Министерство науки и высшего образования Российской Федерации

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Санкт-Петербургский горный университет

Кафедра иностранных языков

ИНОСТРАННЫЙ ЯЗЫК

МАГИСТРАЛЬНЫЕ ТРУБОПРОВОДЫ И ГАЗОНЕФТЕХРАНИЛИЩА

PIPELINES AND OIL AND GAS FACILITIES

Методические указания к практическим занятиям для студентов специальности 21.05.06

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Методические указания предназначены для студентов специальности 21.05.06 «Нефтегазовая техника и технологии (Магистральные трубопроводы и газонефтехранилища)» и согласованы с программой по иностранному языку для студентов неязыковых вузов.

На материале аутентичных текстов, в которых освещаются проблемы проектирования нефтепровода, его очистки, предотвращения от коррозии, а также описания различных типов газонефтехранилищ, студенты смогут сформировать навыки чтения и перевода текстов по специальности, освоить необходимую лексику, а также делать устные сообщения и принимать участие в беседе.

Научный редактор канд. пед. наук, доц. *Ю.В. Гоман*

Рецензент канд. пед. наук, доц. *Е.А. Бугреева* (*Санкт-Петербургский государственный университет*)

ПРЕДИСЛОВИЕ

Данные методические указания предназначены для проведения практических занятий по английскому языку со студентами специальности 21.05.06 «Нефтегазовая техника и технологии (Магистральные трубопроводы и газонефтехранилища)». Методические указания составлены в соответствии с учебной программой по дисциплине «Иностранный язык» для формирования иноязычной профессиональной компетенции будущих специалистов.

В методические указания включены аутентичные тексты, в которых описываются особенности проектирования и конструирования нефтепровода, способы его очистки, причины появления и способы предотвращения коррозии, а также различные газонефтехранилища.

Использование предложенного комплекса упражнений способствует формированию у будущих специалистов навыков перевода с английского языка на русский публицистических и технических текстов, совершенствованию навыков говорения, просмотрового, ознакомительного, изучающего и поискового чтения, а также развитию умений реферировать аутентичные тексты на английском языке.

UNIT 1

PIPELINE DESIGN AND CONSTRUCTION

Text 1

Task 1. Discuss in groups. Which types of pipeline do you know? What is the difference in their usage?

Task 2. Match the types of pipeline (1-8) with their definitions (a-h). Translate into Russian.

Types of pipeline in oil and gas industry

1. Injection lines	a. Pipelines between two processing facilities or from a pig trap to a pig trap or from a block valve station to a block valve station.
2. Flow lines	b. Pipelines connecting the offshore production platforms to onshore processing facilities.
3. Trunk lines / Inter field lines	c. Pipelines injecting water/ steam/ polymer/gas into the wells to improve the lift.
4. Export lines / Loading lines	d. Branch line exiting into trunk line or export line.
5. Transfer lines / Spur lines	e. Pipeline which disposes of normally produced water into disposal wells (shallow/deep).
6. Gathering lines	f. One or more segments of pipelines forming networks and connected from the wells to processing facilities.
7. Disposal lines	g. Pipelines from the wellhead to the nearest processing facility.
8. Subsea pipelines	h. From the processing facility to the loading or export point.

Task 3. Translate the words into Russian: *a valve, leakage, a satellite, to traverse, coating, velocity, ditching, a boring machine, prevention, PVC pipe, safety, a booster station, storage.*

Task 4. Read and translate the following text. Choose the most appropriate title to A-D paragraphs.

1) Components; 2) Operation; 3) Design; 4) Construction

A. Pipeline design includes a selection of the route traversed by the pipe, determination of the throughput (*i.e.*, the amount of fluid or solids transported) and the operational velocity, calculation of pressure gradient, selection of pumps and other equipment, determination of pipe thickness and material (*e.g.*, whether to use steel, concrete, cast iron, or PVC pipe), and an engineering economic analysis and a market analysis to determine the optimum system based on alternate designs. In each design, careful consideration must be given to safety, leak and damage prevention, government regulations, and environmental concerns.

B. A pipeline is a system that consists of pipes, fittings (valves and joints), pumps (compressors or blowers in the case of gas pipelines), booster stations (*i.e.*, intermediate pumping stations placed along the pipeline to house pumps or compressors), storage facilities connected to the pipe, intake and outlet structures, flow meters and other sensors, automatic control equipment including computers, and a communication system that uses microwaves, cables, and satellites. Booster stations are needed only for long pipelines that require more than one pumping station. The distance between booster stations for large pipelines is on the order of 50 miles. Special pipelines that transport cryogenic fluids, such as liquefied natural gas and liquid carbon dioxide, must have refrigeration systems to keep the fluid in the pipe below critical temperatures.

C. Construction of pipelines involves route survey, ditching or trenching, transporting the pipes, fittings, and other materials to the site, stringing the pipes along the ditch, bending steel pipes in the field to suit local topography, applying coating and wrapping to steel pipes, joining pipes together either before or after they are lowered into the trench (this depends on the type of pipes used), checking for possible welding flaws or leakage at the joints, and then covering trenches by soil and restoration of the land to its original appearance. For long pipelines, construction is done in segments so that one segment of the pipeline is completed before

construction proceeds to the next. This minimizes the time that any given place is disturbed by construction activities. Even for large pipelines, construction for any segment is usually completed within six months and often in much less time. Small pipelines can be constructed in days.

When a pipeline must cross a river or creek, the pipe can be either attached a to a bridge, laid on the streambed underwater, or bored through the ground underneath the river. Modern boring machines allow convenient pipeline crossing of rivers and roads.

D. Modern long-distance pipelines are operated mainly automatically by a computer at the headquarters of the pipeline company. The computer monitors the pressure, flow rates, and other parameters at various locations along the pipe, performs many on-line computations, and sends commands to the field to control the operation of the valves and pumps. Manual intervention is frequently needed to modify the automatic operation, as when different batches of fuels are directed to different temporary storage tanks, or when the system must be shut down or restarted.

From https://www.britannica.com/topic/Trans-Arabian-Pipeline

Task 5. Answer the questions:

1. What must be considered before pipeline design?
2. What does a pipeline system usually consist of?
3. What do booster stations serve for?
4. What is more important while constructing pipelines?
5. How long does it usually take to construct pipelines?
6. How are modern long-distance pipelines operated?

Text 2

Task 1. Read the text and insert the missing words from the box into the gaps.

Penetration	jamming	equipment	completion
testing	measure	demands	facilitate	welding

Pipelines are inspected more critically than ever before, and today's radiographic (1)…… and techniques produce clearer radiographs with greater sensitivity than in the past. Although codes have

not changed drastically, interpretation standards have been upgraded. The combination of more rigorous inspection, better (2)…….. methods, and high acceptability standards often approaches an attitude requiring zero defects.

This poses some serious problems because the job of (3)……. cross-country pipelines under typical conditions has always been an extreme challenge requiring specialized and highly developed skills. Now that the (4)……. are greater, even the best welding operators are having trouble. Rejectable defects usually require cutting out the entire weld. This is expensive and can cost competent pipeline welders their jobs.

Sizing plates. Often the debris-removal operation, after (5)……. of construction, is combined with gauging to detect dents and buckles. This operation will prove that the pipeline has a circular hole from end to end. Typically, an aluminum disc with a diameter of 95% of the nominal inside diameter of the pipe is attached to the front of a pig and is inspected for marks at the end of the run. The pig could also be equipped with a transmitter to (6)…….. tracking the location of the pig. If the pig hangs, this will facilitate easy location of the pig to locate the dent/buckle. When constructing offshore pipelines, the most likely place for a buckle to occur during the lay operation is in the sag bend just before the pipe touches the bottom. A gauging pig can be placed inside the pipe and pulled along the pipe. If the lay barge moves forward and the pig encounters a buckle or dent, the pull line will become taut. This indicates that it will be necessary to pick up and replace the dented section of pipe.

Caliper pigging. Caliper pigs are used to (7)……. pipe internal geometry. Typically, they have an array of levers mounted in one of the cups. The levers are connected to a recording device in the body. As the pig travels through the pipeline, the deflections of the levers are recorded. The results can show up details such as girth-weld (8)……., pipe ovality, and dents. The body is normally compact, about 60% of the internal diameter, which, combined with flexible cups, allows the pig to pass constrictions up to 15% of bore. Caliper pigs can be used to gauge the pipeline. The ability to pass constrictions such as a dent or buckle means that the pig can be used to prove that the line is clear with

minimum risk of (9)……. This is particularly useful on subsea pipelines and long landlines where it would be difficult and expensive to locate a stuck pig.

From "Pipelines rules of Thumb"

Task 2. Translate the following words and expressions from Russian into English: *вмятины и неровности, высокая допустимость, морской трубопровод, отклонения, с большей точностью, калибровочный скребок, пересеченная местность, вогнутое колено трубы, неприемлемые дефекты*.

Task 3. Match the adjectives from column A to their synonyms from column B. Translate them.

A	B
accurate	drastic
fixed	upgraded
united	rigorous
dramatic	competent
qualified	mounted
improved	combined

Task 4. ► You are going to watch the video "Pipeline Design" https://www.youtube.com/watch?v=UHZVCCKOyAU. Mark the sentences True or False. Correct the False ones:

1. Pipelines can run across entire continents.
2. There are just a few rules experts follow while collecting information for designers.
3. Designers have computer modeled photos and photos taken from the satellites.
4. A new job has appeared recently: an environmental expert, as environmental care is very important.
5. Different alloys can be added to the steel which the pipes are built from.
6. Each pipe is examined automatically only.
7. Pipes even with tiny imperfections in the coating are rejected.

Text 3
Pipe material selection

Task 1. Match the words and phrases with their Russian equivalents:

1. overwhelming	a. воздействие
2. relatively	b. последующий
3. cladding	c. подавляющий
4. deficiency	d. меры
5. impact	e. относительно
6. to enhance	f. оценивать
7. to evaluate	g. обшивка
8. subsequent	h. благоприятный
9. beneficial	i. недочет
10. measures	j. усиливать

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

1. **Which information is needed when selecting the pipeline materials?**
2. **What do the following abbreviations mean: CP, HIC, SSC, MIC?**

Task 3. Read and translate the text.

The overwhelming majority of pipelines worldwide, be it for oil, gas, or water, are constructed from carbon steel. It is a material that is readily available, relatively cheap, with good mechanical **properties**, excellent weldability, and whose corrosion **resistance** can be enhanced by a number of ways such as coating, lining, cladding, CP, and chemical **inhibition**. There is also a vast amount of information and track record on its use. It is very important, and sometimes critical, to involve corrosion engineers in any new project from the early stages of the design and engineering process. Their early involvement could prevent failures down the line due to corrosion related deficiencies in design and materials selection.

When selecting the pipeline material, we need to have as much information as possible about its operating environment and other relevant factors as explained below. It should also be noted that many of these environmental conditions may change through the course of the design life of structures and equipment and their impact on the corrosion

process may change accordingly. Therefore, it is good practice to check the original design data used for material selection with the actual data from operating conditions from time to time.

Without water there is no corrosion; therefore, the presence and amount of water are of critical importance. Oil is not only noncorrosive but also provides a degree of corrosion inhibition by forming a viscous **film** on the metal surface. Experience over the years has shown that with little or no water, the metal surface remains "oil-wet" and corrosion is kept to a minimum. However, increasing water content changes the metal surface environment from "oil-wet" to "water-wet" leading to a sharp rise in the corrosion rate. It is not just important to know the water content in the pipeline but, just as importantly, when the high water level is reached. This information can then be evaluated alongside the expected design life to reach to the best techno-economic selection.

The gases which presence and levels have a major influence on material selection are oxygen, hydrogen (produced by the cathodic reaction), carbon dioxide, and hydrogen sulfide. Oxygen greatly accelerates the corrosion process and has to be kept out of the pipeline. Carbon dioxide reacts with water to produce carbonic acid, resulting in acidic pH and subsequent rise in corrosion. The main danger with both hydrogen sulfide and hydrogen is environmental cracking: HIC, SSC, and stress oriented hydrogen induced cracking. With hydrogen sulfide, there is also a health and safety risk as it is a highly toxic gas, fatal even at very low levels, and therefore its uncontrolled release to atmosphere must be **prevented** at all costs, especially in populated places. However, H_2S can also be beneficial by forming a protective iron sulfide film on the metal surface.

Increasing the operating pressure, increases the partial pressure of gases, making them more soluble and able to cause corrosion. Increasing the temperature in most cases increases the rate of corrosion reaction. Also, it is very important to know the minimum operating temperature as it may necessitate the requirement of materials resistant to cracking in very low temperatures, such as a low temperature steel.

Both the maximum and minimum flow rates have an important bearing on corrosion. With the maximum flow rate, if it exceeds the erosional **velocity**, then significant erosion corrosion can take place. On

the other hand, very low levels of flow rate can cause stagnation and build-up of liquids and solids, leading to underdeposit corrosion and MIC.

This can have a significant effect on the cost aspect of material selection, when using the life cycle cost analysis. For the same environment, a short design life may allow the use of carbon steel with no further corrosion control, whereas a long design life may require a number of corrosion control measures, or even a higher grade material.

Nonmetallic materials are finding increasing usage as pipeline material, either as lining material or as a stand-alone material. However, when considering nonmetallics as pipeline material, environmental factors such as maximum pressure and temperature must be carefully considered. For nonmetallic pipelines being laid on the desert, soil and sand movements must also be considered. Such environmental factors can have an **adverse** impact on the material.

From "Subsea Pipelines and Risers"

Task 4 Match the words in bold from the article with their meanings:

1._____. a fine, thin skin, surface, layer, or coating;
2._____. anything that slows a chemical or organic reaction;
3._____. quickness or rapidity of motion or action;
4._____ . any of the principal characteristics of a substance;
5._____. unfavourable, harmful;
6._____ . to stop or keep from doing something or happening;
7._____ . a force that opposes motion.

From Webster's Dictionary

Task 5. Use the Internet and prepare a report about any company in the world that produces oil and gas pipes.

UNIT 2

CLEANING PIPELINES

Task 1. Choose a correct prefix to make a new verb:

dis	**re**	**mis**	**un**	**en**	**over**	**out**	**under**
___lock			___finish				___schedule
___hear			___inform				___believe
___solve			___place				___lodge
___large			___able				___sure
___construct			___write				___move
___last			___do				___speak
___work			___value				___come
___go			___heat				___load

Text 1

Task 2. Say these words correctly. Use the proper word stress: *construction, flooded, contamination, hazardous, suspension, gel, particles, a rapture, to install, accelerate, efficiency, pressurized, traction.*

Task 3. Read and translate the text. Pay special attention to the expressions printed in italics.

Cleaning after construction. After construction, the pipeline bore typically contains *dirt, rust, and mill scale*; for several reasons it is normal to clean these off. The most obvious of these reasons is to prevent contamination of the product. *Gas feeding* into the domestic grid, for example, must not be contaminated with *particulate matter*, since it could block the jets in *the burners downstream*. A similar argument applies to most product lines, in that the fluid is devalued by contamination. A second reason for cleaning the pipeline after construction is to allow effective use of *corrosion inhibitors* during commissioning and operation. If product fluid contains corrosive components such as hydrogen sulfide carbon dioxide, or the pipeline has to be left full of water for some time before it can be commissioned, one way of protecting against corrosive attack is by introducing inhibitors into the pipeline. These are, however, less effective where the steel surface is already corroded or covered with mill scale, because the inhibitors do not come into intimate contact with

the surface they intended to protect. Thirdly, *the flow efficiency* is improved by having a clean line and keeping it clean. This applies particularly to longer pipelines where the effect is more noticeable. Increasingly, operators are specifying that the pipe should be sand blasted, coated with inhibitor, and *have its ends capped* after traction in order to minimize the postconstruction cleaning operation. A typical cleaning operation would consist of sending through a train of pigs driven by water. The pigs would have *wire brushes* and would permit some bypass flow of the water so that the rust and mill scale dislodged by the brushing would be flushed out in front of the pigs and kept in suspension by *the turbulent flow*. The pipeline would then be flushed and swept out by *batching pigs* until the particulate matter in the flow has reduced to acceptable levels. Following brushing, the longer the pipeline the longer it will take to flush and sweep out the particles to an acceptable level. *Gel slugs* are used to pick up the debris into suspension, cleaning the pipeline more efficiently. Gels are specially formulated *viscous liquids* that will wet the pipe surface and pick up and hold particles in suspension. A slug of gel would be contained between two batching pigs and would be followed by *a slug of solvent* to remove any traces of gel left behind.

Flooding for hydrotest. In order to demonstrate the strength and integrity of the pipeline, it is filled with water and pressure tested. The air must be removed so that the line can be pressurized efficiently because, if *pockets of air* remain, these will be compressed and absorb energy. It will also take longer to bring the line up to pressure and will be more hazardous in the event of a rupture during the test. It is therefore necessary to ensure that the line is *properly flooded* and all of the air is displaced. A batching pig driven ahead of the water forms an efficient interface. Without a pig, in downhill portions of the line, the water will run down underneath the air trapping pockets at the high points. Even with a pig, in *mountainous terrain* with steep downhill slopes, the weight of water behind the pig can cause it to accelerate away, leaving *a low pressure zone* at the hill crest. This would cause dissolved air to come out of the solution and form *an air lock*. A pig with a high pressure drop across it would be required to prevent this.

Dewatering and drying. After the hydrotest has been completed, the water is generally displaced by the product or by nitrogen. The same

arguments apply to dewatering as to flooding. A pig is used to provide an interface between the hydrotest water and the displacing medium so that the water is swept out of all low points. *A bidirectional batching pig* may be used during hydrotest and left in the line during hydrotest and then reversed to dewater the line. In some cases, it may be necessary to dry the pipeline. This is particularly so for gas pipelines where traces of water may combine with the gas to form hydrates. Drying is also required for chemical pipelines such as ethylene and propylene pipelines, since water will contaminate the material and make it unusable. After dewatering the pipe walls will be damp and some water may remain *trapped in valves and dead legs*. This problem is solved by designing dead legs to be self-draining and installing drains on valves.

From "Pipelines rules of Thumb"

Task 4. Scan the text and complete the following verbs with prepositions to form phrasal verbs. Translate them.

a. flush (…)
b. sweep (…)
c. clean (…)
d. leave (…)
e. bring (…)
f. drive (…)
g. accelerate (…)
h. come (…)
i..drop (…)

Task 5. Try to explain the following words in English: *pigs, drains, dead legs, solvent, rust, blasting, coating, slugs, to absorb, to trap, air pockets.*

Text 2
Dewatering

Task 1. Translate the following words from English into Russian: *to co-mingle, a permit, to disintegrate, a tee, a vent, a bend, to accomplish, debris, damage, appurtenances.*

Task 2. Complete the text using the verbs in brackets in the correct form.

Dewatering is considered to commence with the running of the first pig after hydrostatic testing is completed and begins with the insertion of a displacer, commonly (1) …[REFER] to as a pig, in the pipeline. The dewatering pig may be pushed through the pipeline with crude oil or other petroleum product if no (2) …[DRY] is required. If the pipeline is to be cleaned and/or dried, the pig will be pushed by either compressed air or gas. In either case, proper precautions must (3) …[TAKE] to be sure the test water is properly disposed of and that any required water discharge permits (4) …[OBTAIN] ahead of the dewatering operation. Several types of pigs may be used for the dewatering phase, and pig selection should depend upon the design characteristics of the pipeline and the degree of cleaning, if any, that is desired. Ideally, the pig will form a perfect seal with the inner periphery of the pipe and (5) …[NOT ALLOW] any of the material behind the pig to leak past the pig and co-mingle with the test water ahead of the pig. Normally, the pig will move through the pipeline without difficulty. However, there are many opportunities for problems to develop, (6) …[CAUSE] the pig to stick or even disintegrate.

Sticking may be caused by any or a combination of the following things:

a) pig is incorrect length and cannot negotiate check valves, tees, and bends;
b) pig is too large for heavy wall sections of the line;
c) pipeline may be equipped with reduced opening valves;
d) excess debris or construction material may be left in the pipeline;
e) air/gas may bypass the pig and create an air lock condition.

Air locks are more likely to occur in hilly country than in flat land. Air locks occur when the accumulated static heads are greater than the available displacing pressure. In some cases, a pressure greater than the maximum allowable pipeline pressure would (7) …[REQUIRE] to overcome the air lock. Usually, the air lock (8) …[OCCUR] where air/gas has bypassed the pig and the downhill legs of the pipeline are filled with air and the uphill legs of the pipeline are filled with water. The air/gas can get in front of the dewatering pig in several ways, such as:

a) poor filling techniques;

b) poor dewatering procedure such as draining water from the line at low points;

c) air/gas bypassing the pig because the pig is too small for the pipeline;

d) air/gas bypassing the pig before it is launched;

e) air/gas bypassing the pig in a fitting such as in a tee, or a steel shaft pig in a short radius bend.

When an air lock condition occurs, it is necessary to either increase the displacing pressure or remove air/gas through (9) …[EXIST] vents or other connections at high points in front of the pig. For these reasons, it is important that the dewatering process be carefully planned, especially for pipelines located in hilly country. It (10) …[BELIEVE] there are no written specifications to define the degree of cleaning for a pipeline since there is a question of the definition of a clean pipeline, and furthermore, a method for measuring the cleanliness has not been developed. It is known, however, that cleaning a pipeline does at least four good things.

Cleaning the pipeline will:

a) improve flow efficiency because of a smoother pipe wall;

b) reduce product contamination and formation of hydrates;

c) reduce abrasive damage to pipeline appurtenances such as valves and instruments;

d) facilitate pipeline drying.

Internal cleaning of the pipeline may be accomplished by any of a combination of the following methods:

a) running a brush pig with air, gas, or liquid;
b) internal sand blasting;
c) chemical cleaning;
d) purging with air or gas followed by a liquid flush.

From "Pipelines rules of Thumb"

Task 3. Fill in the table. Form a missing noun, verb or adjective from the following words where possible.

Noun	Verb	Adjective
	operate	
procedure		

	exist	
		improved
facility		
	vary	
		required
	remove	

Task 4. Close the book and try to name the main principles of dewatering.

Text 3

Task 1. Find the English equivalents for the following Russian phrases. Then explain the meaning.

A) температура конденсации;
B) определение содержания влаги;
C) пескоструйная очистка;
D) вакуумная сушка.

Task 2. Read the text and fill in the gaps with suitable prepositions.

Part 1

Pipelines used (1) … transport petrochemicals such as propylene and ethylene must be dried in order (2) … the delivered product to meet moisture specifications. Natural gas pipelines are usually dried to a lesser extent to prevent the formation (3) … hydrates. It is not unusual for a petrochemical line to be dried (4) … a dew point of 80 F. A typical dew point for a propylene pipeline will be 70 F. A carbon dioxide pipeline might be typically dried to a 40 F dew point. The natural gas industry specifies dryness (5) … pounds of water per million standard cubic feet of gas.

The most common methods for drying pipelines are as follows:

a) drying with super dry air;
b) drying with methanol;
c) drying with inert gas such as nitrogen;
d) internal sand blasting;
e) drying with the medium to be transported;
f) vacuum drying.

All of these methods may be applied to pipeline drying depending (6) … the particular line and amount of dryness required. No single method can be considered ideal (7) … all situations. Many times, a combination of two or more methods will be used to achieve a dry pipeline (8) … the least cost. The first three methods are probably the most economical and technically feasible for most pipeline drying applications.

(9) … any type of drying operation commences, it will be necessary to clean the line using one of the previously described processes. If the rust and mill scale are not removed (10) … the pipe wall, moisture will remain trapped and will bleed out over a long period of time. A pipeline can be dried (11) … cleaning; however, the cost and time required will be great.

Task 3. Match the words from the text with their synonyms:

1. to commence	a. to use
2. feasible	b. humidity
3. to achieve	c. to begin
4. to apply	d. inner
5. internal	e. to supply
6. formation	f. to gain
7. moisture	g. reasonable
8. to deliver	h. combination

Task 4. Work in groups of four. Each student in a group chooses one paragraph from Part 2 (A-D), reads and then tells the group about it.

Part 2

A. In drying with **super dry air**, soft foam pigs pushed by dry air are used to absorb any free water remaining in the pipeline after dewatering. After the line is dust dry, wire brush pigs are run to remove any water bearing debris from the pipe wall. The wire brush pigs are then followed by soft foam pigs to absorb the loosened debris. Near the end of this phase, the pigs may be weighed prior to insertion and after removal to monitor the amount of debris that is being removed. The first pigs run through the line will naturally weigh much more than their clean weight. As the cleaning and drying progress, the pig weights will approach their original weight. Pig color will also give some indication of how the

debris removal is proceeding. Dew-point readings will need to be made to determine when the line has been dried to the specified dew point. It will be necessary to give special consideration to laterals, by-passes, and valve body cavities as any free water trapped here could affect the final dew point readings. Drying with super dry air provides internal corrosion protection if the line is to remain out of service for some period of time before it is placed in service.

B. Methanol drying relies on the hygroscopic effect of the methanol. Any remaining moisture in the line will be absorbed by batches of methanol pushed through the line with either gas or dry air. Pigs are used to separate the methanol batches from the displacing medium. Methanol drying usually requires fewer pig runs and, consequently, less line cleaning is accomplished. Pure methanol is expensive, and sometimes a 96% methanol/water mix is used. Since the methanol mix contains water, some water will be left in the pipeline. Some of the methanol will vaporize in the pipeline and will be absorbed by the displacing medium.

Toward the end of the line, the moisture content of the methanol will increase, which in turn reduces the amount of water that it can absorb. If the pressure used in the drying operation is too high, hydrate formation can occur, usually at the far end of the line. If natural gas is being used to push the methanol batches, it will probably be necessary to flare some of the line fill volume to be sure that no methanol impurities are contained in the gas. Methanol run with a dry gas will absorb most of the water and facilitate the vaporization of the remaining water. Soft swabs run through a line with a dry purge gas will accelerate the evaporation of remaining methanol/water solution. Also of great concern with the methanol method of drying is the fact that explosive mixtures can easily be formed, whether gas or air is used to displace the methanol batches. It may be desirable to use an inert gas such as nitrogen to buffer the methanol batch from the air or gas used to displace the methanol batch. However, many pipelines have been dried without the use of nitrogen buffers with no adverse results. The air/methanol mixture is also highly poisonous and corrosive. Plans will need to be made for proper disposal of the spent methanol. If internal corrosion protection is desired, then another drying method should be considered. If the pipeline is to be

used to transport sour gas, the methanol drying method should be carefully evaluated before it is used.

C. Drying with natural gas requires large volumes of gas. This method is slow and not very effective unless the line is thoroughly cleaned by one of the cleaning processes previously described. If, however, the gas being used to dry with can be blended with another dry gas stream and sold or used, then this is an economical method for pipeline drying. The cost of the gas that will be used to purge the line during the drying process should be weighed against the cost of using super dry air. The Btu value of a volume of natural gas is approximately 15 times greater than that of the fuel required to produce an equal volume of super dry air.

D. Vacuum drying is a slow process. All free water should be removed from the pipeline before drying begins. This method appears to be used infrequently, and perhaps only offshore. If the pipeline has been properly cleaned by the water slug method using brush pigs run with liquid, drying can be accomplished by running soft foam pigs with dry air or gas to remove any free water left in the pipeline. This will usually produce a pipeline dry enough for natural gas operations. If additional drying is desired, it can be accomplished by using methanol or super dry air.

From "Pipelines rules of Thumb"

Task 5. Read Part 2 and answer the questions:

1. What are wire brush pigs used for?
2. What are methanol properties?
3. What is the main disadvantage of drying with natural gas?
4. What kind of pipes vacuum drying is applied for?

Task 6. Writing. Choose any type of drying from the list given in Part 1 and write an essay describing the process.

UNIT 3
CORROSION AND COATING

Text 1

Task 1. Use English-English dictionary and give a definition to a word "corrosion". Talk about the nature of corrosion.

Task 2. Before reading the text look at the list of corrosion types and translate them. Can you explain their origin?

Corrosion is generally divided into general corrosion and localized corrosion.

Localized corrosion is classified as follows:

1. Microbiological corrosion
2. Galvanic corrosion
3. Crevice corrosion
4. Pitting corrosion
5. Galvanic corrosion
6. Erosion corrosion
7. Stress corrosion cracking (SCC)
8. Fatigue corrosion

This classification of corrosion is based on visual characteristics of morphology of attack as well as the type of environment to which the surface is exposed. Microbiological corrosion, also called bacterial corrosion, bio-corrosion, microbiologically influenced corrosion, or microbially induced corrosion (MIC), is corrosion caused or promoted by microorganisms. It can apply to both metals and nonmetallic materials.

Task 3. In pairs, find English equivalents for the following phrases in the text above: *ухудшение, впускной патрубок, примеси, усугубить, щелевая коррозия, коэффициент питингообразования, насосное колесо (гидропривода), кавитация (ударная коррозия), сплав, скопление, точечная коррозия, повышение ломкости, прилежащий, уровень жесткости, подверженность к чему-л., паровая турбина, напряжение при растяжении.*

Task 4. Read and translate the text. Use a dictionary:

Crevice corrosion is a localized attack on a metal adjacent to the crevice between two joining surfaces (two metals or metal-nonmetal crevices). The corrosion is generally confined to one localized area of one metal. This type of corrosion can be initiated by concentration gradients (due to ions or oxygen).

Accumulation of chlorides inside the crevice will aggravate damage.

Various factors influence crevice corrosion, such as: a) materials: alloy composition, metallographic structure; b) environmental conditions such as pH, oxygen concentration, halide concentrations, temperature; c) geometrical features of crevices, surface roughness; d) metal-to-metal or metal-to-nonmetal type.

Filiform corrosion is a special type of crevice corrosion. Pitting corrosion is a localized phenomenon confined to smaller areas. Formation of micro-pits can be very damaging. Pitting factor (ratio of deepest pit to average penetration) can be used to evaluate the severity of pitting corrosion which is usually observed in passive metals and alloys. Concentration cells involving oxygen gradients or ion gradients can initiate pitting through generation of anodic and cathodic areas. Chloride ions are damaging to the passive films and can make pit formation autocatalytic. Pitting tendency can be predicted through measurement of pitting potentials. Similarly, critical pitting temperature is also a useful parameter.

Galvanic corrosion often referred to as dissimilar metal corrosion occurs in galvanic couples where the active one corrodes. EMF series (thermodynamic) and galvanic series (kinetic) could be used for prediction of this type of corrosion. Galvanic corrosion can occur in multiphase alloys.

Erosion corrosion is the deterioration of metals and alloys due to relative movement between surfaces and corrosive fluids. Depending on the rate of this movement, abrasion takes place. This type of corrosion is characterized by grooves and surface patterns having directionality. Typical examples are: a) stainless alloy pump impeller; b) condenser tube walls.

All equipment types exposed to moving fluids are prone to erosion corrosion. Many failures can be attributed to impingement (impingement attack). Erosion corrosion due to high-velocity impingement occurs in steam condenser tubes, slide valves in petroleum refinery at high temperature, inlet pipes, cyclones, and steam turbine blades. Cavitation damage can be classified as a special form of erosion corrosion.

Stress corrosion cracking refers to failure under the simultaneous presence of a corrosive medium and tensile stress. Two classic examples of SCC are caustic embrittlement of steels occurring in riveted boilers of steam-driven locomotives and season cracking of brasses observed in brass cartridge cases due to ammonia in the environment. Stress cracking of different alloys does occur depending on the type of corrosive environment. Stainless steels crack in a chloride atmosphere. Major variables influencing SCC include solution composition, metal/alloy composition and structure, stress, and temperature.

From "Corrosion protection for the oil and gas industry"

Task 5. ► You are going to watch the video "Pipeline corrosion prevention". Watch this video that shows techniques for pipeline corrosion prevention, including the cathodic protection process:.**https://www.youtube.com/watch?v=PPTBZXlvBS4.** Which information was new for you?

Text 2
Coating selection

Task 1. Translate the following words and phrases into Russian: *application, pipe joints, a reasonable rate, S-lay, thermal insulation, inspection methods, constraints, reel barge, negligible absorption, contraction, vapor transmission, highly impermeable.*

Task 2. Fill in the gaps with words and phrases from Task 1:

High-temperature and (1)…… coatings are applied to pipelines to isolate the steel surface from the corrosive environment and provide the pipeline with thermal insulation. Before a choice of coating can be made, it is necessary to consider the following factors:

• The environment surrounding the pipe;

• The pipeline operating temperature;

• Ease of application (yard or site);
• (2) …… and ease of repair of defect and (3) ……;
• Comparative coating system costs;
• Coating properties;
• Environment and health (4) ……;
• Degree of thermal insulation required;
• Pipeline design life;
• Ease of field jointing.

Following consideration of the items listed above, selection of a suitable coating material for the envisaged service conditions may now be carried out. As there are limitations to each type of coating material, an ideal coating system would possess the following characteristics:

• Ease of application: the coating should be capable of (5)…… in the factory at (6)……, and it should be possible to handle the pipe as soon as possible without damaging the coating.

• The coating must be able to form an excellent bond to the pipe steel with the use of a suitable primer where necessary. In addition, for multilayer systems, there must be good adhesion between the different coating layers.

• The coating must be capable of withstanding stresses imposed on it by soil/pipe movement.

• The coating must be capable of withstanding impact without cracking or disbonding. Should the outer layer be breached, then the underlying layers should resist water penetration/absorption.

• The coating must be sufficiently flexible to withstand any deformation due to the forces associated with (7)……, (8)…… installation, and any expansion and (9)…..... due to temperature change.

• The coating must be resistant to the action of soil bacteria.

• The coating must demonstrate (10)…… of water and must be (11)…… to water or water (12).……

• The coating should show no tendency to creep under the prevailing environmental conditions and must have sufficient resistance to not be displaced from the underside of large-diameter pipes.

• The coating must have sufficient inherent roughness, or be able to have its surface roughness increased without damaging the coating, to prevent slippage between the coating and a concrete weight coating.

From "Corrosion protection for the oil and gas industry"

Task 3. Write down all adjectives from the text and make up new sentences with them.

Text 3
Coating protection

Task 1. Skim the text and choose the most appropriate title to A-E paragraphs.

1) Polyethylene coatings;
2) Epoxy coatings;
3) Fusion bonded epoxy coatings;
4) Asphalt coatings;
5) Epoxy and urethane liquid coatings.

Task 2. Now read the text in detail. Pay special attention to the words printed in bold.

A. These hot applied enamel coatings have a long and successful record of **accomplishment** throughout the world, both onshore and offshore. However, recognition of possible **health hazards** during the application of asphalt enamel has contributed to reduction/withdrawal of their use. The standard BS 4147 is **relevant** to the materials and applications of these coatings: a) coal tar enamels generally absorb less water than asphalts; b) coal tar enamels adhere better to clean steel than asphaltic enamels, although this difference is not marked under normal pipeline conditions; c) although both enamels are soluble in **chemical solvents**, asphalt is **dissolved** by petroleum products, while coal tar is only softened; d) these coatings should not be used where the pipe operating temperature is likely to exceed 60°C for normal grade coatings. However, higher temperatures can be withstood with higher grade coatings; e) both coal tar enamel and asphalt coatings are still widely used for **submarine lines** under concrete weight coatings.

B. FBE coatings have gained wide acceptance in the pipeline industry and can be applied on small and large-diameter pipes. FBE coatings consist of **thermosetting powders** that are applied to a white metal blast-cleaned surface by **electrostatic spray**. The pipe is preheated to 230˚C, and the quantity of **residual** heat determines the maximum coating thickness that can be achieved. Following application, the powder

melts, flows, and cures to produce thickness between 250 and 650 microns, following which the pipe is cooled by **water quenching**. Thickness nearer the maximum is generally required where concrete weight coating is to be applied by **impingement methods**. Due to the nature of the coating, strict control of the **fusion process** is necessary to ensure a satisfactory coating quality.

C. Polyethylene coatings are a relatively recent innovation, and consequently less is known about their long-term performance than FBE coatings. Polyethylene coatings may be applied by one of the following three processes: 1. Circular or ring-type head **extrusion**; 2. **Powder sintering**; 3. Side extrusion and **wrapping**. In addition, the extruded polyethylene may be applied in **conjunction** with primer or adhesive systems. Polyethylene coating systems favor the use of a **high-density** polyethylene with either butyl rubber or hot applied mastic adhesives. Improved **adhesion and resistance** to cathodic disbondment can be achieved by priming the pipe surface first with an epoxy-based layer on top of which the adhesive layer and polyethylene coating is applied. Sintered polyethylene coatings have recently become available and are produced by **pouring polyethylene granules** onto preheated steel pipe at 450°C. Polyethylene coatings should not be used where the pipe service temperature is likely to exceed 65°C. They are resistant to damage during handling and laying.

D. Although the previous sections have summarized the various coating systems generally used for the corrosion protection of pipelines, a number of other paint systems exist which may be used for specific applications where a high degree of chemical or **abrasion resistance** is required. These paint systems are based on epoxy and urethane resins and may be used to coat short lengths of subsea pipelines and protection structures after **fabrication.** The paint systems normally considered for use on pipelines are the two-pack high build systems. Preparation of the pipe surface by **abrasive blasting** is generally required for these coatings in order to achieve a satisfactory bond to the steel. Following this, the paint is normally applied to the required thickness in one coat using airless spray equipment. Both polyurethanes and epoxies can be used with a coal tar in order to reduce the material cost.

E. A coal tar epoxy is a black surface protection polymer used on surfaces subjected to extremely corrosive environments. It is a blend of various epoxy resins and coal tar. Coal tar epoxy is made by the conversion of polyamide epoxy with a pitch of refined coal tar. It is mostly used on **metal substrates** and concrete in offshore, petroleum, and industrial environments. It is commonly used to make high solids coatings or paints to provide **moisture protection** for underground systems like pipelines, **water treatment facilities**, clarifiers, and tanks; it is further used in **the sewage industry** and for prevention of microorganisms. There are different types of paints: two-component paint, three-component paint, and so on. The mixture is used in two-component paints. **The fluctuation of temperatures** can make the product crystallize. It is stable at room temperature or at least 5°F above dew point. The environmental conditions affect the drying time of the product.

From https://www.corrosionpedia.com

Task 3. Work in two groups. One group makes a list of advantages of each method and the other one lists all disadvantages.

Task 4. Which words in the text mean the same as the ones given below: *to sustain, adoption, to define, manufacture, processing, achievement, mucilage, displacement, hesitation, to mitigate, drainage system, integration.*

UNIT 4
TANKS AND RESERVOIRS

Text 1

Task 1. Racing in groups. During 2 minutes make a list of all types of oil reservoirs you know. Then name your type and cross out if other groups have the same. The group which has the most types left wins.

Task 2. Read and translate the description above. Use a dictionary to make a written translation of the table below.

The core of facilities is vertical and horizontal tanks. The storage capacity depends upon facility location:

- total tankage capacity may not be more than 2000 m^3 if petroleum-storage depots are a part of the industrial enterprises;
- independent storage plants, trunk pipelines, oil refineries etc. may have total tankage capacity over 2,000 m^3.

Oil storage tanks have different design factors:

- depending on location mode - aboveground and underground tanks;
- on construction and design features - vertical or horizontal, single- or double-walled;
- on capacity-the maximum tank volume is 20,000 m^3.

If tanks and vessels are operated in cold climate or with viscous oil heat insulation (blanket type thermal insulation) and heating system are used.

In addition to tanks and vessels there are other oil storage and production facilities:

Unit	**Objectives**	**Equipment**
Railway jobs zone	Oil intake and oil-by-rail shipment	Tank car loading/unloading rack, operator's shack, pump plant, approach lines
Marine operations area	Oil intake, offshore loading system and offshore oil delivery	Oil jetty, shore tanks, pump plant, oil-pipe lines, operator's shack
Storage area	Oil storage	Tank fields, oil-pipe lines, operator's shack
Allowable zone	Oil loading	Loading/unloading rack, warehouse for storage, quality control laboratory etc.

Unit	Objectives	Equipment
Support facilities	Maintenance of equipment	Boiler-house, maintenance shop and warehouse, Utilities, Infrastructure and Offsites
Management	Petroleum storage facilities management and control	Security post, headquarters, fire station with required facilities etc.
Petroleum refining area	Oil-refining, degassing and dehydration	Gas-oil separator, dehydration tanks, oil catchers, treating facilities, pumping stations, oil filters etc.

Task 3. Look at the picture of internal floating roof storage tank and read a brief description. Then talk about advantages and disadvantages of this type of oil storage.

The outline structure of internal floating roof storage tank is roughly the same as that of dome oil tank. Compared with external floating roof tank, internal floating roof storage tank has a fixed roof, which is beneficial to improve the storage condition of oil products, especially to prevent the rain water from entering the oil tank and slow down the aging of sealing ring. At the same time, internal floating roof can effectively reduce the oil loss, therefore, internal floating roof storage tank has the advantages of fixed roof tank and floating roof tank.

From http://www.largestoragetank.com/news/introduction-of-internal-floating-roof-storage-tank.html

Task 4. Talk about advantages and disadvantages of other types of industrial oil storage tanks such as: *fixed roof tank; bunded tank, single skin and double skin tanks; open top tank*. Use PetroWiki site (petrowiki.spe.org) for help.

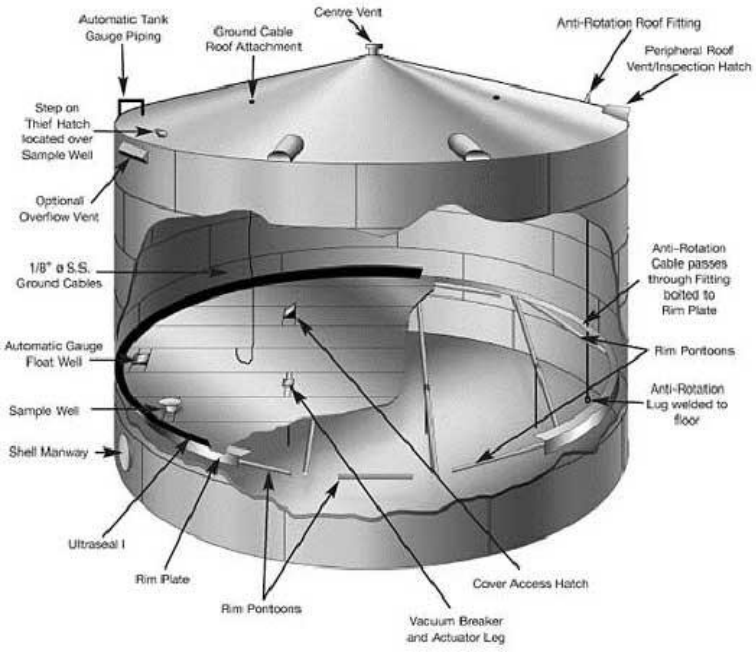

Fig.1 Oil storage tank

Text 2

Oil and gas facilities operation

Task 1. Say these words from the text correctly. Use the proper word stress: *excess, depot, pressure, breathing, custody, assembly, fluctuations, climatic, vehicle, preservation, topography.*

Task 2. Skim the text and answer the questions:

1. What are the means of oil transfer?
2. What are the steps of oil and gas facilities installation?

Task 3. Now read the text in detail and translate inserted Russian words into English.

The main production goal of petroleum-storage depot, tank fields is oil (1) *забор нефти*, storage, handling, treatment and transfer.

Oil storing is carried out in steel tanks which are intended for the petroleum products with the following characteristics: (2) *плотность* - up to 1600 kg/m^3, excess pressure - up to 5 kPa, gas space (3) *разряд* – up to 0,5 kPa, the maximum wall temperature - +160°C, the maximum media temperature - + 90°C, media temperature should be lower closed-cup (4) *точка возгорания* by at least 35°C.

Another goal is oil transfer, which is the process of oil transportation between several means of transport. Petroleum product via (5) *брандспойт* is derived from the tank and goes down the pipeline where custody transfer metering station is installed, pumping equipment and (6) *раздаточное* equipment. The pipelines are equipped with shut-off and (7) *предохранители* that provide fluid flow regulation.

When petroleum products storing and transfer, breathing and filling loss occur. Tank breathing is the loss through the pressure vent valves resulting from temperature (8) *колебания* and absolute pressure changes. The volume of losses depends on gas space capacity and design overpressure. Filling loss results from loading-unloading operations, which lead to gas (9) *испарение* mixture driving-out. For example, when filling the tank with gasoline about 0.55 kg/m^3 will be lost in the summer and about 0.35 kg/m3 in the winter. While (10) *опорожнение (выгрузка)* of tank, losses can be approximately 0.1 kg/m^3.

Oil and gas facilities installation includes pre-construction activities and construction-(11*) сборочные* works. List of works depends on the equipment and facility specifics. Standard activities conducted in field are listed below:

a) Tank foundation arrangement; b) Vehicle loading/unloading rack (12) *возведение*; c) Crude oil rail loading erection; d) Pumping station installing; e) Internal floating roof assembling; f) Tank heating system assembling.

Work performance is carried out taking into account the facility earth information, climatic data, local topography and geology of the

area. Fire and explosion hazard management and environment preservation are also taken into account.
From https://ipgsintez.com/packaged_solutions/oil_gas_facilities

Task 4. ► You are going to watch video "Transportation of crude oil and petroleum products". Look at the gapped sentences below and try to predict what words can be there. Then watch the video https://www.youtube.com/watch?v=JXRFIqtCMzM and fill in the gaps with the detailed information. Translate the sentences into Russian.

1.A pipeline …… or …… is a major concern.

2. Control centres can open and close …… on a pipeline through remote control.

3. Federal and state regulations govern the …… from marine vessels and tanks during the transfer process.

4. The …… is a large flame that burns the vapors at approximately 1,400 degrees.

5. Volatilize, …… and atmospheric release are greatly reduced.

6. …… treatment plays an important role in the operation of petroleum storage and pipeline facilities.

Task 5. Make a short report about the largest crude oil storages in the world.

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PIPELINES AND OIL AND GAS FACILITIES

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РИЦ Санкт-Петербургского горного университета
Адрес университета и РИЦ: 199106 Санкт-Петербург, 21-я линия, 2