ИНОСТРАННЫЙ ЯЗЫК

ГОРНЫЕ МАШИНЫ И ОБОРУДОВАНИЕ

Методические указания к самостоятельной работе для студентов специальности 21.05.04

FOREIGN LANGUAGE

MINING MACHINES AND EQUIPMENT

САНКТ-ПЕТЕРБУРГ
2019

Министерство науки и высшего образования Российской Федерации

Федеральное государственное бюджетное образовательное
учреждение высшего образования
Санкт-Петербургский горный университет

Кафедра иностранных языков

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УДК 811.111 (073)

ИНОСТРАННЫЙ ЯЗЫК. Горные машины и оборудование: Методические указания к самостоятельной работе / Санкт-Петербургский горный университет. Сост. *М.А. Троицкая.* СПб, 2019**.** 47 с.

Изучение предложенного материала на английском языке направлено на совершенствование навыков просмотрового, поискового и коммуникативного чтения, а также отработку навыков перевода текстов по специальности и формирование терминологического словарного запаса.

Предназначены для самостоятельной работы студентов специальности 21.05.04 «Горное дело» специализации «Обогащение полезных ископаемых» и согласованы с программой по иностранному языку для студентов неязыковых вузов.

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ПРЕДИСЛОВИЕ

Данные методические указания по дисциплине «Иностранный язык» предназначены, прежде всего, для самостоятельной работы студентов, обучающихся по специальности 21.05.04 «Горное дело», а так же могут быть полезны для вузов технического профиля близких специальностей.

В соответствии с требованиями государственных программ Российской Федерации по профессиональной подготовке горных инженеров и специалистов в области обогащения полезных ископаемых данные методические указания разработаны для организации самостоятельной работы студентов с целью формирования у них умений и навыков англоязычного общения в профессиональной области.

Предложенные аутентичные материалы на английском языке и разработанный комплекс упражнений к ним направлены на совершенствование навыков устной и письменной иноязычной речи в ситуациях профессионально-ориентированного общения. Тематика текстов затрагивает современные машины и различные виды оборудования минерально-сырьевого комплекса.

Большая часть заданий предназначена для развития умений анализировать информацию, совершенствование навыков перевода, а также умений и навыков ознакомительного и поискового чтения.

Особое внимание уделяется накоплению активного словарного запаса, который включает наиболее употребительные для специальности термины и слова общетехнического значения. Методические указания состоят из 3 разделов. В приложении представлен англо-русский словарь терминов.

UNIT I. MINING MACHINES AND EQUIPMENT

TEXT A. MINING MACHINES AND EQUIPMENT

Task 1. Answer the following prediction questions.

1. What mining machines do you know?
2. How can they be classified?

Task 2. Read the text. Choose the best alternatives 1, 2, 3, 4 or 5 to answer the questions.

Machines make mining easier, quicker, and sometimes safer. The nature of the material, the topography and general conditions, the quantities to be handled, capital investment and engineering determine the methods of excavation and the selection of the machines.

Surface mining is a type of mining in which soil and rock overlying the mineral deposit (the overburden) are removed. It is the opposite of underground mining, in which the overlying rock is left in place, and the mineral removed through shafts or tunnels.

Here are some of the machines used in mining:

Surface Mining:

Wheel loaders: These are used when a lot of mining materials need to be moved at one time.

Excavator: Most surface mines have one of these. This machine is used to do the digging. This machine also dumps the materials that it dug up into a dump truck.

Dump Trucks: These are used to take away or move materials. Sometimes they are called monster trucks because they are very big.

Crawler-tractor: Sometimes these are called dozers. Instead of rubber tires, these have chains. Chain tractors are used on land where rubber tires won't work too well - like in mud or on mountain slopes. Dozers push dirt from one place to another. When mines close and they begin to fix the land that has been changed, dozers push dirt and materials where they need to go.

Motor grader: These are used to make the ground level when they are clearing off the land for mining or fixing it when they are done.

Underground mining:

Articulated dump trucks: These are used to move large amounts of material in the mine. They can turn easier inside mines than most trucks can.

Continuous miners are machines with a large rotating steel drum equipped with tungsten carbide teeth that scrape coal from the seam. Operating in a "room and pillar" system – where the mine is divided into a series of 20-to-30 foot "rooms" – it can mine as much as five tons of coal a minute – more than a miner of the 1920s would produce in an entire day. Continuous miners account for about 45% of underground coal production, and also utilize conveyors to transport the removed coal from the seam. They can be used instead of blasting and drilling.

Longwall mining equipment: This is used to cut out the coal in layers. Part of the machinery will hold up the roof, too.

Shuttle cars: In room-and-pillar systems, electric-powered, rubber-tired vehicles called shuttle cars haul coal from the face to the intermediate haulage system.

№	Questions	Alternatives
1.	What is the difference between surface and underground mining?	1. surface mining can be done without machinery 2. surface mining is more expensive 3. in underground mining the overburden is left in place 4. underground mining is used to extract the most valuable minerals 5. there is no difference
2.	What is the overburden?	1. the host rock containing valuable minerals 2. the rock underlying the mineral deposit 3. poor soil 4. what is removed through shafts or tunnels 5. the soil and another material which lie over the mineral deposit

3.	When are wheel loaders used?	1. when it is necessary to excavate the surface soil 2. when a lot of mining materials need to be moved at the same time 3. when drilling operations are carried out 4. after blasting in the mine 5. in underground mining
4.	What is the main function of an excavator?	1. dumping the materials into a dump truck 2. extracting minerals from the earth 3. transportation of ore or coal 4. digging 5. drilling
5.	Why dump trucks are called monster trucks?	1. they make a loud screaming noise while operating 2. they look like monsters 3. they have teeth and tails 4. miners are afraid of them 5. because they are huge
6.	How do crawler-tractors differ from other mining machines?	1. they have chains instead of rubber tires 2. only they can work in mud 3. they can turn easier than other machines 4. they are used when mines close 5. they can move large amounts of material
7.	What mining machine can work well in mud or on mountain slopes?	1. wheel loaders 2. dump trucks 3. motor graders 4. dozers 5. any mining machine
8.	What advantage do articulated dump trucks have compared to other	1. they are much quicker 2. they are safer 3. they turn easier inside mines

	mining trucks?	4. they move larger amounts of material in the mine 5. they can be used for digging
9	Why are continuous miners so useful in mining?	1. they can work non-stop 2. they make mining easier and safer 3. they push dirt from one place to another 4. they make the ground level 5. they can be used instead of blasting and drilling
10.	The part of longwall mining equipment …	1. supports the roof 2. can fix the land 3. is used to make the ground level 4. has chains 5. can mine five tons of coal a minute

Task 3. Give Russian equivalents to the following words and word combinations: surface mining, overburden, wheel loaders, digging, dump trucks, crawler-tractors, rubber tires, mountain slopes, motor graders, underground mining, articulated dump trucks, continuous miners, a large rotating steel drum equipped with tungsten carbide teeth, to scrape coal, to operate in a "room and pillar" system, to transport the removed coal from the seam, blasting and drilling, longwall mining, shuttle cars, electric-powered vehicles, to haul coal from the face to the intermediate haulage system.

Task 4. Match the mining machines and their descriptions

1.	Continuous miner	A	a platform with sides that moves mined materials into a mine shuttle to take it out of the mine.
2.	Conveyor	B	a machine that digs the coal off of the walls of the mine and then loads it in a device to take it out of the mine.

3.	Shuttle car	C	a machine that operates on a set of tracks instead of tires. Commonly called bulldozers or cats from the brand name Caterpillar.
4.	Crawler-tractor	D	a vehicle that is used to take ore out of the mine.
5.	Dump truck	E	is equipped with an open-box bed, which is hinged at the rear and equipped with hydraulic rams to lift the front, allowing the material in the bed to be deposited on the ground behind the vehicle at the site of delivery.

TEXT B. MINING MONSTERS

Task 1. Read the text about 5 spectacular mining machines and write questions to the following answers:

a) 100 tonnes
b) a max speed of 65km per hour
c) The Komatsu D575A
d) 398 horsepower
e) 5270mm

Ever wondered which enormous pieces of mining industry equipment were the biggest? Find out our top 5 picks.

The mine site is home to some of the most monster machinery known to man. From excavators to trucks to dozers to jumbos, these enormous pieces of equipment definitely stack up on site, leaving a large imprint in the rubble and dust. But which ones come out on top? We've trawled through the mines and compiled a list of the five biggest players in their respective categories.

Terex - Bucyrus RH400 — the biggest excavator

Excavators are the largest machines, found on the mine site and this hydraulic face shovel is the biggest of the biggest. Weighing in at a mammoth 980 tonnes, the RH400 weighs 100 tonnes more than the next largest hydraulic excavator, Hitachi's EX8000-6. With a max power of 4400 horsepower at 1800 RPM and a bucket capacity of 50 cubic metres, the RH400 truly is the biggest of them all. Powered by two 16-cylinder Cat 3516B or Cummins QSK60 diesel engines, the RH400 is the ideal digger that is always up to the Task.

BelAZ 75710 — a huge dump truck

The BelAZ 75710, or as it's affectionately referred to, 'The 450', is the largest mining dump truck in the world. Standing at an impressive 7,9 metres and weighing a whopping 450 tonnes, the 75710 truly is a monster truck. Released in late 2013, 'The 450' is 25 per cent larger than its next model down, the 360 tonne truck. Powered by two 16-cylinder, 65-litre diesel engines, 'The 450' provides a max speed of 65km per hour with 2300 horsepower. For easy access around the site it's fitted with eight wheels the same size as the 360 with two turnable axles, which allow it to haul more quickly and efficiently.

Komatsu D575A — an enormous bulldozer

The Komatsu D575A comes up trumps in its category as the largest dozer you'll find in mining since the beginning of its operations in 1991. Tipping the scales at 152.6 tonnes and standing at 4.88 metres tall, 12.5 metres long and 7.3 metres wide, the D575A is the biggest and best in the business. With its 2250 horsepower engines, it can move nearly 70 cubic metres of material per pass with its standard blade. Even more impressive, it can move nearly 100 cubic metres with its optional blade, making it the ideal mining partner.

Caterpillar R3000H — a giant load-haul dump vehicle

Known as the largest load-haul dump vehicle in the Caterpillar line, the R3000H model is the perfect underground bogger companion for digging up hard-to-remove muck. Specifically designed for a rated payload of 22 cubic metres in both load-and-carry and truck loading applications, the R3000H has a 16 per cent production advantage over its predecessor, the R2900 XTRA. With a max power of 398 horsepower and a bucket capac-

ity of 9.1 to 13.9 cubic metres, this bogger is up to the challenge that even the most demanding underground mining applications present .

Sandvik DD422i — a jumbo drill. It's all in a name, with this massive drilling jumbo being the biggest and best yet, while still managing to maneuver itself in the trickiest and tightest of spots. Along with Atlas Copso, Sandvik has marked its territory in underground development, and the DD422i is its headhunter. Sandvik calls it the most advanced underground rig on the market. The DD422i has a feed length of 5270mm, a hole diameter of 43 to 64mm and an engine power of 159 horsepower. Boasting the widest range of automatic drilling functions, it uses a 10274mm by 2590mm RD 525 rock drill for increased productivity, making it a truly enormous asset.

Task 2. Surf the Internet and find the videos showing the machines described in the text in action. Would you like to work with some of these incredible machines when you start your career in the mining industry?
Task 3. Compare the machines mentioned in the text in relation to their technical characteristics. Make use of the following expressions: the same as, much bigger than, almost, as ... as, not quite as ... as, twice as ... as, like, different from, in contract to, etc.

UNIT II. MINERAL PROCESSING TECHNOLOGIES

TEXT A. MINERAL PROCESSING

Task 1. Read the following text and answer the questions:

1. What is mineral processing?
2. What are four main types of mineral processing? How do they differ?
3. What can you say about early processing techniques?
4. What are the main stages of modern mineral processing?

Mineral processing refers to a number of interrelated procedures that are all aimed at extracting valuable material from ores. Many valuable minerals are mined as ores, which are rocks that contain useful substances. Mineral processing was done by hand in the past, though in modern times it is typically achieved through the use of heavy machinery. There are four main types of mineral processing, each of which uses a

different method to separate valuable materials from ore gangue. The four different methods involve the reduction of ore particle sizes, the separation of particles by size, concentration of wanted minerals, and the removal of liquids from the solid minerals.

Early mineral processing typically involved manual labor, such as striking ore with hammers to break it open. This process of separating minerals from ore by hand was known as spalling. Similar processes were developed during the 10th century that mechanized the use of hammers to break the ore. These stamp mills typically used a water wheel to lift the hammers and the force of gravity to draw them down onto the ore. Early processing techniques also relied on manual labor to pick out each individual mineral particle from the ore gangue.

Modern mineral processing techniques typically use mechanized unit processes to separate minerals from ore. The first process is typically comminution, which can consist of crushing or grinding an ore. This procedure can break minerals out of the ores, allowing them to be further processed. The next step may be to separate out the particles according to size. One common way this can be accomplished is through the use of progressively finer screens.

After the ore has been broken down and sorted by size, it may undergo one or more processes to separate desired minerals from unwanted ore gangue. The specific processes may vary between different minerals, and are highly dependent on the physical qualities of both the mineral and ore. Gravity concentration is a relatively simple method that works due to the different specific gravity of each mineral and ore. This is a relatively low tech method and one of the earliest used. It typically involves placing the mineral and ore into a container and shaking it until the different materials have settled separately.

The final procedure in mineral processing is often dewatering, which separates moisture from the minerals. This may be achieved by passing the minerals over specialized screens, or through other methods. Particular minerals, such as metals, may undergo additional processing methods. Metals may be subjected to a variety of pyrometallurgical mineral processing techniques, such as smelting.

Task 2. Match the following words and word combinations with their English equivalents.

1.	mineral processing	A	пустая порода
2.	valuable minerals	B	разделение частиц по размерам
3.	heavy machinery	C	обогащение полезных ископаемых
4.	ore gangue	D	удаление жидкости
5.	reduction of ore particle size	E	полезные ископаемые
6.	separation of particles by size	F	грохоты
7.	concentration	G	измельчение
8.	removal of liquids	H	мощные машины
9.	stamp mill	I	дробление
10.	comminution	J	гравитационное обогащение
11.	crushing	K	уменьшение размера частиц руды
12.	grinding	L	обезвоживание
13.	screens	M	концентрация
14.	gravity concentration	N	плавление
15.	dewatering	O	пест, толчея
16.	smelting	P	крупное дробление

Task 3. Define whether the statements are true or false.

1. The goal of mineral processing is to produce maximum value from a given raw material.
2. Heavy machines have been used in mineral processing since the early times of its development.
3. Crushing is the first controlled size reduction stage in the process.
4. Manual labour is mostly used in modern mineral processing to separate minerals from ore.
5. The process of comminution usually involves crushing or grinding an ore.

6. Fine screens are designed for breaking the ore.
7. The choice of separation technologies highly depends on the physical qualities of both the mineral and ore.
8. Gravity concentration is a recently developed method in mineral processing and can be characterized as highly effective.
9. Dewatering may be achieved by passing the minerals over specialized screens.
10. Smelting is one of pyrometallurgical mineral processing techniques.

Task 4. Translate from Russian into English:

1.Обогащение полезных ископаемых это совокупность процессов первичной обработки минерального сырья, имеющая своей целью отделение всех ценных минералов от пустой породы. **2.** В зависимости от метода отделения ценного компонента от пустой породы выделяют четыре основных типа обогащения полезных ископаемых. **3.** Они включают уменьшение размера частиц руды, разделение частиц по размерам, концентрацию нужных минералов и удаление воды из твердых минералов. **4.** На современном этапе обогащения полезных ископаемых применяют мощные машины. **5.** Металлы могут подвергаться специальным пирометаллургическим методам обогащения, например, плавлению.

TEXT B. A CAREER IN THE MINERAL PROCESSING INDUSTRY

Task 1. Study the information about a Mineral Processing Engineers' responsibilities and working conditions. Make up a list of 10-15 questions to a Mineral Processing Engineer to get an insight about this career.

Mineral processing engineers have the responsibility of obtaining ore mined from the earth, and removing minerals in the form of concentrates.

Their typical duties are the following:

Mineral Processing Engineers are involved in all stages of raw materials processing;

Plan, organise and oversee the extraction of metallic and non-metallic matter from the ore at mines;

Transform low value impure metals, recycled materials and byproducts into valuable products;

This extraction process can occur at both underground and open pit mines;

Study and apply chemical and process metallurgy techniques;

Responsible for onsite testing and research;

Constantly looking for new methods to improve the production of these metals;

Create new materials from matter that was considered waste;

Process design and development;

Process control and management;

Prepare and oversee operational budgets to evaluate the economic, and environmental efficiency and feasibility.

Working Conditions:

Mineral Processing Engineers may work in laboratories or be required to travel to mine sites, where they work with other engineers and Mineral Processing Operators or Technicians.

Depending on the type of mine, Mineral Processing Engineers may work in the open above ground, or underground where it can be cramped and hot.

Production sites can be remotely located and can be hot and noisy, and Engineers may be required to wear protective glasses and clothing.

Mineral Processing Engineers must be prepared to travel and will often stay away from home for extended periods. They may be required to live on site away from home, or to work on a fly in fly out basis. FIFO (Fly In Fly Out) commonly involves flying in for a certain period of time whilst the Mineral Processing Engineer would be on site, and then flying home for periods when they are off work

Mineral Processing Engineers may get to see the world as if working for large international companies, their job will often involve international travel.

Task 2. Write a 200-word short essay on the topic «The Challenges of My Future Professin».

TEXT C. MINERAL PROCESSING TECHNOLOGIES

Part I

Task 1. Read the text and find Russian equivalents to the following English words and word combinations:

automatic control systems, sampling device, hand-operated pestles and mortars, shovel, pipe sampler, machine sampler, conveyor belt, crusher, mill, log washer, cone crusher, jaw crusher, disintegrate, cylinder mill, grinding bodies, autogenous mill , semiautogenous mill, roll crusher, mount, sieve, millstone

Task 2. Think of a possible title for the text.

The operating stages in minerals processing have remained the same for thousands of years, but of course we have come far in development of equipment and processes since then.

The primary operations of minerals processing are comminution and concentration, but there are other important operations in a modern mineral processing plant, including sampling, analysis, and dewatering.

Routine sampling and analysis of the raw material being processed are undertaken in order to acquire information necessary for the economic appraisal of ores and concentrates. Modern plants have fully automatic control systems that conduct in-stream analysis of the material as it is being processed.

Sampling is done either by hand or by machine. Hand sampling is usually expensive, slow, and inaccurate, so that it is generally applied only where machinery is either not available or too expensive to install.

Many different sampling devices are available, including shovels, pipe samplers, and automatic machine samplers. After one or more samples are taken from an amount of ore passing through a material stream such as a conveyor belt, the samples are reduced to quantities suitable for further analysis. Analytical methods include chemical, mineralogical, and particle size. Coarsely ground minerals can be classified according to size by running them through special sieves or screens, for which various national and international standards have been accepted.

In order to separate the valuable components of an ore from the waste rock, the minerals must be liberated from their interlocked state

physically by comminution. As a rule, comminution begins by crushing the ore to below a certain size and finishes by grinding it into powder.

In primitive times, crushers were small, hand-operated pestles and mortars, and grinding was done by millstones turned by men, horses, or waterpower. Today, these processes are carried out in mechanized crushers and mills. Whereas crushing is done mostly under dry conditions, grinding mills can be operated both dry and wet, with wet grinding being predominant.

Crushing, Some ores occur in nature as mixtures of discrete mineral particles, such as gold in gravel beds and streams and diamonds in mines. These mixtures require little or no crushing, since the valuables are recoverable using other techniques (breaking up placer material in log washers, for instance). Most ores, however, are made up of hard, tough rock masses that must be crushed before the valuable minerals can be released.

In order to produce a crushed material suitable for use as mill feed (100 percent of the pieces must be less than 10 to 14 millimetres, or 0.4 to 0.6 inch, in diameter), crushing is done in stages. In the primary stage, the devices used are mostly jaw crushers with openings as wide as two metres. These crush the ore to less than 150 millimetres, which is a suitable size to serve as feed for the secondary crushing stage. In this stage, the ore is crushed in cone crushers to less than 10 to 15 millimetres. This material is the feed for the grinding mill.

Grinding. In this process stage, the crushed material can be further disintegrated in a cylinder mill, which is a cylindrical container built to varying length-to-diameter ratios, mounted with the axis substantially horizontal, and partially filled with grinding bodies (*e.g.,* flint stones, iron or steel balls) that are caused to tumble, under the influence of gravity, by revolving the container.

A special development is the autogenous or semiautogenous mill. Autogenous mills operate without grinding bodies; instead, the coarser part of the ore simply grinds itself and the smaller fractions. To semiautogenous mills (which have become widespread), 5 to 10 percent grinding bodies (usually metal spheres) are added.

Yet another development, combining the processes of crushing and grinding, is the roll crusher. This consists essentially of two cylinders

that are mounted on horizontal shafts and driven in opposite directions. The cylinders are pressed together under high pressure, so that comminution takes place in the material bed between them.

Task 3. What kinds of crushers and mills were described in the text?

Part II

Task 1. Read the text and find English equivalents to the following Russian words and word combinations: фотометрический метод сепарации, флотационная сепарация, гравитационная сепарация, разделение в тяжёлой среде, мелкораздробленный тяжелый минерал, суспензия, измельченная руда, частицы пустой породы, хвосты, отсадка, колебание, нижний слой, первоначальный материал, центробежная сила, качающийся концентрационный стол, спиральный сепаратор, поперечное сечение, смесь тонко измельчённого ископаемого с жидкостью, смачиваемость, флотационная камера, пена при флотации, магнитные сепараторы низкого напряжения, пески тяжёлых минералов

Task 2. Read the text and give definitions to the following processes: optical separation, gravity separation, flotation separation, magnetic separation, electrostatic separation, jigging, flotation, heavy-media separation

Task 3. Think of a possible title for the text

Concentration involves the separation of valuable minerals from the other raw materials received from the grinding mill. In large-scale operations this is accomplished by taking advantage of the different properties of the minerals to be separated. These properties can be colour (optical sorting), density (gravity separation), magnetic or electric (magnetic and electrostatic separation), and physicochemical (flotation separation).

Optical separation is used for the concentration of particles that have sufficiently different colours (the best contrast being black and white) to be detected by the naked eye. In addition, electro-optic detectors collect data on the responses of minerals when exposed to infrared, visible, and ultraviolet light. The same principle, only using gamma radiation, is called radiometric separation.

Gravity methods use the difference in the density of minerals as the concentrating agent. In heavy-media separation (also called sink-and-float separation), the medium used is a suspension in water of a finely ground heavy mineral (such as magnetite or arsenopyrite) or technical product (such as ferrosilicon). Such a suspension can simulate a fluid with a higher density than water. When ground ores are fed into the suspension, the gangue particles, having a lower density, tend to float and are removed as tailings, whereas the particles of valuable minerals, having higher density, sink and are also removed. The magnetite or ferrosilicon can be removed from the tailings by magnetic separation and recycled.

In the process called jigging**,** a water stream is pulsed, or moved by pistons upward and downward, through the material bed. Under the influence of this oscillating motion, the bed is separated into layers of different densities, the heaviest concentrate forming the lowest layer and the lightest product the highest. Important to this process is a thorough classification of the feed, since particles less than one millimetre in size cannot be separated by jigging.

Finer-grained particles (from 1 millimetre to 50 micrometres) can be effectively separated in a flowing stream of water on horizontal or inclined planes. Most systems employ additional forces—for example, centrifugal force on spirals or impact forces on shaking tables. Spirals consist of a vertical spiral channel with an oval cross section. As the pulp flows from the top to the bottom of the channel, heavier particles concentrate on the inner side of the stream, where they can be removed through special openings. Owing to their low energy costs and simplicity of operation, the use of spirals has increased rapidly. They are especially effective at concentrating heavy mineral sands and gold ores.

Gravity concentration on inclined planes is carried out on shaking tables, which can be smoothed or grooved and which are vibrated back and forth at right angles to the flow of water. As the pulp flows down the incline, the ground material is stratified into heavy and light layers in the water; in addition, under the influence of the vibration, the particles are separated in the impact direction. Shaking tables are often used for concentrating finely grained ores of tin, tungsten, niobium, and tantalum.

Flotation is the most widely used method for the concentration of fine-grained minerals. It takes advantage of the different physicochemical surface properties of minerals—in particular, their wettability, which can be a natural property or one artificially changed by chemical reagents. By altering the hydrophobic (water-repelling) or hydrophilic (water-attracting) conditions of their surfaces, mineral particles suspended in water can be induced to adhere to air bubbles passing through a flotation cell or to remain in the pulp. The air bubbles pass to the upper surface of the pulp and form a froth, which, together with the attached hydrophobic minerals, can be removed. The tailings, containing the hydrophilic minerals, can be removed from the bottom of the cell.

Flotation makes possible the processing of complex intergrown ores containing copper, lead, zinc, and pyrite into separate concentrates and tailings—an impossible task with gravity, magnetic, or electric separation methods. In the past, these metals were recoverable only with expensive metallurgical processes.

Magnetic separation is based on the differing degrees of attraction exerted on various minerals by magnetic fields. Success requires that the feed particles fall within a special size spectrum (0.1 to 1 millimetre). With good results, strongly magnetic minerals such as magnetite, franklinite, and pyrrhotite can be removed from gangue minerals by low-intensity magnetic separators. High-intensity devices can separate oxide iron ores such as limonite and siderite as well as iron-bearing manganese, titanium, and tungsten ores and iron-bearing silicates.

The electrostatic method separates particles of different electrical charges and, when possible, of different sizes. When particles of different polarity are brought into an electrical field, they follow different motion trajectories and can be caught separately. Electrostatic separation is used in all plants that process heavy mineral sands bearing zircon, rutile, and monazite. In addition, the cleaning of special iron ore and cassiterite concentrates as well as the separation of cassiterite-scheelite ores are conducted by electrostatic methods.

Task 4. Complete the following sentences and translate them.

1. In large-scale operations …… of the minerals to be separated are taken into account in the process of concentration.

2. The best contrast colous are …….
3. A suspension in water of a finely ground heavy mineral can simulate a fluid……than water.
4. In the process called jigging, ……..is pulsed, or moved by pistons upward and downward, through the material bed.
5. The use of spirals is especially effective at …… .
6. …… are often used for concentrating finely grained ores of tin, tungsten, niobium, and tantalum.
7. Flotation is…….. for the concentration of fine-grained minerals.
8.……. is based on the differing degrees of attraction exerted on various minerals by magnetic fields.
9. High-intensity devices are used for separating……
10. All plants that process heavy mineral sands bearing zircon, rutile, and monazite apply the method of ….

Part III

Task 1. Match the following Russian words and word combinations with their English equivalents.

1.	water circuits	A	гравитационный фильтр
2.	processing plant	B	барабанный ячейковый фильтр
3.	thickening	C	водно-шламовая схема
4.	dewatering bin	D	обогатительная фабрика
5.	filter cake	E	конвейерная печь для сушки
6.	reduce the demand for	F	обезвоживающий бункер
7.	pressure filter	G	осаждение
8.	sedimentation	H	вращающаяся барабанная сушилка
9.	gravity filter	I	уплотнение
10.	flocculating agent	G	фильтр для обезвоживания под давлением
11.	drum cell filter	K	снижать потребность в
12.	rotary drum drier	L	флокулянт
13.	fluidized-bed dryer	M	кек фильтрования
14.	conveyor dryer	N	сушилка с кипящим слоем

Concentrates and tailings produced by the methods outlined above must be dewatered in order to convert the pulps to a transportable state. In addition, the water can be recycled into the existing water circuits of the processing plant, greatly reducing the demand for expensive fresh water.

Filtration is the separation of a suspension into a solid filter cake and a liquid filtrate by passing it through a permeable filtering material. Important factors in this process are the properties of the suspension (*e.g.,* size distribution, concentration), the properties of the filtering materials (*e.g.,* the width and shape of pores), and the forces applied to the suspension. Filtration is carried out in gravity filters (screens, dewatering bins), in centrifugal filters (screen centrifuges), in vacuum filters (drum cell filters, disk filters), or in pressure filters (filter presses). Such devices make it possible to produce filter cakes containing 8 to 15 percent moisture.

In the process of thickening (also called sedimentation), the solids in a suspension settle under the influence of gravity in a tank and form a thick pulp. This pulp, and the clear liquid at the top of the tank, can be removed continuously or intermittently. In comparison with filtration, thickening offers the advantage of low operation costs; on the other hand, it has the disadvantage of leaving a higher moisture content in the pulp. For this reason, the dewatering of pulps containing fine particles often involves a combination of thickening and filtration. The thickening of finely grained pulps is often aided by the use of flocculating agents.

The removal of water from solid materials by thermal drying plays a significant role in modern mineral processing. A great number of dryer types are available. Convection dryers, employing a flow of hot combustion gases to remove moisture from a pulp stream, are the most common. To this type belong rotary drum, conveyor, and fluidized-bed dryers.

UNIT III. MINERAL PROCESSING EQUIPMENT
TEXT A. CRUSHERS

Task 1. Read the text and give the Russian equavalents to the following English words and word combinations:

rock crusher, hopper, belt drive, conveyor belt, jaw crusher, vibrating feeder, flywheel, eccentric shaft, bearing, tension rod, toggle plate, jaw plate and fixed jaw, roller crusher, gyratory and cone crushers, impact crusher

Task 2. Read the text and answer the questions:

1. What is a rock crusher?
2. What are the main components of a rock crusher?
3. What are the main types of crushers? Compare the fields of their application.

A rock crusher is a device used to crush rocks into smaller pieces. Most rock crushers have a hopper at the top - a container which holds the rock above the crusher and uses gravity to feed it in. Alternately, rock crushers can use a belt drive to continuously transport the rock into the crusher. At the bottom of nearly every type of crusher is a hole. Once a rock has been pressed into small enough pieces to fit through the hole, it exits the crusher either onto, a conveyor belt, into a bin or onto a large pile. In some cases, one rock crusher may feed directly into a second one, crushing the rocks up into finer and finer particles in two or three stages.

Jaw crushers are the oldest and one of the simplest sorts of rock crushers. A jaw crusher is like a giant collapsible V made out of two metal walls. At the bottom, the two walls are very close together and at the top they are further apart. One wall is held still while the other is closed against it - usually about three times a second. When it closes, the jaw crushes the rocks inside it. Because it tapers, the rocks are crushed to smaller and smaller sizes as they go down, then dropped through the bottom. The main components of a jaw crusher include vibrating feeder, flywheel, eccentric shaft and bearing, tension rod, toggle plate, jaw plate and fixed jaw.

The jaw crusher is widely used in mining, building materials, chemical industry, metallurgy and so on. It is suitable for primary and

secondary crushing all kinds of minerals and rocks with compressive strength less than 320 MPa.

Another common type is the roller crusher. The roller crusher is a set of two large metal rollers rotating in opposite directions. Rocks are fed into the space between the two rollers, where they are crushed and then dropped to the ground. Roller crushers are often used as a secondary crushing stage. Small, pre-crushed rocks are inserted into the roller, which then breaks them down into gravel.

Gyratory and cone crushers work in pretty much the same way, although they have slightly different designs. The rock falls into the top of a chamber with a spinning grinder at the bottom. As the rock falls down, it is squeezed between the grinder and the walls of the chamber and crushed. As it continues to fall down the chamber, it is pulverized into smaller and smaller bits until it falls out the bottom.

The impact crusher is a machine which works with shock principle, the materials in the crushing chamber suffer a high speed crush from the high-speed rotating hammer, the crushed materials rush over to the impact plate and coming back again, this process will repeat until the products satisfied the requirements, i. e. the fractured particle can discharged as its size is smaller than the gap between the counterattack plate and the hammer.

Task 3. Read the following text and fill in the gaps with the words from the box:

reduce , environmental, machines, jaws, input, maintenance, crush, medium, movable, jaw crushers, raw material , secondary, bottom

Jaw crushers are (1) _____ used for primary and (2)_____ hard material crushing. They use compressive force to (3)_____ the size of raw materials and according to the feeding spread, they can be divided into large, (4)_____ and small sized. These machines are designed for heavy-duty applications, however different types of (5)_____ uses different methods to crush the materials and are used for different purposes. Each jaw crush has a specific feeding size, which basically represent the size of the material that the machine is capable to (6)_____ in smaller pieces

Jaw crushers can be used in departments of mining, construction and demolition field to reduce the size or large materials such as concrete, stones etc. Typical jaw crushers are consisted of a pair of vertical jaws, one (7)_____ and the other fixed, which moves back and forth; a crushing chamber, that is the cavity between the two (8)_____; a gape, a wide opening at the top of the positioned jaws; a thin outflow opening at the (9)_____, that can be set to achieve the desired output size. The (10)_____ is gradually crushed, becoming smaller and smaller as it travels downward the outflow opening.

Jaw crushers machines work on a simple principle, allow the (11)____ of a wide variety of raw feed material, offer reliable operation, and an incredible versatility, What's more, their lubrication system have an outstanding performance and (12)____ is very simple. They cost less energy, compared to other crushers, and cause less (13)_____ problems such as less noise and dust.

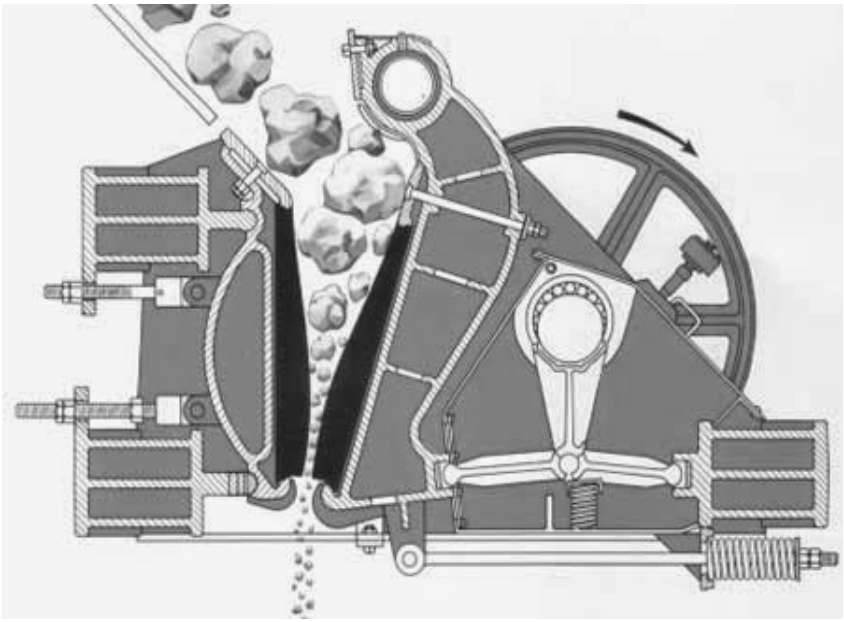

Figure 1. Jaw Crusher

Task 4. Look at the Figure 1 and label the components of the jaw crusher. Explain the working principle of the jaw crusher.
Task 5. Surf the Internet and find videos demonstrating different types of crushers in action.

TEXT B. GRINDING MILLS AND THEIR TYPES

Part I

Task 1. Read the text and find English equavalents to the following Russian words and word cobinations: дробление, крепость, уменьшение размера, удельная плотность, шаровая мельница, температура плавления, стальной шар, истиратель, хрупкость, содержание свободной влаги, мельница самоизмельчения, мельница полуизмельения, частота вращения, стержневая мельница, износ мелющих тел и футеровки

Task 2. Read the text and answer the questions:

1. What are grinding mills?
2. Why have many types of mills been developed?
3. What characterictics of the material should be taken into consideration when deciding on what type of mill to choose?
4. What is the main difference between rod mills and ball mills?

Grinding mills are size reductions machines that often follow crushers in the processes where finer products are desired after crushing. Different grinding machines are usually named as mills, for example rod mills, ball mills, and attrition mills. Because of the name, verb milling is also been used as a synonym for grinding.

Milling, sometimes also known as fine grinding, pulverizing or comminution, is the process of reducing materials to a powder of fine or very fine size. It is distinct from crushing or granulation, which involves size reduction of a material to a smaller size.

A wide range of mills has been developed each for particular applications. Some types of mills can be used to grind a large variety of materials whereas others are used for certain specific grinding requirements.

The characteristics of the material, which are to be taken into account during the selection of the grinding mill, are hardness, brittleness,

toughness, abrasiveness, stickiness, softening and melting temperature, structure, specific gravity, free moisture content, chemical stability, homogeneity, and purity.

The hardness of a material is probably the most important characteristic to be considered when deciding on what type of mill to choose. Trying to grind a material which is too hard results either in costly damage to the mill or an expensive maintenance requirement.

The grinding mills are categorized in three groups: tumbling mills, roller mills, and very fine grinding mills.

Tumbling autogenous (AG) mills are drum mills which consist of horizontally rotating slightly inclined cylinders of large diameter and small length and fitted with lifting bars. Coarse feed is entering the mill from one end and outlet is at the other end. In the mill, the feedstock is lifted and then allowed to drop through a significant height. Three significant mechanisms cause the breakdown of the mineral. These are:

1) impact due to the fall of the mineral onto the charge below causes a reduction in the size of the feedstock,
2) attrition of smaller particles between larger grinding bodies,
3) abrasion or rubbing off of particles from the larger bodies.

Steel or ceramic balls are often added to aid with the reduction process. In this case the mill is then referred to as a semi autogenous (SAG) mill. The process can be carried out wet or dry.

Feed is grinded during its way through the mill. The mill is normally used for grinding of ores. Lining of the cylinder plays very important role. It protects the mill from abrasions and at the same time it helps in lifting of the material from the bottom of cylinder.

Removal of the final product can be carried out using air (where the process is dry) removing only the fines. Rotational speed is usually fairly low, about 80 % of critical speed (critical speed is the speed at which the charge will be pinned to the rotating drum and does not drop) and typical drum diameter ranges from 2 to 10 meters. This type of mill is often used as a single stage process, providing sufficient size reduction in a single process. Alternatively, it can be part of a two stage process where further size reduction is required.

This type of mill is only suited for those kind of ores which are of a fairly coarse nature, but once they are broken, they readily disintegrate

into smaller sizes. Typically, this type of mill can produce a product with a fineness of less than 0.1 mm.

This type of mill has a distinct advantage of accepting coarse input material and supplying a relatively fine ground product. This advantage can provide a reduction in the plant cost, since a single mill can be used as a substitute for two or more stages. There is little wear as the grinding is often carried out by the material itself. Autogenous mills are more suited to large installations i.e. more than 50 tons per hour and have a power requirement ranging from 40 kW up to hundreds of kW.

Rod mills are only suited for those kinds of ores which are of a fairly coarse nature but once they are broken, disintegrate readily into small size. Typically this type of mill can deliver a product with a fineness of less than 0.1 mm. Testing of material is needed before hand to determine the suitability of the ore for processing in an autogenous mill.

The rod mill (Fig 2) is a tumbling mill which is having a large percentage of its volume (30 % to 40 %) loaded with steel rods. The rods are placed axially in the mill and are loose and free to move within the mill. The internal lining of the drum has a series of lifters which raise the rods and drop them at a predetermined point. The liners prevent long and heavy rods to slide on the cylinder lining and help them to lift up. Because of the high kinetic energy of a dropping rod, it is important to pay attention to protecting the cylinder when choosing a liner for the mill.

The material is fed in at one end with a maximum size of about 25 mm. The rods crush the material and as the charge passes through the mill, it is reduced in size to approximately 2 mm to 0.1 mm. The mill can be fed from one end with the product removed from the other end or, alternatively, the mill can be fed from both ends with the discharge at the centre. The process can be wet or dry but generally it is carried out wet. Maximum rod length is about 6 to 7 meters, otherwise there is a risk of the rods bowing. The drum diameter is limited to 0.6 or 0.7 times the length of the mill.

Rod mills are used for grinding hard minerals. This type of mill is normally used as the first stage of a milling process to provide a reduced size feedstock for a further milling process.

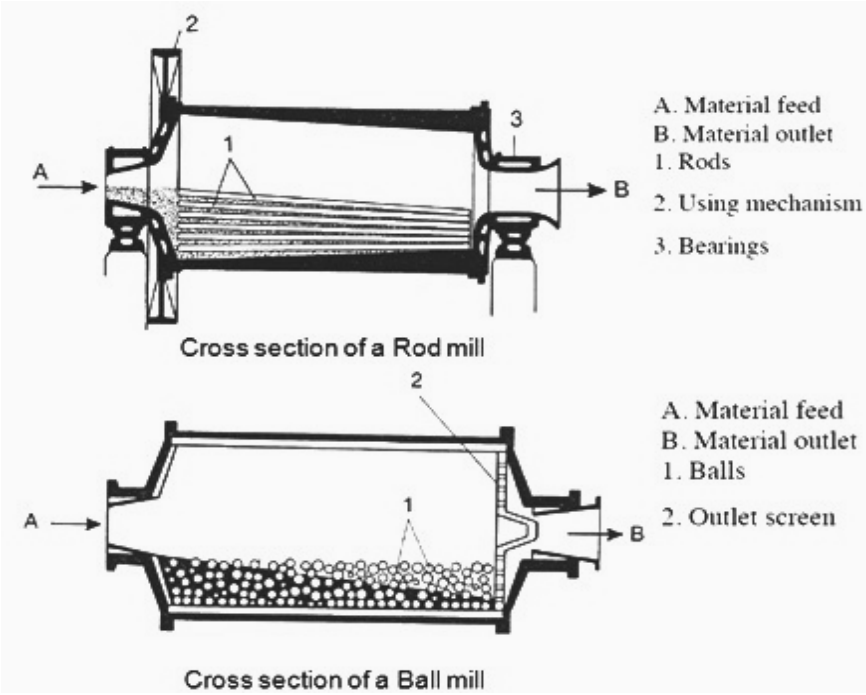

Figure 2. Cross Sections of a Rod Mill and a Ball Mill

Ball mill (Fig 2) is same kind of mill as rod mill, except that it is filled with balls instead of rods. Because of balls have greater ratio of surface area than rods they are more suitable for fine grinding. Balls are also lighter, so the kinetic energy of a single dropping ball is smaller than a rod. The lining material is of great importance as there is a significant amount of wear taking place due to the action of the steel balls.

The ball mill consists of a cylindrical drum, sometimes tapered at one end, and usually has a charge of steel balls (up to 40 % by volume) ranging in size up to 125 mm for larger mills. Product size can be as small as 0.005 mm, but product size is dependent upon the time the charge spends in the grinding zone and therefore the reduction rate is a function of the throughput. The speed of rotation is optimum at about 75 % of critical speed. Some mills are compartmentalized with each subsequent section having a smaller ball size. The material can pass through to the

proceeding section, but the balls cannot. This ensures that the smaller particles are attacked by the smaller grinding media.

Ball mill is a versatile grinding mill and has a wide range of applications. The mill can vary in size from small batch mills up to mills with outputs of hundreds of tons per hour. They are the most widely used of all mills.

Task 3. Translate from Russian into English:

1. Шаровые и стержневые мельницы сравнительно просты по конструкции, удобны и надёжны в эксплуатации, обеспечивают высокую степень измельчения. Недостатки: низкий кпд - 0,01-0,05, высокий расход электроэнергии - 10-40 кВт·ч/т материала, значительный износ мелющих тел и футеровки - 1-3 кг/т материала, большая металлоёмкость и высокий шум при работе.

2. Шаровые мельницы со стальными, чугунными, кремневыми, фарфоровыми шарами диаметром 30-150 мм применяют для тонкого (до 40-100 мкм) измельчения материалов исходной крупностью до 25-30 мм сухим и мокрым способами. Для однородности помола используют смесь шаров разл. диаметра. Объём заполнения барабана шарами обычно не выше 45%.

3. Стержневые мельницы (со стальными стержнями диаметром 40-125 мм) применяют для грубого помола (до 500-1000 мкм) обогащаемого сырья перед окончат. помолом в шаровых мельницах. Конструктивным отличием стержневых мельниц от шаровых является увеличенный диаметр разгрузочного отверстия, что позволяет снизить уровень пульпы при сливе, увеличить скорость прохождения материала и снизить его переизмельчение. Объём заполнения барабана стержнями до 35%.

Part II

Task 1. Read the text and find the English equavalents to the following Russian words and word combinations: вальцовая мельница, вальцы, измельчение в замкнутом цикле, начальная крупность, грохоты, молоткаовая дробилка, корпус, штифтовая мельница, неподвижный диск, мельница измельчения в замкнутом цикле с воздушной классификацией, лопасть, чувствительный к изменению температуры,

помольная камера, неуравновешенный груз, футеровка камеры, мельница смешанного типа, струйная мельница, мельница для тончайшего помола, мелющие тела

Task 2. Five words (feed size, milling, frequency, power consumption, contamination) have been removed from the text. Fill in the gaps with them.

Roller mills are basically of two distinct types. The first has a series of rollers which rotate around a central axis within a drum. The reduction takes place between the rollers and the drum. The second type is where there are a series of fixed rollers and a rotating table. The **A**_____ takes place between the rollers and the table. This type of mill is used for dry grinding only and accepts only relatively soft materials. Small machines can have a throughput of only a few tens of kg per hour whereas larger machines are capable of handling up to 40 or 50 tons per hour and occasionally more. **B**_____ varies according to the machine. The machines are often fitted with screens for closed circuit grinding. Product size can be controlled by changing screens.

Very fine grinding mills are the mills used for very fine grinding. Hammer mills are high speed mills operating at speeds of between 2000 rpm and 6000 rpm. A set of 'hammers' rotate about a central axis in a vertical or horizontal plane. The hammers are either be fixed or are swinging freely. The whole system is enclosed in a cylindrical casing. Feed is dropped to mill from the top of the casing and the outlet for the product is usually via a screen which sieves the product and allows only the required size of particle to pass.

The product size can be extremely fine, although an air classifier is required when such product size is required. Maximum capacity is of the order of 10 tons per hour and **C**_____ is relatively high. Rotating hammer mills are suited for the milling of softer materials.

A pin mill comprises two discs, one rotating and one stationary which are fitted with intermeshing pins set in a concentric pattern. The charge is fed into the centre of the discs and is broken down as it moves outwards through the pins which are moving at very high speed (up to 20,000 rpm).

The air classifying mill is similar in construction to the pin mill but incorporates a built in classifier. This type of mill produces a significant airflow through the machine to aid with keeping temperature as low as possible. Oversize materials, which pass through the mill, are usually recycled.

Turbo mills use a similar concept but the rotating disc is fitted with paddles or bars rather than pins. This rotating disc sits within a cage which is fitted with grids, screens or breaker plates.

Pin mills are capable of very fine grinding without the need for screens and provide a uniform product size. Air classifying mills are used where the product is temperature sensitive. They are suitable for relatively soft materials and for small quantities of material. Wear on the pins is significant if used continuously.

Vibratory mill does not rely on rotation for the main grinding action. The vibrating mill has a grinding chamber which is filled to around 65 % to 80 % of its capacity with grinding media such as balls or rods. The chamber is vibrated at a **D**_____of between 1000 and 1500 times per minute (can be variable speed) by cams or unbalanced weights.The grinding action is efficient and thorough. Grinding media material and chamber lining can vary depending on application.

Vibrating mills are usually batch mills and can grind hard or soft materials. Maximum throughput is about 20 tons per hour. The feed size is normally kept fairly small. Although final product size can be as low as 0.005 mm, this type of mill is often used for less fine applications.

Stirred media mills are usually constructed in the form of a cylindrical drum inside which there are a series of rods, arms or perforated discs which are rotated on a central shaft. The drum is loaded with grinding media, such as metal balls or glass sand. The media and the charge is ‘stirred’ together and thus the grinding takes place.

These mills are suited primarily for very fine grinding of soft materials. They are normally used with wet grinding but can also be used for dry grinding. Product size is as small as 0.005 mm.

The general principle of operation in a fluid energy mill is that the material to be ground is fed into a grinding chamber in a high speed, high pressure and, often, high temperature jet of air (or other gas). The particles collide violently and this causes comminution to take place. Va-

rious designs of fluid energy mill exist, the most common being the micronizer. This mill has a shallow circular grinding chamber and a series of peripheral jets set tangentially to a common circle. The turbulence causes bombardment which effects a rapid reduction in particle size. A centrifugal classification system keeps larger particles within the chamber while allowing fine particles to leave. In a well designed fluid energy mill, there is usually almost no contact between the charge and the mill lining.

These mills are suitable for hard or soft materials to be reduced to 0.02 mm or less. This method of milling tends to be energy intensive and slow but is suitable where the product is highly sensitive to heat or **E** _____ from grinding media.

Task 3. Make up 5 yes-no questions and 5 questions with a question word to the text.

Task 4. Translate from Russian into English:

1.Мельница - машина или аппарат для измельчения сыпучих материалов. Применяют при рудоподготовке, обогащении полезных ископаемых, в металлургии, теплоэнергетике, химической и др. отраслях промышленности. **2.** Существуют различные виды мельниц: барабанные (шаровые, стержневые, трубные, конусные, самоизмельчения), роликовые (ролико-кольцевые, шаро-кольцевые, катково-чашевые, катково-дисковые), ударно-центробежные (молотковые, дезинтеграторы, дисмембраторы), жерновые, вибрационные, струйные. **3.** Прототип М. в виде песта и ступки из камня известен с древнейших времён (8 тыс. лет до н.э.). **4.** За 3 тыс. лет до н.э. ручные мельничные жернова применялись для измельчения п. и. в Др. Египте и Китае. **5.** Первая роликовая мельница изобретена Шранцем в Германии в 1870. **6**. Барабанные мельницы применяются с 80-х гг. 19 в., широко распространены с 1910.**7.** Трубные мельницы применяют для получения наибольшей степени измельчения в одном аппарате при работе в открытом цикле. **8.** Для повышения эффективности работы с возможностью измельчения в несколько стадий трубные мельницы выполняют многокамерными. **9.** Камеры разделяют между собой решётчатыми перегородками для пропуска материала и заполняют мелющими телами (шарами, цильпебсами) уменьшающегося размера. **10.** Такое распределение

мелющих тел делает процесс измельчения в трубных мельницах более равномерным и менее энергоёмким, чем в шаровых и стержневых мельницах.

Task 5. Label the components of the tube mill in English.

Рис. 3. Трубная мельница: I-II - камеры помола; 1 - загрузочная воронка; 2 - роликовая опора; 3 - загрузочная часть; 4 - люк; 5 - барабан мельницы; 6 - разгрузочная часть; 7 - кожух разгрузки; 8 - эластичная муфта; 9 - редуктор; 10 - пальцевая муфта; 11 - электродвигатель.

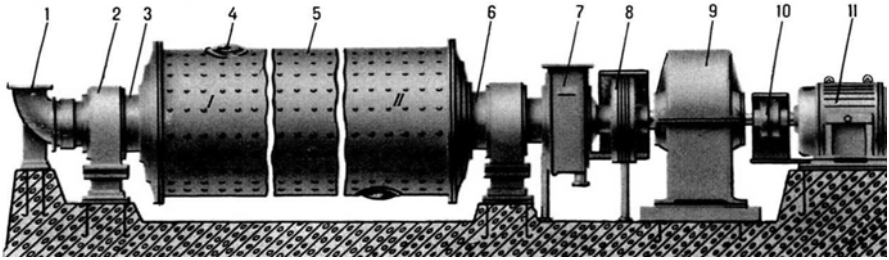

Figure 3. Tube Mill

TEXT C. SCREENS

Part 1

Task 1. Read the text and find the English equavalents to the following Russian words and word combinations: поверхность с отверстиями, эффективность грохочения, сортировочный грохот, в промышленном применении, вращение неуравновешенных грузов, дека грохота, маховик, колосниковый грохот, поток руды, износостойкая сталь, горизонтальный грохот, дренажно-промывочный грохот, резонансный грохот, каркас грохота, собственная резонансная частота, уменьшать потери энергии, обезвоживающий грохот, сгущённая пульпа, эффективность грохочения, расположенные последовательно, размер ячейки сита, занимать меньшую площадь, высокочастотный грохот

Task 2. Read the text and answer the following questions:

1. What is a screen?
2. What does the efficiency of screening depend on?
3. What is the most common type of screening machines?
4. How many screening decks do most vibrating screens have?
5. What screens are used for very coarse material?
6. What screens are used in sizing applications where screening efficiency is critical?
7. What screens produce a drained sand product?
8. What screen has the greatest capacity?
9. What is the main advantage of the modular screen?
10. What principle is the Mogensen Sizer based on?

Task 3. Look at Figure 4 and describe the structure of the vibrating screen.

The types of screening equipment are many and varied. In its simplest form, the screen is a surface having many apertures, or holes, usually with uniform dimensions. Particles presented to that surface will either pass through or be retained, according to whether the particles are smaller or larger than the governing dimensions of the aperture. The efficiency of screening is determined by the degree of perfection of separation of the material into size fractions above or below the aperture size.

There are numerous different types of industrial screens available. The dominant screen type in industrial applications is the vibrating screen, of which there are many sub-types in use for coarse and fine-screening applications.

Vibrating screens are the most important and versatile screening machines for mineral processing applications. Vibrating screens have a rectangular screening surface with feed and oversize discharge at opposite ends. They perform size separations from 300 mm in size down to 45 μm and they are used in a variety of sizing, grading, scalping, dewatering, wet screening and washing applications.

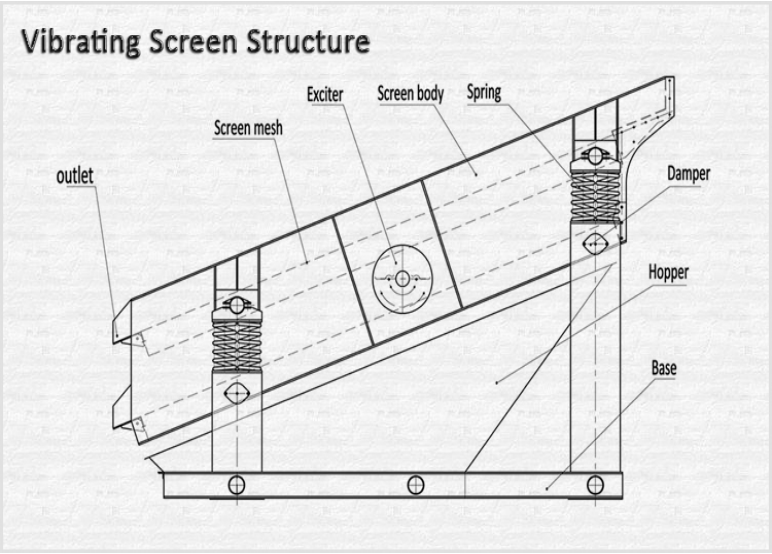

Figure 4. Vibrating Screen Structure

Vibrating screens of most types can be manufactured with more than one screening deck. On multiple-deck systems, the feed is introduced to the top coarse screen; the undersize falling through to the lower screen decks, thus producing a range of sized fractions from a single screen.

Inclined screens or circular motion screens are widely used as sizing screens. A vertical circular or elliptical vibration is induced mechanically by the rotation of unbalanced weights or flywheels attached usually to a single drive shaft. The amplitude of throw can be adjusted by adding or removing weight elements bolted to the flywheels. The rotation direction can be contra-flow or in-flow. Contraflow slows the material more and permits more efficient separation, whereas in-flow permits a greater throughput. Single-shaft screens must be installed on a slope, usually between 15 ° and 28°, to permit flow of material along the screen.

Grizzly screens. Very coarse material is usually screened on an inclined screen called a grizzly screen. Grizzlies are characterised by parallel steel bars or rails set at a fixed distance apart and installed in line

with the flow of ore. The gap between grizzly bars is usually greater than 50 mm and can be as large as 300 mm, with feed topsize as large as 1 m. Vibrating grizzlies are usually inclined at an angle of around 20° and have a circular throw mechanism. The capacity of the largest machines exceeds 5000 th.

The most common use of grizzlies in mineral processing is for sizing the feed to primary and secondary crushers. If a crusher has a 100mm setting, then feed can be passed over a grizzly with a 100mm gap in order to reduce the load on the crusher.

The bars are typically made from wear-resistant manganese steel, and are usually tapered to create gaps that become wider towards the discharge end of the screen to prevent rocks from wedging between the bars.

Horizontal low-head or linear vibrating screens have a horizontal or near-horizontal screening surface, and therefore need less headroom than inclined screens. Horizontal screens must be vibrated with a linear or an elliptical vibration produced by a double or triple-shaft vibrator. The accuracy of particle sizing on horizontal screens is superior to that on inclined screens; however because gravity does not assist the transport of material along the screen they have lower capacity than inclined screens. Horizontal screens are used in sizing applications where screening efficiency is critical, and in drain-and-rinse screens in heavy medium circuits.

Resonance screens are a type of horizontal screen consisting of a screen frame connected by rubber buffers to a dynamically balanced frame having a natural resonance frequency which is the same as that of the vibrating screen body. The vibration energy imparted to the screen frame is stored up in the balancing frame, and re-imparted to the screen frame on the return stroke. The energy losses are reduced to a minimum, and the sharp return motion produced by the resonant action imparts a lively action to the deck and promotes good screening.

Dewatering screens are a type of vibrating screen that are fed a thick slurry and produce a drained sand product. Dewatering screens are often installed with a slight up-hill incline to ensure that water does not flow over with the product. A thick bed of particles forms, trapping particles finer than the screen aperture.

Banana* or *multi-slope screens have become widely used in high-tonnage sizing applications where both efficiency and capacity are important. Banana screens typically have a variable slope of around 40-30° at the feed end of the screen, reducing to around 0-15° increments of 3.5-5°. Banana screens are usually designed with a linear-stroke vibrator. The steep sections of the screen cause the feed material to flow rapidly at the feed end of the screen. The resulting thin bed of particles stratifies more quickly and therefore has a faster screening rate for the very fine material than would be possible on a slower moving thick bed. Towards the discharge end of the screen, the slope decreases to slow down the remaining material, enabling more efficient screening of the near-size material. The capacity of banana screens is significantly greater and is reported to be up to three or four times that of conventional vibrating screens

Modular screens consist of two or more independent screen modules arranged in series, effectively making a large screen from a number of smaller units. A key advantage of this arrangement is that each screen module can be separately configured with a unique screen slope, screen surface type, vibration stroke, and frequency. This allows screening performance to be optimised separately on different sections of the screen. The individual screen sections being smaller and lighter are mechanically more robust compared with a single screen with an equivalent total size. Modular screens are frequently installed in a multi-slope configuration.

The Mogensen Sizer is a vibrating screen that uses the principle that particles smaller than the aperture statistically require a certain number of presentations to the screen in order to pass. The Mogensen Sizer consists of a system of oscillating and sloping screens of decreasing aperture size, the smallest of which has a mesh size up to twice the size of the desired separation size. This arrangement allows particles very much finer than the screens to pass through quickly, but causing larger particles to be rejected by one of the screen surfaces. A thin layer of particles on each screen surface is maintained, enabling high capacity such that a particular screening duty can be met with a machine occupying less floor space than a conventional screen, and blinding and wear are reduced.

High frequency screens. Efficient screening of fine particles requires a vibration with small amplitude and high frequency. Frequencies up to 3600 rpm are used to separate down to 100 microns compared with vibrating screens for coarser applications that are vibrated at around 700-1200rpm. The vibration of the screening surface can be created by electric motors or with electrical solenoids.

High-frequency wet screens such as the *Derrick repulp screen* permit screening down to 45 microns. Screening efficiency decreases rapidly once the free water has passed through the screen, therefore these screens incorporate water-sprays to periodically re-pulp the screen oversize to ensure good washing.

Task 4. Translate from Russian into English:

1.Вибрационный грохот используется для дробления, просеивания и сортировки камней и других сыпучих материалов. **2**. При помощи грохота можно также отделить рудные материалы от нерудных, а также освободить их от излишков влаги. **3.** Во время работы аппарат издает сильный шум, поэтому он и получил свое название. **4.** Данная машина может использоваться самостоятельно или в качестве элемента больших обрабатывающих установок. **5.** Кроме того, эти устройства могут быть мобильными или стационарными. **6.** Конструкция вибрационного грохота является достаточно простой. **7**. Он состоит из короба, в котором размещены рамы, вибратор и привод, который запускает весь аппарат. **8.** На загрузочной части короба закрепляется эксцентрик вибросита. **9.** Благодаря мощному двигателю он может вращаться. **10.** Таким способом загрузочная часть совершает кругообразные горизонтальные движения. **11**. Тот материал, который высыпается на сито, равномерно распределяется по всей его поверхности. **12.** В это время производится отсев частиц через отверстия заданного размера. **13.** Во время работы сито периодически подбрасывается. **14.** Это действие сопровождается соответствующим ударным шумом. **15.** Благодаря подбрасыванию материал лучше просеивается. **16.** Движения сит вибрационного грохота можно регулировать. **17.** Преимуществами виброгрохотов считаются: долгий срок эксплуатации, длительный безремонтный промежуток грохочения, высокая производительность.

Терминологический словарь

abrasiveness	абразивность
articulated dump truck	самосвал с шарнирно сочленённой рамой
aperture	отверстие
attrition	трение, истирание
attrition mill	истиратель
autogenous mill	мельница самоизмельчения
automatic control systems	система автоматизированного управления
ball mill	шаровая мельница
banana screen	грохот-банан
bearing	содержащий
belt drive	привод ленточного конвейера
bin	бункер
breaker plate	футеровочная плита дробилки
bogger	погрузочная машина
brittleness	хрупкость
bucket capacity	емкость ковша
centrifugal filter	центрифуга-фильтр
circular motion screen	грохот с круговым движением сит
chamber lining	футеровка камеры
closed circuit grinding	измельчение в замкнутом цикле
coal preparation plant	углеобогатительная фабрика
concentrate	концентрат
concentration	обогащение, концентрация
cone crusher	конусная дробилка
conveyor belt	ленточный транспортёр
conveyor dryer	конвейерная печь для сушки

comminution	дробление
continuous miner	проходческий комбайн непрерывного действия
crawler-tractor	гусеничный трактор
cross section	поперечное сечение
crusher	дробилка
crusher chamber	камера дробилки
crushing	дробление (крупное)
crushing cavity	камера дробления
cylinder mill	цилиндрическая мельница
dewatering	обезвоживание
dewatering bin	обезвоживающий бункер
dewatering screen	обезвоживающий грохот
discharging opening	разгрузочное отверстие
disintegrate	раздроблять; измельчать
disk filter	дисковый фильтр
drain-and-rinse screen	дренажно-промывочный грохот
drum	шнек
drum cell filter	барабанный ячейковый фильтр
dryer	сушильный аппарат, сушилка
dozer	бульдозер
dump truck	самосвал
eccentric bearing	подшипник эксцентрика
eccentric shaft	эксцентриковый вал, распределительный вал
electrostatic separation	электростатическая сепарация
face	забой, лава
face shovel	забойный экскаватор
feed	первоначальный материал
feed opening	загрузочное отверстие

feed length	длина подачи
feed size	начальная крупность
filter cake	кек фильтрования
fixed jaw	неподвижная щека
flint stones	кремнёвый камень
float	держаться на поверхности, флотировать
flocculating agent	флокулянт
flotation cell	флотационная камера
flotation separation	флотационная сепарация
fluid energy mill	струйная мельница
fluidized-bed dryer	сушилка с кипящим слоем
froth	пена при флотации
fly wheel	маховик
gape	ширина загрузочного отверстия
gravel bed	гравийный подстилающий слой
gravity concentration	гравитационное обогащение
gravity filter	гравитационный фильтр, фильтр-отстойник
gravity separation	гравитационная сепарация
grinder	дисковая дробилка
grinding	измельчение
grinding bodies	мелющие тела
grinding mill	мельница, дробилка
grinding media	мелющие тела
grizzly screen	колосниковый грохот
gyratory crusher	жираторная дробилка
hammer mill	молотковая дробилка
hardness	крепость, твердость
heavy machinery	мощные машины

heavy-media separation	разделение в тяжёлой среде
horizontal low-head screen	горизонтальный грохот
homogeneity	однородость
hopper	загрузочная воронка
jaw crusher	щёковая камнедробилка
jaw plate	(дробящая) щека дробилки
jigging	отсадка
intermediate haulage	откатка до главного откаточного пути
impact crusher	ударная дробилка
length-to-diameter ratio	отношение диаметра к длине
lifting bar	подвес
lining	внутреннее покрытие, футеровка
lining material	футеровочный материал
load-haul dump	погрузочно-доставочная машина
log washer	корытная мойка
longwall mining	разработка длинными очистными забоями (лавами)
machine sampler	автоматический пробоотбиратель
magnetic separation	магнитная сепарация
mesh size	размер ячейки сита
micronizer	мельница для тончайшего помола
mill (grinding mill)	мельница
mill feed	обогатительное сырьё
milling	измельчение в мельнице
millstone	жерновой камень
mineral processing	обогащение полезных ископаемых
mineral processing plant	горнообогатительный комбинат
mortar	толчейное корыто

motor grader	автогрейдер
mount	устанавливать, монтировать
muck	неубранная порода
openings	отверстия
optical sorting	фотометрический метод сепарации
ore gangue	пустая порода
ore reduction	измельчение руды, дробление руды
oscillating motion	колебание
overburden	вскрыша, покрывающая порода
permeable	проницаемый
pestle	толчейный пест, ступа
pin mill	штифтовая мельница
pipe sampler	трубчатый пробоотбиратель
pressure filter	фильтр для обезвоживания под давлением, фильтропресс
processing plant	обогатительная фабрика
pulp	пульпа, смесь тонко измельчённого ископаемого с жидкостью
pyrometallurgical processing	пирометаллургическая обработка
resonance screen	резонансный грохот
rod mill	стержневая мельница
roller crusher	валковая дробилка
roller bearing	шарикоподшипник
roller mill	вальцовая мельница
rollers	вальцы
room	очистная выработка
room and pillar mining	камерно-столбовая разработка
rotary drum drier	вращающаяся барабанная сушилка

sampling device	прибор для отбора проб
screen	грохот
screening deck	дека грохота, ситовая поверхность
semiautogenous mill	мельница полусамоизмельчения
sieve	сетчатый фильтр, решето
sizing screen	сортировочный грохот
shaking table	вибростол, качающийся концентрационный стол
separation of particles by size	разделение частиц по размерам
shovel	ковш (экскаватора)
shuttle car	самоходная вагонетка
softening	размягчение
specific gravity	удельная плотность
spiral	спиральный сепаратор
smelting	плавление
spalling	расщепление
stamp mills	пест, толчея (для мелкого дробления пород)
stickiness	слипаемость
surface mining	открытая разработка
suspension	суспензия
tailings	хвосты
taper	сужаться (сходить на конус)
tension rod	натяжной стержень
thickening	уплотнение
throughput	пропускная способность
toggle plate	распорная плита(дробилки)
tumbling mill	барабанная мельница

tungstan carbide teeth	вставные карбидвольфрамовые зубья шарошки
tumble	падать
vacuum filter	вакуумфильтр
valuable minerals	полезные ископаемые
vibrating feeder	вибрационный питатель
vibrating screen	вибрационный грохот, виброгрохот
vibratory mill	вибромельница
water circuits	водно-шламовая схема
wear-resistant steel	износостойкая сталь
wheel loader	колёсный погрузчик

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Методические указания к самостоятельной работе для студентов специальности 21.05.04

FOREIGN LANGUAGE

MINING MACHINES AND EQUIPMENT

Сост. *М.А. Троицкая*

Печатается с оригинал-макета, подготовленного кафедрой иностранных языков

Ответственный за выпуск *М.А. Троицкая*

Лицензия ИД № 06517 от 09.01.2002

Подписано к печати 04.04.2019. Формат 60×84/16.
Усл. печ. л. 2,7. Усл.кр.-отт. 2,7. Уч.-изд.л. 2,5. Тираж 50 экз. Заказ 302. С 115.

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