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ДЕЛОВОЙ ИНОСТРАННЫЙ ЯЗЫК

НЕФТЕГАЗОВАЯ ТЕХНИКА И ТЕХНОЛОГИИ (ТЕХНОЛОГИЯ БУРЕНИЯ НЕФТЯНЫХ И ГАЗОВЫХ СКВАЖИН)

Методические указания к практическим занятиям для студентов специальности 21.05.06

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ИНОСТРАННЫЙ ЯЗЫК. Нефтегазовые техника и технологии (Технология бурения нефтяных и газовых скважин). Методические указания к практическим занятиям / Санкт-Петербургский горный университет. Сост.: *С.А. Пушмина.* СПб, 2021. 34 с.

На материале аутентичных текстов, в которых освещается технология бурения нефтяных и газовых скважин, необходимые для этого оборудование, инструменты и программное обеспечение, а также особенности профессий, связанных с этой сферой. Студенты смогут овладеть необходимыми навыками для решения коммуникативных задач в профессиональной деятельности, а также подготовиться к зачету по дисциплине «Деловой иностранный язык».

Методические указания предназначены для студентов, обучающихся по специальности 21.05.06 Нефтегазовые техника и технологии специализации «Технология бурения нефтяных и газовых скважин» и согласованы с программой по деловому иностранному языку для студентов неязыковых вузов.

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ПРЕДИСЛОВИЕ

Данные методические указания предназначены для проведения практических занятий по английскому языку со студентами по направлению подготовки 21.05.06 «Нефтегазовые техника и технологии (Технология бурения нефтяных и газовых скважин)». Методические указания составлены в соответствии с учебной программой по дисциплине «Деловой иностранный язык» для формирования иноязычной профессиональной компетенции будущих инженеров нефтегазового дела. В методические указания включены аутентичные тексты, в которых описываются различные способы художественной обработки материалов, необходимые для этого оборудование, инструменты и ПО, а также особенности профессий, связанных с этой сферой.

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. DRILLING TECHNOLOGIES

TEXT 1. OIL WELL DRILLING

1. Essential vocabulary

a complex operation	комплексная процедура, работа, операция
an array of machinery	комплексоборудования
advances	преимущества
an operating company	эксплуатирующая компания
a service company	сервисная компания
application	применение
onshore	береговой, наземный
offshore	шельфовый
conventional drilling	традиционноебурение
slim-hole drilling	бурениескважинмалогодиаметра
bit	долото

2. Read and translate the following text.

Oil well drilling is a complex operation and the drilling industry engages the services of personnel and a complicated array of machinery and materials to drill an oil/gas well to depths greater than 6000 meters, The drilling industry has seen technological progress, however, these advances have not changed the fact that, besides the use of complicated machinery, successful drilling is a result of tremendous team effort. Numerous personnel from the operating company and several service companies work together to drill and complete an oil/gas well.

A drilling rig is used to drill a hole, and this requires qualified personnel, different types of equipment the application of a great variety of technology.

When a drilling project is commenced, two goals must be achieved:

1. To drill and finish the well in a safe manner (personal injuries, technical problems) and according to its purpose;
2. To complete the project with minimum cost.

The overall costs of the well must be optimized and this optimization may influence where the well is drilled (onshore – extended reach or offshore above reservoir), the drilling technology applied

(conventional or slim-hole drilling) as well as the evaluation procedures run to gather subsurface information for future drilling projects.

Rotary drilling is the most efficient technology applied in the oil and gas industry.

It is a drilling technology that relies on continuous circular rotation of the bit to break rocks, while drilling fluids circulate through the bit and up the wellbore to the surface, making possible to drill safely and efficiently the well.

3. **Complete the table and make 6 sentences with any of the words from the table.**

verb	noun	adjective/participle
	operation	
progress		
		optimized
drill		
		safe
	rotation	

4. **Answer the following questions:**
    1. What is oil well drilling?
    2. What does the drilling industry engage?
    3. What is required in a drilling rig?
    4. What are the goals to achieve in a drilling project?
    5. What does the cost of the well influence?

VIDEO 1. DRILLING

5. **Watch the video "Drilling animation" (educational movie), get a better idea of the process and provide a detailed overview of a drilling operation:**
   https://www.youtube.com/watch?v=eBOtXD_UQSo

TEXT 2. A ROTARY DRILLING RIG

6. **Read and translate in the written form the text about a rotary drilling rig.**

Rotary drilling is mostly used to drill big holes in large quarries, open pit mines, petroleum extraction, and other fields.

The drilling rig consists of a set of equipment and machinery located on the so-called drilling site and normally the rig is not owned by the oil company but by drilling service companies, which hire out the rig complete with operators and which construct the well according to the client's specifications.

The most important items of equipment are shown in the figure below.

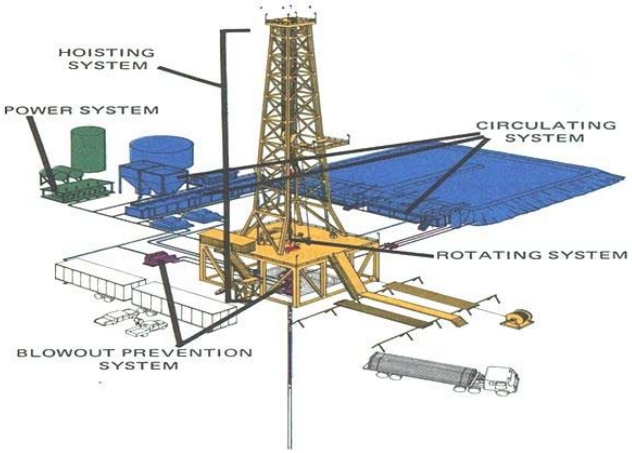


Fig. 1 Drilling Rig Systems

7. Study the following words and expressions:

Hoisting system	грузоподъёмнаясистема
Power system	двигательнаясистема
Circulation system	циркуляционнаясистема
Blowout prevention system	противовыбросоваясистема
Rotating system	вращающаясясистема

8. Read, translate and study the main equipment of a rotary drilling rig:

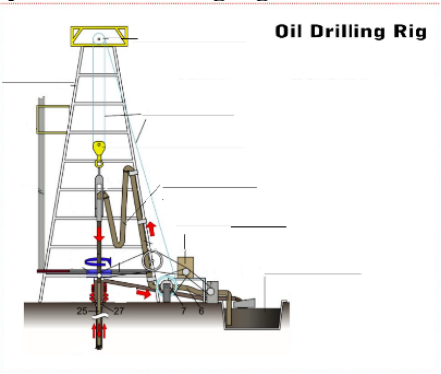
Fig.2 Main Equipment of a Rotary Drilling Rig

1. Crown block
2. Mast
3. Monkey board
4. Travelling block
5. Hook
6. Swivel
7. Elevators
8. Kelly
9. Kelly bushing
10. Master bushing
11. Mousehole
12. Rathole
13. Drawworks
14. Weight indicator
15. Driller's console
16. Doghouse
17. Rotary hose
18. Accumulator unit
19. Catwalk
20. Pipe ramp
21. Pipe rack
22. Substructure
23. Mud return line
24. Shale shaker
25. Choke manifold
26. Mud gas separator
27. Degasser
28. Reserve pit
29. Mud pits
30. Desander
31. Desilter
32. Mud pumps
33. Mud discharge lines
34. Bulk mud components storage
35. Mud house
36. Water tank
37. Fuel storage
38. Engines and generators
39. Drilling line

9. Match the left and the right:

pipe rack	подъёмный крюк
rotary hose	соединяющий стояк с вертлюгом, буровой рукав
swivel	хранилище топлива
mousehole	шурфдлярабочейштанги
rathole	вибросито
catwalk	дегазатор бурового раствора
kelly	ведущаятрубаквадратногосечения
shale shaker	карман, пилотная часть скважи
fuel storage	винтовая стяжка,вертлюг
reserve pit	кронблок, верхний блок(буровой установки)
degasser	резервный отстойник
hook	трубонакатник, стеллаж,площадка для труб
crown block	лестница на верхнем поясе резервуара

10. Name the parts of a drilling rig.



11. Complete the sentences with given words:

traveling block	swivel	shale shakers	kelly	crown block

1. The rotary _____ serves two important functions in the drilling process. It is a connecting point between the circulating system and the rotary system. It also provides a fluid seal that must absorb rotational wear while holding pressure.
2. The _____ is the first section of pipe below the swivel.

3. _____ are the first phase of a solids control system on a drilling rig, and are used to remove large solids (cuttings) from the drilling fluid ("mud").
4. A _____ is the stationary section of a block and tackle that contains a set of pulleys or sheaves through which the drill line (wire rope) is threaded or reeved and is opposite and above the traveling block.
5. A _____ is the freely moving section of a block and tackle that contains a set of pulleys or sheaves through which the drill line (wire rope) is threaded or reeved and is opposite (and under) the crown block (the stationary section).

TEXT 3. HISTORICAL FACTS

12. Read and translate the text.

The idea of using a rotary drill bit is not new. Archeological records show that as early as 3000 B.C., the Egyptians may have been using a similar technique. Leonardo Di Vinci, as early as 1500, developed a design for a rotary drilling mechanism that bears much resemblance to technology used today. Despite these precursors, rotary drilling did not rise in use or popularity until the early 1900s.

Although rotary drilling techniques had been patented as early as 1833, most of these early attempts at rotary drilling consisted of little more than a mule, attached to a drilling device, walking in a circle. It was the success of the efforts of Anthony Lucas and Patillo Higgins in drilling their 1901 Spindletop well in Texas that catapulted rotary drilling to the forefront of petroleum drilling technology.

(https://www.thedriller.com/articles/88669-rotary-drilling-an-overview)

13. Answer the following questions:

1. When did the idea of rotary drilling first appear?
2. Who developed the design of a rotary drilling mechanism applied nowadays?
3. When were rotary drilling techniques patented?

4. What caused rotary drilling be so highly popular in petroleum drilling technology?

14. Speak about a rotary drilling as a technique in petroleum drilling.

VIDEO 2. RIG TYPES.

In a broad sense, rigs can be categorized as immobile and mobile. These terms describe the ability of the rig to depart quickly from a drillsite if necessary. This categorization is broad and provides little definition on each rig type.

15. Essential vocabulary

landrig	наземная буровая установка
jack-uprig	самоподъёмная морская буровая установка
platformrig	морская платформапод буровую
submersiblerig	погружная буровая установка
semi-submersiblerig	полупогружная буровая установка
drillship	буровое судно
dualderrickdrillship	буровое судно с двумя бурильными центрами
Light-dutyrig	буровая установка облегчённого типа/ обладающий малой грузоподъёмностью
Heavy-dutyrigs	буровая установка тяжёлого типа/ предназначенный для тяжёлых работ
Ultra-heavy-dutyrigs	буровая установка сверхтяжёлого типа

16. Watch the video and write out all the types of a drilling rig:https://www.youtube.com/watch?v=73zM4zEAoNI&feature=emb_logo

17. Watch the video again and mark the sentences as TRUE or FALSE

1. A land rig drills on dry land;they are the most common rigs.
2. A platform rig is a mobile offshore structure that is once built it never moves from the drill site.

3. Small light duty rigs are pretty hard to move.
4. A jack-up rig drills onshore wells.
5. Jack-up rigs can drill in water depths ranging from a few feet (or meters) up to more than 400 feet (over 120 meters).
6. Rig builders design submersibles to drill in deep water only.
7. A semi-submersible is a self-propelled floating offshore drilling unit.

ACTIVATE YOUR GRAMMAR SKILLS

18. Comparative and superlative forms

a) Make up comparative and superlative forms of the adjectives and adverbs in the expressions listed below and translate them:

Heavy oil, refined oil, flammable gas, liquefied gas, integrated technology, environment-oriented development, volatile petroleum, an old rig, a well-computerized equipment, a malfunctioning travelling block, a necessary procedure, a desired velocity, a small pore, low permeability.

b) Translate these sentences into Russian. Pay attention to the comparative and superlative forms of the adjectives and adverbs:

1. The external flush drill pipe is suitable for the percussive-rotary drilling (hydraulic and gas) of downhole drill with its structural characteristics of *stronger* rigidness*, more excellent* sealing and external flush.
2. The concept behind this rests on decades of experience in special civil engineering applications, and takes into account *the toughest* demands now placed on modern rotary drilling rigs.

3. It seemed to him that the drilling projects described by the authors constituted a risk of *further* violations rather than initial violations.
4. However, assigning private drill companies, who proceed to illegal well drillings, is *simpler* and economically *more effective* for the population.
5. Rotaries are also one of *the fastest growing* areas of production, although not at the same levels as scroll and in particular screw compressors.
6. The advantages of *the most widely used* downhole motor technology were so obvious that the technology itself managed to survive through another strong rotary drilling campaign.

UNIT 2. SYSTEMS OF A DRILLING RIG

1. **Read the texts about various systems of a drilling rig. Write out the vocabulary and translate it into Russian.**

A drilling rig is composed of different systems:

TEXT 1. THE HOSTING SYSTEM

- It is the set of equipment necessary for handling any material inside the well(drill string and the casing);
- It consists of a structural part (derrick/mast and substructure), the complex of the crown and travelling block, the drawworks (hoist) and the drilling line;
- The substructure is the supporting base for the derrick, the drawworks and the rotary table, and constitutes the working floor for operations, or drilling floor.

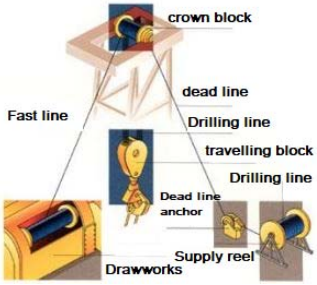


Fig.3 The Hosting System

Fig.4 The Derrick Types

Fig.5 The Mast Types

2. **Learn about the hoisting system paying special attention to Figures 4-5**.
3. **Read the text about the rotating system and translate it in a written form. Write out the terms describing it.**

TEXT 2. THE ROTATING SYSTEM

- The rotating system allows the rotation of the drill string, and it consists of the rotary table, the kelly and the swivel;
- In modern rigs, a *top drive* groups together the functions of the above three items of equipment.

Fig.6 The Kelly System

Fig.7 The Top Drive System

4. Read and learn about the circulation system. Write out the words describing it.

TEXT 3. THE CIRCULATION SYSTEM

- The circulation system consists of mud pumps, distribution lines, and the mud cleaning and accumulation system;
- It is the closed hydraulic circuit which allows the mud to flow from the surface to the bottom of the hole, inside the drill string, and subsequently back to the surface, in the drillstring borehole annulus;
- The mud from the hole has to have the cuttings removed before being reinjected to the bottom of the hole and the mud pumps supply the energy necessary for circulation;
- The choice of drilling fluid is dictated mainly by the characteristics of the formations to be drilled, by their drillability and reactivity to water, and by problems of disposing of the spent fluid;

5. Read and learn about the power generation system. Write out the words describing it.

TEXT 4.THE POWER GENERATION SYSTEM

- A power generation system is needed to run the machines driving the main components of the rig and it is provided by diesel engines, diesel-electric engines;
- Power is transferred from the engines to the different rig systems by belts, chains, and drive shafts on a mechanical rig, or by generated DC electrical power on an electric rig and it is distributed to the rotary table and mud pumps and to the drawworks.

(https://www.drillingcourse.com/2015/12/drilling-rig-systems.html)

VIDEO 1. DRAWWORKS FUNDAMENTALS

6. **Watch the video called "Drawworks fundamentals" and write out all the parts mentioned. Make a presentation to the group. Link: https://www.youtube.com/watch?v=1GJdN4-nXlw**

7. **Quiz**

1) It is the set of equipment necessary for handling any material inside the well(drill string and the casing);
   a. The hoisting system
   b. The rotating system
   c. The circulation system
   d. The power generation system
2) This system is needed to run the machines driving the main components of the rig and it is provided by diesel engines, diesel-electric engines;
   a) The hoisting system
   b) The rotating system
   c) The circulation system
   d) The power generation system
3) This system is the closed hydraulic circuit which allows the mud to flow from the surface to the bottom of the hole, inside the

drill string, and subsequently back to the surface, in the drillstring borehole annulus;

a) The hoisting system
b) The rotating system
c) The circulation system
d) The power generation system

4) It consists of a structural part (derrick/mast and substructure), the complex of the crown and travelling block, the drawworks (hoist) and the drilling line;

a) The hoisting system
b) The rotating system
c) The circulation system
d) The power generation system

5) It consists of mud pumps, distribution lines, and the mud cleaning and accumulation system;;

a) The hoisting system
b) The rotating system
c) The circulation system
d) The power generation system

UNIT 3 THE DRILL STRING

TEXT 1. DRILL STRING

1. Read the text about drill strings and their function

The drill string is an assemblage of hollow pipes of circular section, extending from the surface to the bottom of the hole.

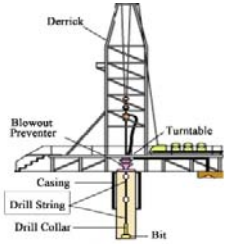


Fig.8 Drill string as a part of a drilling rig (https://www.geodesicdrilling.co.za/wp-content/uploads/2016/04/BOP-272x300.png)

It has three functions:

- it takes the drilling bit to the bottom of the hole, while transmitting its rotation and its vertical load to it;
- it permits the circulation of the drilling fluid to the bottom of the hole;
- it guides and controls the trajectory of the hole.

Starting from the surface, drill string consists of:

- a kelly, drill pipes, intermediate pipes, drill collars and a number of accessory items of equipment (stabilizers, reamers, jars, shock absorbers, downhole motors, etc.), and it ends with the bit;
- The bit is connected on to the end of the drill string – it is the tool that bores the rock, transforming it into fragments called *cuttings*, which are then transported to the surface by the drilling fluid;
- The choice of the type of bit depends on the hardness, abrasiveness and drillability of the rock formation.

2. Fill in the gaps with appropriate prepositions:

1. The drill string is an assemblage ____hollow pipes of circular section, extending _____the surface _____the bottom of the hole.
2. The bit is connected _____to the end _____the drill string.
3. The choice of the type of bit depends ____the hardness, abrasiveness and drillability of the rock formation.
4. It guides ___ and controls the trajectory of the hole.
5. A drill string consists _____a kelly, drill pipes, intermediate pipes, drill collars and a number of accessory items of equipment and it ends ____the bit.
6. Cuttings are transported _____the surface _____the drilling fluid.

3. Match the word with its definition.

drillability	the curved path an object follows after it is thrown or shot
hardness	substance used to aid the drilling of boreholes into the earth and carry cuttings out of the hole
abrasiveness	movement in a circle around a fixed point
bit	the quality of being difficult to bend, cut, or break
kelly	the part of a tool used for cutting or drilling (= making holes)

drilling fluid	a collection of things
rotation	broken bits of solid material removed from a borehole drilled by rotary, percussion, or auger methods and brought to the surface in the drilling mud.
trajectory	the capacity to be drilled
cuttings	the quality of being slightly rough
assemblage	A long square or hexagonal steel bar with a hole drilled through the middle for a fluid path. It is used to transmit rotary motion from the rotary table or kelly bushing to the drill string

(taken from https://dictionary.cambridge.org/dictionary/english)

4. Translate the sentences given with the terms from the text

1. Бурильная штанга является обязательным элементом, который необходим для бурения скважины при помощи малогабаритной буровой установки.
2. Бурильные установки состоят из большого количества взаимосвязанных элементов, каждый из которых выполняет определенную функцию.
3. Буровая штанга служит для передачи крутящего момента от вращателя к долоту.
4. При бурении с забойным двигателем долото привинчено к валу, а бурильная колонна – к корпусу двигателя.
6. Бурильная колонна состоит из ведущей трубы, тонкостенных стальных бурильных труб и утяжелённых бурильных труб, к нижней части которых присоединяется буровое долото.
7. Надёжность бурильной колонны в значительной степени определяет эффективность бурения (особенно при роторном бурении).

TEXT 2. DRILL PIPE

5. Read the text, write out all the words in bald, and translate them.

The drill pipe constitutes the majority of the drill string length. It is **seamless** with **threaded connections**. The drill pipe has two **tool joints**, one female is called a box and the other male is called pin. The outer diameter of the tool joint is larger than the body of the drill pipe to accommodate the threads.

One drill pipe is called **a single or a joint**. The **dimensions** of the drill pipe are specified by the API (American petroleum Institute). There are three ranges of length; range 2 is most common on rig sites. The drill pipe must be measured on a rig site to get accurate length of a drill pipe. The drill pipe is characterized by **burst**, **collapse**, **tensile** and **torsional** strength. These specifications are used to select the appropriate drill pipe for a particular drilling operation.

The weight of the drill pipe is called weight in air. When drill pipe is in the well, it has to be taken in consideration the **buoyancy force**that is related to **density** of the drilling fluid. The weight of the drill pipe when run in the well can be calculated as following:

Buoyant weight= weight of a pipe in air ^{x}**buoyancy factor**

DRILL PIPE STRESS AND FAILURE:

The drill pipe can be exposed to various stresses:

- **Tension**: due to hole problems, an overpull can be exerted causing extra tension on the drill pipe (ex: stuck pipe). This **tensile load** can lead to drill pipe failing.

- **Torsion**: Bad hole conditions can increase the **twisting force** and **torque** on each **joint** leading to poor rotation transmission from the surface to the bottom.

- **Cyclic fatigue**: The wall of the drill pipe while drilling **deviated wells**is exposed at **point of bending** to **tensile** and **compressive forces**. While rotating the drill string, the same point on a drill pipe sustains a cycle tensile and compressive forces. This cyclic stresses can result in fatigue of the drill pipe.

Also there are other causes of fatigue like **abrasive friction, vibration** and bit bouncing off bottom.

Corrosion is also another issue, which can affect drill pipe strength; corrosion can be due to presence of **dissolved gases** and **acids**.

Carbone dioxide can form **acid dioxide**, which can lead to **steel corrosion**.

The **hydrogen sulfide** can be present in the **formation**. It can cause **hydrogen embrittlement** or **sulfide stress cracking**. The surface of the steel **absorbs** the hydrogen in the presence of the sulfide. When the concentration will be greater than a certain level(less than 13 ppm), **cracks** can appear on pipe body. The combination of stress and cracks leads to a pipe failure.

6. Answer the following questions.

1. What are the main parts of a drill pipe?
2. How is the drill pipe length chosen?
3. What is a drill pipe characterized by?
4. Dwell on the equation applied to calculate the weight of a pipe in a well.
5. What factors can lead to a drill pipe failing?

TEXT 3. DRILLING BITS

1. Essential vocabulary

drilling bit	долото
rate	быстрота протекания какого-нибудь процесса, производительность
rotate	вращать
trip time	время прохождения
full-gauge hole	ствол скважины, пробуренный долотом
run casing	обсадить трубами, установить обсадную колонну
alternating layers	чередующиеся слои, смешаннослойный
impracticable	невыполнимый, невыполнимый
roller cone bit	шарошечное коническое долото
drag bit	лопастное долото, долото режущего типа
cutting element/ cutter	режущий, вырубной элемент
tungsten carbide	карбид вольфрама
a bearing (sealed bearing/ open bearing)	подшипник (подшипник с уплотнением и пластичным смазочным материалом/ разъёмный подшипник)
lubrication system	смазочная система

gauging	тарировать, производить замер, шаблонировать,
shoveling	перелопачивание (работа с лопатой)
chiseling	долбление, рубка зубилом
nozzle	гидромониторная насадка, насадка для подачи бурраствора на долото
wear-resistant material	износостойкий материал
diamond matrix	матрица алмазной коронки
shearing	срезывающее или сдвигающее усилие

Read the texts and make notes about drilling bits
DRILLING BITS

When talking about oil well drilling, it is important to know how well the drilling bit drills depends on several factors, such as the condition of the drilling bit, the weight applied to it, and the rate at which it is rotated. Also important for a drilling bit performance is the effectiveness of the drilling fluid in clearing cuttings, produced by the bit away from the bottom.

The aim of oil well drilling is to:

a) make hole as fast as possible by selecting drilling bits which produce good penetration rates;

b) run drilling bits with a long working life to reduce trip time;

c) use drilling bits which drill a full-size or full-gauge hole during the entire time they are on bottom.

The choice of drilling bit depends on several factors. One is the type of oil formation to be drilled, whether it is it hard, soft, medium hard or medium soft. A second factor is the cost of the bit. Getting the highest possible footage from the bit cuts down bit costs and minimizes the number of trips needed for bit changes. It should be stated, however, that continuing to use a bit that is still drilling but slowly is false economy.

In the shallower part of the hole only one or two bits are needed before a pipe is pulled for logging or running a casing string and often one drilling bit is sufficient to make the hole in which the conductor is to be set. As formations near the surface are usually very soft, one bit may prove sufficient for several wells. However, in the deeper part or the hole, several bits often have to be drilled before casing depth is reached.

It is normal that the drilling bit used to drill the cement left in the casing is also used to drill the formation, although in some instances a separate bit is run to drill the cement and thereafter changed for a more suitable one for the formation expected deeper down.

Oil formations vary a lot in hardness and abrasiveness and have a considerable effect on drilling bit performance. If there were no difference in rock formations, one type of bit only would be needed which requires standard bit weight, rotary speed and pump pressure to drill at the maximum rate.

Unfortunately, such a situation does not exist and several drilling bits are required for the alternating layers of soft material, oil reservoir hard rocks and abrasive sections. Changing the bit every time as the formation changes is, however, impracticable. Therefore, a compromise has to be made and a bit that performs reasonably well in all conditions is selected. The choice of drilling bit for a well in a field where the formations are familiar is obviously easier than for a wildcat.

Drilling Bits can generally be classified into two categories;

a) Roller bits;

b) Drag bits.

ROLLER CONE BITS

The cutting elements of roller cone bits are arranged on "conical" structures that are attached to a bit body. Typically, three cones are used and the teeth (cutters) may be tungsten carbide that is inserted into pre-drilled holes into the steel cone shell or steel teeth that are formed by milling directly on the cone shell as it is manufactured. The length, spacing, shape, and tooth material are tailored for drilling a particular rock. Insert types used as teeth on roller-cone bits.

Each roller bit cone contains a bearing and lubrication system. In some cases, the drilling mud is used as the lubricant (open bearing) and in other cases, a special lubricant is confined inside the case (sealed bearing). The apes bearing system is used almost exclusively with roller bearings. The sealed bearing system may be used with either roller or journal bearings.

The rock cutting process of the roller cone bit is either by gauging (digging and shoveling) in soft formation or by chiseling in hard formation. A hydraulic cuttings removal system is incorporated in each bit to remove the cuttings from around the teeth. Typically, a nozzle is placed between each cone to direct mud at the bottom of the hole and cutters. These nozzles are usually located at a height approximately equal to the top of the cone, but in some cases are extended towards the arms where the cutters contact the rock.

The drilling fluid is pumped through the nozzles at relatively high velocity in order to remove the drilled cuttings. The three-cone rolling cutter bit is by far the most common bit type currently used in rotary

drilling operations. This general drilling bit type is available with a large variety of tooth design and bearing types and, thus, is suited for a wide variety of formation characteristics. The three cones rotate about their axis as the bit is rotated on bottom. The shape of the bit teeth also has a large effect on the drilling action- of a rolling cutter bit. Long, widely spaced, steel teeth are used for drilling soft formations. As the rock type gets harder, the tooth length and cone offset must be reduced to prevent tooth breakage; the drilling action of a bit with zero cone offset is essentially a crushing action. The smaller teeth also allow more room for the construction of stronger bearings.

The metallurgy requirements of the drilling bit teeth also depend on the formation characteristics. The two primary types used are: (1) milled tooth cutters. (2) tungsten carbide insert cutters. The milled tooth cutters are manufactured by.milling the teeth out of a steel cone while the tungsten carbide insert bits arc manufactured by pressing a tungsten carbide cylinder into accurately machined holes in the cone. The milled tooth bits designed for soft formations usually are faced with a wear-resistant material, such as tungsten carbide, on one side of the tooth. The milled tooth bits designed to drill harder formations are usually case hardened by special processing and heat-treating the cutter during manufacturing. The tungsten carbide teeth designed for drilling soft formations are long and have a chisel-shaped end. Rolling cutter bits with the most advanced bearing assembly are the journal bearing bits In this type bit, the roller bearings are eliminated and the cone rotates in contact with the journal bearing pin. This type bearing has the advantage of greatly increasing the contact area through which the weight on the bit is transmitted to the cone.

DRAG BITS

There are two general types of drag bits that are in common usage. The oldest is the natural diamond matrix bit in which industrial grade diamonds are set into a bit head that is manufactured by a powdered metallurgy technique.

The size, shape, quantity, quality, and exposure of the diamonds are tailored to provide the best performance for a particular formation. Each drilling bit is designed and manufactured for a particular job rather

than being mass produced as roller cone bits are. The cuttings are removed by mud that flows through a series of water courses. The design of these water courses is aimed at forcing fluid around each individual diamond. The matrix diamond bit cuts rock by grinding and thus a primary function of the fluid is to conduct heat away from the diamonds.

The other type of drag bit is the polycrystalline diamond compact (PDC) bit that is constructed with cutters comprised of a man made diamond material. The cutters are generally much larger than natural diamonds and are designed to cut the rock by shearing, similar to metal machining. PDC bits have proven very successful in homogeneous and, soft to moderate strength formations. In formations where they are successful, they can drill two to three times faster than a roller cone bit and may have an equally long life.

2. Complete the table and make 6 sentences with any of the words from the table

verb	**noun**	**adjective/participle**
rotate		
		resistant
	conductor	
pump		
		sealed
	reduction	

3. State the sentences as TRUE or FALSE

1. The choice of drilling bit depends on the cost of the bit.
2. Continuing to use a bit that is still drilling but slowly is cost-effective but slow.
3. In the shallower part of the hole, there are 7 bits that are needed before a pipe is pulled for logging or running casing.
4. Oil formations vary a lot in hardness and abrasiveness and have a considerable effect on drilling bit performance.
5. Changing the bit every time as the formation changes is necessary.
6. The cutting elements of roller cone bits are arranged on “conical” structures that are attached to a bit body.

7. The rock cutting process of the roller cone bit is either by gauging (digging and shoveling) in hard formation or by chiseling in soft formation.
8. Each drilling drag bit is designed and manufactured for a particular job rather than being mass-produced.
9. Polycrystalline diamond compact bits have proven very successful in homogeneous and, soft to moderate strength formations.

ACTIVATE YOUR GRAMMAR SKILLS

1. Open the brackets and put the verb into the correct form (Active and Passive Voice). Translate the text into Russian.

The drill string ….**(to connect)** to the kelly saver sub. A saver sub is basically a short piece of connecting pipe with threads on both ends. In cases where connections have to **…. (to make up)** and broken frequently, the sub "saves" the threads of the more expensive equipment. The kelly is a six-sided piece of pipe which **…(to fit)** tightly into the kelly bushing which **…(to fit)** into the rotary table. By turning the latter, torque **…(to transmit)** from the kelly down the hole to the bit. It may take a number of turns of the rotary table to initially turn the bit thousands of meters down the hole.

The kelly**….(to hang)** from the travelling block. Since the latter **(to rotate/not)**, a bearing **…(to require)** between the block and the kelly. This bearing **….(to call)** a swivel. All components of the drill string **…(to make)** of high quality steels. After the drilling **…(to progress)** for some time, a new piece of drill pipe will have to be added to the drill string. Alternatively, the bit may need to be replaced or the drill string has to be removed for logging. In order to "pull out of hole", hoisting equipment **…(to require)**. On a rotary rig this consists of the hook which is connected to the travelling block. The latter **…(to move)** up and down via a steel cable ("block line") which **….(to spool)** through the crown block

on to a drum ("draw works"). The draw works, fitted with a large brake, move the whole drill string up and down as needed. The derrick or mast provides the overall structural support to the operations described.

Most rigs are now fitted with a system whereby the drill string **…(to rotate)** by a drive mechanism in the mast. Thus 90 foot sections can be drilled before connections need to be made, and the drill string can be rotated while pulling out of the hole in 90 foot sections. This improved system, which **…(to speed up)** the operation and **…(to allow)** better reaming of the hole,**…(to know)** as top drive.

UNIT 4 CASING

1. Read the text, write out, translate and learn the underlined words concerning casing.

TEXT 1. HOW DOES CASING WORK?

Once a well has been drilled, if it is to become a production well, the well must undergo completion. While drilling a well cuts through the rock formations and allows drilling engineers to reach the reservoir below, the raw sides of the well cannot support themselves. Similar to the bones of your spine protecting the spinal cord, casing is tubing that is set inside the drilled well to protect and support the well stream.

In addition to providing stabilization and keeping the sides of the well from caving in on themselves, casing protects the well stream from outside contaminants, as well as any fresh water reservoirs from the oil or gas that is being produced.

Also known as setting pipe, casing a well involves running steel pipe down the inside of a recently drilled well. The small space between the casing and the untreated sides of the well is filled with cement to permanently set the casing in place.

TEXT 2. CASING A WELL

The casing is fabricated in sections, or joints, that are usually about 40 feet long and screwed together to form longer lengths of casing, called casing strings. Each end of the casing joint has male threads that are protected by cap called a thread protector until the casings are ready to be jointed. Then, a collar or coupling, composed of a short cylindrical steel pipe that is slightly larger in diameter than the joints and also has female threads, is used to connect the two male joint ends. A thread compound is used on the two ends to ensure a tight seal.

Casing is run from the rig floor, connected one joint at a time by casing elevators on the traveling block and stabbed into the previous casing string that has been inserted into the well. Hanging above the drill floor, casing tongs screw each casing joint to the casing string.

Casing is run into the well and officially landed when the weight of the casing string is transferred to the casing hangers, which are located at the top of the well and use slips or threads to suspend the casing in the well.

A rounded section of pipe with an open hole on the end, a guide shoe is connected to the first casing string to guide the casing crew in running the casing into the well. Additionally, the outside of the casing has spring-like centralizers attached to them to help position in casing string in the center of the well.

After running the casing and before the cementing the well, a used drill bit is inserted into the well via a drill string, and drilling fluid is then circulated for a certain amount of time to remove any remaining cuttings from the well. In addition, wall scratchers are dispatched into the well to remove any filter cake that may have formed on the sides of the well.

A cement slurry is then pumped into the well and allowed to harden to permanently fix the casing in place. After the cement has hardened, the bottom of the well is drilled out, and the completion process continues.

(https://www.rigzone.com/training/insight.asp?insight_id=333&c_id)

2. Find English equivalents to the words from the text

1. роторная площадка/ бурплощадка
2. захват трубной головки
3. направляющий башмак
4. загрязняющий агент
5. предохранительное кольцо для резьбы
6. цементный раствор
7. скребок для чистки ствола скважины
8. продуктивная скважина
9. приток к скважине

3. Answer the questions

1. What is the main function of casing?
2. What does casing involve?
3. How is casing fabricated?
4. What is a casing string?
5. Where are the casing hangers located?

VIDEO 1. CASING STRING TYPES

4. Video. Watch the video and write out various types of casing strings. Make a brief review to the video: https://www.youtube.com/watch?v=NHO3nkwsYjo&feature=emb_logo

5. Translate the sentences applying the terms from the text.

1. Обсадная колонна - это труба, применяемая в скважинах для изоляции ствола скважины от пластовых флюидов и укрепления стенок ствола скважины.
2. Для создания герметичности при высоких давлениях нефти и газа (более 30 МПа) применяются соединения с уплотнительными элементами.

3. Именно обсадная колонна является главным конструктивным элементом скважины, находящимся непосредственно на уровне горизонта полезных ископаемых.

4. Монтаж такой трубы производится непосредственно в пробурённую скважину.

5. Используются обсадные трубы для защиты скважины от осыпания грунта.

6. Некоторые типы труб применяют в сфере строительства и могут быть использованы только один раз, потому что их монтаж осуществляется с заливкой всей конструкции раствором бетона. После окончания работ демонтаж такой колонны невозможен даже с использованием специальной техники.

7. Выбор материала зависит от особенностей грунта, глубины скважины и других показателей.

6. Read the text and translate it in a written form.

Sometimes the well is drilled in stages called a casing program. Here, a well is drilled to a certain depth, cased and cemented, and then the well is drilled to a deeper depth, cased and cemented again, and so on. Each time the well is cased, a smaller diameter casing is used. The widest type of casing is called conductor pipe, and it usually is about 30 to 42 inches in diameter for offshore wells and 16 inches in diameter for onshore wells. The next size in casing string is the surface casing, which can run several thousand feet in length.

In some wells, protection or intermediate casing is run to separate challenging areas or problem zones, including areas of high pressure or lost circulation.

The last type of casing string that is run into the well, and therefore the smallest in diameter, is the production or oil string. The oil string is run directly into the producing reservoir. (894 characters)

ACTIVATE YOUR GRAMMAR SKILLS

7. Open the brackets and put the words in the correct form

1. Although it is not typical, if natural gas …(to recover) from the well, it can … (to reinject) into the well to establish underbalance.

2. Although top drives can be used on both onshore and offshore rigs, there … (to be) some differences between the two.
3. Most recently, dynamic positioning …..(to offer) a more stable way to ensure that the vessel ….(to stay) in position.
4. Sometimes mooring and dynamic positioning … (to use) together to keep the vessel on position.
5. Top drives typically …(to decrease) the frequency of stuck pipe, which ….(to contribute) to cost savings.
6. In the early 1900s, Conrad Schlumberger ….(to envision) the concept of …(to use) electrical measurements to map subsurface formations; and in 1927, he and his brother Marcel …(to perform) the world's first electrical resistivity well log in France.
7. If the wind and waves … (to knock) the facilities off-track, the development would have to stop production and undergo extensive repairs.
8. Logging tools …(to insert) into the well to measure the electrical, acoustic, radioactive and electromagnetic properties of the subsurface formations.
9. For many years, well logging tools …(to lower) into the well at regular intervals while drilling …(to retrieve) data.

8. Find Participle I and Participle II and translate into Russian

1. The negative differential pressure obtained during underbalanced drilling between the reservoir and the wellbore encourages production of formation fluids and gases.
2. Though not as common as overbalanced drilling, underbalanced drilling is achieved when the pressure exerted on the well is less than or equal to that of the reservoir.
3. Typically used for only a section of the entire drilling process, underbalanced drilling cannot be used in most shale environments.
4. There are four main techniques to achieve underbalance, including using lightweight drilling fluids, gas injection down the drill pipe, gas injection through a parasite string and foam injection.

5. Keeping floating equipment in position, whether performing drilling or production operations, is an important logistical aspect of the overall procedures.
6. Chosen both for increased safety and efficiency, top drives provide several key benefits.
7. Many times, top drives are completely automated, offering rotational control and maximum torque, as well as control over the weight on the bit.
8. Reducing risk and increasing safety during the drilling process, top drives remove much of the manual labor that was previously required to drill wells.
9. Commonly used in underbalance operations, nitrogen is preferred for its somewhat low cost of generation, scale of control and minimal potential for downhole fires.

REFERENCES:

1. Drilling Course https://www.drillingcourse.com/p/about.html
2. Drill pipe https://www.drillingcourse.com/2015/12/drill-string-components.html
3. Casing https://www.rigzone.com/training/insight.asp?insight_id=333&c_id
4. Oil & Gas Portal http://www.oil-gasportal.com/drilling/technologies
5. Types of drilling bits https://www.arab-oil-naturalgas.com/types-of-drilling-bits/

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