilers – horizontal return tubular, short firebox, compact, locomotive, vertical tube (steam jenny), Scotch type, and residential units.
2) Water-tube boilers – both horizontal straight tube and bent tube units. The horizontal straight tube boiler may have a box type header made of steel plate, or a sectional header each section of which connects

The tubes in a single vertical row. The bent tube boiler may have one to four drums. If the drums is parallel to the tubes, the boiler is long – longitudinal drum; if across the tubes, it is a cross drum. If the furnace is enclosed with water-cooled surfaces, it is a water wall (water-cooled) furnace.

Text 3. Районные и промышленные котельные

Do the following task:

1) Translate the text into English.

Районные и промышленные котельные

При централизованном теплоснабжении в качестве источника тепла могут выступать (помимо ТЭЦ) районные котельные, обеспечивающий теплом определенный район. Если котельная отпускает тепло в тепловую сеть промышленного предприятия, то они называются промышленными котельными. По назначению и набору оборудования районные и промышленные котельные одинаковы, и поэтому они объединяются под общим названием «районные котельные». В районных котельных, в отличие от ТЭЦ, вырабатывается только один вид продукции – тепло, которое отпускается в виде пара или горячей воды. Выработка тепла осуществляется в котельных установках. Котельные агрегаты разделяются н два основных класса: паровые, предназначаемые для производства пара, водогрейные, предназначаемые для получения горячей воды. Паровой котельный агрегат (парогенератор) характеризуется паропроизводительностью, давлением и температурой производимого пара. Паровые котлы используют, что бы произвести пар для промышленного использования. Котлы различаются по формам и размерам. Котлы нагревают воду и циркулируют горячую воду через трубы и радиаторы, обогревающие комнату.

Unit 5

Memorize the words

shaft-driven – приводимый от вала;

reciprocation – возвратно-поступательное движение;

torque – крутящий (закручивающий) момент; вращающий момент;

rotor – роторный процесс; ротор;

blades – лопасть, лопатка (турбины), лопатка с регулируемым углом установки;

nozzle – насадок; сопло; форсунка, выпускное отверстие; наконечник;

impinge – налетать, сталкиваться, отражаться;

grid – сетка, решетка; энергосистема; электрическая сеть;

curve – кривая, график, изгибать;

tandem – последовательно соединенный;

compound – состав; смесь; соединение, составлять; смешивать; составной, сложный;

turbine – турбина;

photovoltaics – фотоэлектрический;
mitigate – смягчать, уменьшать;
trough – жёлоб для стока воды, лоток, корыто; котловина;
loop – петля, скоба, отверстие, рамочная антенна; пучность(волны, тока или напряжения); обводной трубопровод.

Text 3. Turbine

Do the following tasks:

1) Give a written translation of the text into Russian.
2) Look through the text. What information did you get about turbines.

Turbines

The steam turbine is prime mover in which a part of that form of energy of the steam evidenced by a high pressure and temperature is converted into kinetic energy of the steam and then into shaft work.

The basic advantage of the turbine over other forms of prime movers is the absence of any reciprocating parts. With only rotating motion involved, high speeds are attainable. Since power is directly proportional to torque times speed, an increase in the rotative speed materially decreases the value of the torque required for a given power output. A decrease in the required torque permits a reduction in the size of the prime mover by reducing the length of the torque arm or the force acting on the torque arm. Also, with the absence of any reciprocating parts, vibration is greatly minimized. Owing to the high rotative speeds available with relatively little vibration, the size and cost of the driven machinery, of the building space, and of the foundations are greatly reduced. These advantages are most apparent in large prime movers and permit the steam turbine to be built in sizes of over 350,000 hp in single units, and 760,000 hp in compound units.

Text 3. Types of turbine

Do the following tasks:

1) Read and retell each part of the text separately.
2)Write down the terms given in the text and give their meanings in English.

Types of turbines

Steam turbines may be broadly grouped into three types, the classification being made in accordance with the conditions of operation of the steam on the rotor blades.

The groups are as follows:

1) Impulse. This may be divided into

a) Simple impulse Pressure compounded

b) Compound impulse — Velocity compounded
c) Combined impulse — Pressure velocity compounded
2) Reaction subdivided into
a) Axial flow
b) Radial and axial flow
3) Combination of 1 and 2.

1. Impulse Turbines. In an impulse turbine the potential energy in the steam due to pressure and superheat is converted into kinetic energy in the form of weight and velocity by expanding it in suitably shaped nozzles.

The whole of the expansion takes place in the fixed nozzle passages. As there is no expansion in the passage between the rotor blades, the steam pressure is the same at the inlet and outlet edges of these blades. The steam impinges on the wheel blades causing the wheels to rotate. The expansion is carried out in stages referred to as "pressure stages", each stage being separated from the next by a diaphragm with nozzle openings through which the steam passes on its way through the turbine.

a) Simple impulse. This type has a considerable number of pressure stages, a wheel in each stage having one row of blades. To obtain high economy it is necessary that the steam should flow through the turbine with high velocity. This is attained by provision of a large number of pressure stages, the greater the available heat drop, the greater the number of stages. In the simple impulse turbine a wheel of comparatively large diameter is used in the first stage which can deal efficiently with a large energy drop. This large wheel, under nozzle control of the steam can maintain a higher efficiency over a wider range of load than a small one could and is less liable to be affected by changes of steam conditions. An added advantage of a large wheel is that the maximum rating of the machine can be obtained without by-passing which results in a flat consumption curve being maintained over the whole output range.

b) Compound impulse. This turbine has comparatively few pressure stages, a wheel in each of them provided with two or more rows of blades. Low velocity steam is obtained by the provision of what are usually termed "velocity stages" in each of the pressure stages. In these velocity stages the steam after passing through the first row of blades on a wheel is re-directed on to the second row of blades on the same wheel, and successively on to other rows of blades on this wheel, if provided. The steam is re-directed by arranging stationary blading between each two adjacent rows of wheel blading so that the steam leaving the first row of blades on a wheel in a backwards direction enters the first row of stationary blades where its direction is reversed ready for entering the second row of blades on the wheel and so on. This action is repeated in each pressure stage on the turbine.

c) Combined impulse. This turbine is a combination of the types a) and b). It consists of one or more pressure stages with a wheel in each of these stages provided with two or more rows of blades. In the velocity compounded impulse turbine the "carry-over" velocity and-the speed of the shaft are much less than with the simple impulse machine. Each disk carrying the moving blades is perforated, thus maintaining the same pressure on both sides of the wheel. The pressure velocity compounded design is generally known as the "Curtis" type. The pressure compounded turbine has a higher efficiency since the pressure drop per stage may be arranged to give the most suitable jet velocity for a given speed of the machine.

2. Reaction Turbines. In the reaction turbines expansion takes place in both the stationary and rotating passages-and the pressure at entrance to the rotor blades is therefore greater than at exit.

a) Axial flow. In a pure reaction turbine expansion should take place only as the steam passes through the moving blades, the turning effect being due to the reaction consequent on the increase in velocity which accompanies expansion. The reaction turbine has a ring of stationary blades instead of a diaphragm with nozzle passages between the blades of each pair of adjacent wheels. The steam expands in the fixed blades, increasing its velocity, which is imparted to the moving blades on the impulse principle.

Steam is supplied direct to the blading system without expansion in nozzles and the rotation produced is chiefly due to the reaction set up by the steam between the stationary and rotating blades while expanding in them.

b) Radial flow. The Ljungstrom turbine is really a combined radial and axial flow machine. The flow of steam is radial, being admitted at the center of the blade discs and flowing outwards, the steam then being inverted to axial flow in the last stages. The turbine may be constructed for single or double motion. With the double motion design the discs rotate in opposite directions at equal speeds and the relative speed of the blades is therefore equal to twice the running speed. This design consists of one group of radial flow double rotation blading and two groups in parallel of low pressure axial flow single rotation blading, the divided flow in the final stages assisting in the reduction of the "leaving losses". Each steam rotor is coupled to an alternator which carries half the total output.

3. Combination Turbines. This type consists of a machine embodying the "impulse" and "reaction" principles, the high- pressure turbine being the impulse section and the intermediate and low-pressure turbines being the reaction section. Where the term reaction is used it is to be understood that this refers to the "impulse-reaction" type of turbine. The practice in large output high speed sets is to include reaction blading at the low pressure end. The blade areas are large and therefore the leakage areas are proportionately small, and as a double-flow exhaust is used the end thrust is balanced. These arrangements enable the length of the turbine to be reduced.

Further Classification. As the output capacities and working conditions have affected the construction of each particular make it has been suggested that the following particulars be given for each turbine: 1) number of shafts, 2) number of cylinders, 3) number of exhausts, 4) the speed.

Many types of industrial turbines are in use today, depending upon the conditions under which they must operate. They are classified as high-or-low-pressure turbines, according to the inlet pressure of the steam, and as superposed, condensing, and non-condensing turbines, according to the exhaust steam pressure. A superposed or high backpressure turbine is one that exhausts to pressures well above atmospheric pressure, 100 to 600 psi. A superposed turbine operates in series with a medium-pressure turbine. The exhaust steam of the superposed turbine drives the medium-pressure unit. The non-condensing turbine has lower exhaust pressures, but the steam still leaves at atmospheric pressure or above 15 to 50 psi. The exhaust steam may be used for drying or heating processes.

The condensing turbine operates at exhaust pressures below atmospheric pressure and requires two auxiliaries: a condenser and a pump. The condenser reduces the exhaust steam to water. As the steam is condensed and the water is removed by a pump, a partial vacuum is formed in the exhaust chamber of the turbine. This type of turbine is used chiefly for the low-cost electric power it produces.

If steam is required for processing, a turbine may be modified by extracting or bleeding the steam.

Extraction takes place at one more point between inlet and exhaust, depending upon the pressures needed for the processes. The extraction may be automatic or non-automatic. Generally, factory processes require steam at a specific pressure, in the case, and automatic-extraction turbine is necessary. When steam is needed within the power plant itself for heating boiler feed-water, non-automatic extraction is generally used.

Turbines may be classified according to their speed and size. Small turbines, varying in size from a few horsepower to several thousand horsepower, are used to drive fans, pumps, and other auxiliary equipment directly. The speed of these units is adjusted to the speed of the driven machinery or is converted by a suitable gear arrangement. These turbines are used wherever steam is readily available at low cost or where exhaust steam is needed.

Turbines for the production of electric power range in size from small units to those of over 500,000 kw, and the trend is toward even larger units.

Sometimes turbo generator units are constructed to operate at 3,600 or 1,800 rpm. The selection of the speed depends almost entirely on the size of the turbo generator desired. The speed of 3,600 rpm is preferred whenever the size of the turbine permits. The turbine operating at the higher speed has the following advantages:

lighter weight, more compactness, and great suitability for high-pressure, high-temperature operation.

With a few exceptions turbines larger than 100,000 kw will operate at 1,800 rpm. All turbines of smaller capacity will run at 3,600 rpm. However, because of the advantages of the 3,600 rpm unit and because of the greater efficiency of large units turbine manufacturers will continue to raise the upper limit of speed and capacity.

Generally, turbo generators on a single shaft and within a given speed range are constructed with either a single or a double-rotor.

The double-rotor arrangement is used for only the largest turbines falling within a given speed range. A double rotor unit is called a tandem-compound turbine, and the flow is double-exhaust to accommodate the large volumes of steam occurring at the low-pressure end.

Text 4

Do the following task:

1) Read the text and express its main idea.

Паровые турбины и парогенераторы составляют основное оборудование ТЭС. Кроме этих агрегатов, на электростанциях используются разнообразные машины и механизмы, входящие в группу машин орудии, называемых вспомогательным оборудованием. Среди этих машин большой интерес в отношении преобразования энергии представляют машины, предназначенные для перемещения жидкостей, капельных и упругих, по трубопроводам. К ним относятся насосы, вентиляторы и компрессоры. В противоположность тепловым двигателям в этих машинах происходит не преобразование тепловой энергии в механическую, а наоборот – механическая (электрическая) энергия превращается в тепло.

Unit 6

Text 6. Solar energy

Do the following tasks:

1) Give the Russian variant of the following expressions: solar photovoltaics, light dispersing properties, alternate resources, glazed flat plate collectors, thermal mass materials, arid climates, vertical shaft, water potable, double-slope stills, viable method, waste water, algae grow, chilled water.
2) Make up the sentences with the words above.
3) Translate the text into Russian.

Solar energy

Solar energy, radiant light and heat from the sun, is harnessed using a range of ever-evolving technologies such as solar heating, solar photovoltaics, solar thermal electricity, solar architecture and artificial photosynthesis.

Solar technologies are broadly characterized as either passive solar or active solar depending on the way they capture, convert and distribute solar energy. Active solar techniques include the use of photovoltaic panels and solar thermal collectors to harness the energy. Passive solar techniques include orienting a building to the Sun, selecting materials with favorable thermal mass or light dispersing properties, and designing spaces that naturally circulate air.

In 2011, the International Energy Agency said that "the development of affordable, inexhaustible and clean solar energy technologies will have huge longer-term benefits. It will increase countries' energy security through reliance on an indigenous, inexhaustible and mostly import-independent resource, enhance sustainability, reduce pollution, lower the costs of mitigating climate change, and keep fossil fuel prices lower than otherwise. These advantages are global. Hence the additional costs of the incentives for early deployment should be considered learning investments; they must be wisely spent and need to be widely shared.

Solar technologies are broadly characterized as either passive or active depending on the way they capture, convert and distribute sunlight. Active solar techniques use photovoltaic panels, pumps, and fans to convert sunlight into useful outputs. Passive solar techniques include selecting materials with favorable thermal properties, designing spaces that naturally circulate air, and referencing the position of a building to the Sun. Active solar technologies increase the supply of energy and are considered supply side technologies, while passive solar technologies reduce the need for alternate resources and are generally considered demand side technologies.

Solar thermal technologies can be used for water heating, space heating, space cooling and process heat generation.

Solar hot water systems use sunlight to heat water. In low geographical latitudes (below 40 degrees) from 60 to 70% of the domestic hot water use with temperatures up to 60 °C can be provided by solar heating systems. The most common types of solar water heaters are evacuated tube collectors (44%) and glazed flat plate collectors (34%) generally used for domestic hot water; and unglazed plastic collectors (21%) used mainly to heat swimming pools.

As of 2007, the total installed capacity of solar hot water systems is approximately 154 GW. China is the world leader in their deployment with 70 GW installed as of 2006 and a long term goal of 210 GW by 2020. Israel and Cyprus are the per capita leaders in the use of solar hot water systems with over 90% of homes using them. In the United States, Canada and Australia heating swimming pools is the dominant application of solar hot water with an installed capacity of 18 GW as of 2005.

In the United States, heating, ventilation and air conditioning (HVAC) systems account for 30% (4.65 EJ) of the energy used in commercial buildings and nearly 50% (10.1 EJ) of the energy used in residential buildings. Solar heating, cooling and ventilation technologies can be used to offset a portion of this energy.

Thermal mass is any material that can be used to store heat—heat from the Sun in the case of solar energy. Common thermal mass materials include stone, cement and water. Historically they have been used in arid climates or warm temperate regions to keep buildings cool by absorbing solar energy during the day and radiating stored heat to the cooler atmosphere at night. However they can be used in cold temperate areas to maintain warmth as well. The size and placement of thermal mass depend on several factors such as climate, day lighting and shading conditions. When properly incorporated, thermal mass maintains space temperatures in a comfortable range and reduces the need for auxiliary heating and cooling equipment.

A solar chimney (or thermal chimney, in this context) is a passive solar ventilation system composed of a vertical shaft connecting the interior and exterior of a building. As the chimney warms, the air inside is heated causing an updraft that pulls air through the building. Performance can be improved by using glazing and thermal mass materials in a way that mimics greenhouses.

Solar distillation can be used to make saline or brackish water potable. The first recorded instance of this was by 16th-century Arab alchemists. A large-scale solar distillation project was first constructed in 1872 in the Chilean mining town of Las Salinas. The plant, which had solar collection area of 4,700 m^2, could produce up to 22,700 L per day and operated for 40 years. Individual still designs include single-slope, double-slope (or greenhouse type), vertical, conical, inverted absorber, multi-wick, and multiple effect. These stills can operate in passive, active, or hybrid modes. Double-slope stills are the most economical for decentralized domestic purposes, while active multiple effect units are more suitable for large-scale applications.

Solar water disinfection (SODIS) involves exposing water-filled plastic polyethylene terephthalate (PET) bottles to sunlight for several hours. Exposure times vary depending on weather and climate from a minimum of six hours to two days during fully overcast conditions. It is recommended by the World Health Organization as a viable method for household water treatment and safe storage. Over two million people in developing countries use this method for their daily drinking water.

Solar energy may be used in a water stabilization pond to treat waste water without chemicals or electricity. A further environmental advantage is that algae grow in such ponds and consume carbon dioxide in photosynthesis, although algae may produce toxic chemicals that make the water unusable.

Solar concentrating technologies such as parabolic dish, trough and Shuffler reflectors can provide process heat for commercial and industrial applications. The first commercial system was the Solar Total Energy Project (STEP) in Shenandoah, Georgia, USA where a field of 114 parabolic dishes provided 50% of the process heating, air conditioning and electrical requirements for a clothing factory. This grid-connected cogeneration system provided 400 kW of electricity plus thermal energy in the form of 401 kW steam and 468 kW chilled water, and had a one hour peak load thermal storage.

Text 7. SCADA – Automation of industrial processes

Do the following tasks:

1) Read the text and make up questions about the text and let your neighbour answer them, then change parts.
2) Complete the following sentence from the text. Translate them into Kazakh/Russian.

a) … often have embedded control capabilities such as ladder logic in order to accomplish boolean logic operations.

b) … are sometimes used in place of RTUs as field devices because they are more economical, versatile, flexible, and configurable.

c) . … … system, gathering (acquiring) data on the process and sending commands (control) to the process.

d) … … … usually refers to centralized systems which monitor and control entire sites, or complexes of systems spread out over large areas (anything from an industrial plant to a nation).

e) … systems typically implement a distributed database, commonly referred to as a *tag database,* which contains data elements called *tags* or *points*.

3) Look through the text again. What kind a new information did you get from the text.

SCADA – Automation of industrial processes

SCADA (supervisory control and data acquisition) is a type of industrial control system (ICS). Industrial control systems are computer-controlled systems that monitor and control industrial processes that exist in the physical world. SCADA systems historically distinguish themselves from other ICS systems by being large-scale processes that can include multiple sites, and large distances. These processes include industrial, infrastructure, and facility-based processes, as described below:

- Industrial processes include those of manufacturing, production, power generation, fabrication, and refining, and may run in continuous, batch, repetitive, or discrete modes.
- Infrastructure processes may be public or private, and include water treatment and distribution, wastewater collection and treatment, oil and gas pipelines, electrical power transmission and distribution, wind farms, civil defense siren systems, and large communication systems.
- Facility processes occur both in public facilities and private ones, including buildings, airports, ships, and space stations. They monitor and control heating, ventilation, and air conditioning systems (HVAC), access, and energy consumption.

A SCADA system usually consists of the following subsystems:

- Remote terminal units (RTUs) connect to sensors in the process and converting sensor signals to digital data. They have telemetry hardware capable of sending digital data to the supervisory system, as well as receiving digital commands from the supervisory system. RTUs often have embedded control capabilities such as ladder logic in order to accomplish boolean logic operations.
- Programmable logic controller (PLCs) connect to sensors in the process and converting sensor signals to digital data. PLCs have more sophisticated embedded control capabilities, typically one or more IEC 61131-3 programming languages, than RTUs. PLCs do not have telemetry hardware, although this functionality is typically installed alongside them. PLCs are sometimes used in place of RTUs as field devices because they are more economical, versatile, flexible, and configurable.
- A telemetry system is typically used to connect PLCs and RTUs with control centers, data warehouses, and the enterprise. Examples of wired telemetry

media used in SCADA systems include leased telephone lines and WAN circuits. Examples of wireless telemetry media used in SCADA systems include satellite (VSAT), licensed and unlicensed radio, cellular and microwave.

- A data acquisition server is a software service which uses industrial protocols to connect software services, via telemetry, with field devices such as RTUs and PLCs. It allows clients to access data from these field devices using standard protocols.
- A human–machine interface or HMI is the apparatus or device which presents processed data to a human operator, and through this, the human operator monitors and interacts with the process. The HMI is a client that requests data from a data acquisition server.
- A Historian is a software service which accumulates time-stamped data, boolean events, and boolean alarms in a database which can be queried or used to populate graphic trends in the HMI. The historian is a client that requests data from a data acquisition server.
- SCADA is used as a safety tool as in lock-out tag-out
- A supervisory (computer) system, gathering (acquiring) data on the process and sending commands (control) to the process.
- Communication infrastructure connecting the supervisory system to the remote terminal units.
- Various process and analytical instrumentation.

The term SCADA usually refers to centralized systems which monitor and control entire sites, or complexes of systems spread out over large areas (anything from an industrial plant to a nation). Most control actions are performed automatically by RTUs or by PLCs. Host control functions are usually restricted to basic overriding or *supervisory* level intervention. For example, a PLC may control the flow of cooling water through part of an industrial process, but the SCADA system may allow operators to change the set points for the flow, and enable alarm conditions, such as loss of flow and high temperature, to be displayed and recorded. The feedback control loop passes through the RTU or PLC, while the SCADA system monitors the overall performance of the loop.

Data acquisition begins at the RTU or PLC level and includes meter readings and equipment status reports that are communicated to SCADA as required. Data is then compiled and formatted in such a way that a control room operator using the HMI can make supervisory decisions to adjust or override normal RTU (PLC) controls. Data may also be fed to a Historian, often built on a commodity Database Management System, to allow trending and other analytical auditing.

SCADA systems typically implement a distributed database, commonly referred to as a *tag database,* which contains data elements called *tags* or *points*. A point represents a single input or output value monitored or controlled by the system. Points can be either "hard" or "soft". A hard point represents an actual input or output within the system, while a soft point results from logic and math operations applied to other points. (Most implementations conceptually remove the distinction by making every property a "soft" point expression, which may, in the simplest case, equal a single hard point.) Points are normally stored as value-timestamp pairs: a value, and the timestamp when it was recorded or calculated. A series of value-timestamp pairs gives the history of that point. It is also common to store additional metadata with tags, such as the path to a field device or PLC register, design time comments, and alarm information.

SCADA systems are significantly important systems used in national infrastructures such as electric grids, water supplies and pipelines. However, SCADA systems may have security vulnerabilities, so the systems should be evaluated to identify risks and solutions implemented to mitigate those risks

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Содержание

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Жусупова Акбота Утепбергеновна

Кабдушева Ляйля Жунусбековна

ПРОФЕССИОНАЛЬНО-ОРИЕНТИРОВАННЫЙ

АНГЛИЙСКИЙ ЯЗЫК

Методические указания для развития навыков перевода

профессионально-ориентированных текстов для студентов специальности 5В071700 – Теплоэнергетика

Редактор Н.М. Голева

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