**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE**

**O. M. BEKETOV NATIONAL UNIVERSITY**
**of URBUN ECONOMY in KHARKIV**

Methodological guidelines

for practical work

on the subject

# “ENGLISH”

*(for 1-year full-time Bachelor degree students majoring in 185 – Oil and Gas Industry and Technologies)*

**Kharkiv – O. M. Beketov NUUE – 2018**

Methodological Guidelines for Practical Work on the Subject “English” (for 1-year full-time Bachelor degree students majoring in 185 – Oil and Gas Industry and Technologies) / O. M. Beketov National University of Urban Economy in Kharkiv ; com. V. B. Pryanitska. – Kharkiv : O. M. Beketov NUUE, 2018. – 34 p.

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Recommended by the department of foreign languages, record № 4 on 08.12.2016

# INTRODUCTION

These educational materials are designed for the ESP students of Oil and Gas Industry department of the first year of studies to develop their knowledge and skills in the English language.

This manual is based on the authentic texts from different sources concerning cross-cultural issues. It contains the tasks for reading and translation, vocabulary tasks and grammar exercises.

Each unit contains:

- An authentic text for reading and translation;
- Comprehension exercises;
- Exercises for memorization and mastering new vocabulary;
- Grammar exercises;
- Supplementary reading

The manual is recommended for practical lessons

## UNIT 1. ROLE OF FOREIGN LANGUAGES IN OUR LIFE.

**Task 1. Read and translate the text.**

# Education and Role of Foreign Languages.

Education is very important in our life. A pupil gets knowledge at school, higher educational establishments, from books, magazines, from TV educational programs. The pupils can get deeper knowledge in different optional courses in different subjects and school offers these opportunities. They can improve their knowledge by attending different optional courses in different subjects. The result of the educative process is the capacity for Further education. Nowadays the students of secondary schools have opportunities to continue their education by entering gymnasiums, lyceums, colleges, institutes, universities. But the road to learning is not easy. To be successful in studies one must work hard. It's for you to decide to learn and make progress or not to learn wasting your time. The role of foreign languages is also increasing today. Thanks to the knowledge of foreign languages one can read books, magazines in the original, talk to foreigners, translate various technical articles. Moreover, joint ventures which have recently appeared in our country need specialists with profound knowledge of foreign languages like English, German or French. To know foreign languages is absolute necessary for every educated person, for good specialists. Our country is transferring to a market economy. Research and innovations should improve living, working conditions of our people. That is why it is so important to be persistent in students. The movement of English around the world began with the pioneering voyages to the Americas and Asia, continued with the 19th century colonial developments in Africa and the South Pacific, and took a significant further step when it was adopted in the 20th century as an official or semiofficial language by many newly-independent states. English is now the dominant or official language by many newly-independent states. English is now the dominant or official language in over 60 countries, and is represented in every continent and in the three major oceans – Atlantic, Indian, and Pacific. It is this spread of representation which makes the application of the term "world language" a reality. The present-day world status of English is the result of two factors: the expansion of British colonial power, which peaked towards the end of the 19th century, and the emergence of the United States as the leading economic power of the 20th century. There are many different reasons why people study foreign languages, English in particular. Here are some of them:· to travel abroad;· to get good job to have something to do in your spare time;· to be better educated;· to be familiar with social and cultural life in other countries; to be able to participate in conversations with people from English-speaking countries. English is the language of international air traffic control, and is currently developing its role in international maritime, policing, and emergency services. English is the chief language of international business and academic conferences, and the leading language of international tourism. English is the main language of popular music, advertising,

satellite broadcasting, home computers, and video games. A foreign language is not just a subject learnt in the classrooms. It's something which is used in real life situations. There are many reasons why we begin to study foreign languages. First of all it's an effective medium of international communication. Learning foreign languages opens up opportunities and careers that didn't even exits some years ago. Knowing foreign languages can help us to find a job in such fields as science and technology, foreign trade and banking, international transportation communication, teaching librarian science and others. A more general aim is to make us intellectually developed. Learning a foreign language also includes learning culture, traditions and mode of thought of different people.

Task 2 Answer the questions.

1. Where can an educated person get knowledge?
2. What is important to be successful?
3. Why is the role of foreign languages increasing today?
4. What did the movement of English around the world begin with?
5. What are the reasons why people study foreign languages?
6. Is it important to know foreign languages if you want to find a good job? Why?

Task 3. Put verbs into the correct form (Present Simple or Present Continuous)

a. An educated person always … (try) to learn, find out, discover more about the world around him.

b. To be successful in studies one must … (work) hard.

c. The role of foreign languages … also … ( increase) today.

d. Our country … (transfer) to a market economy.

e. It … (be) this spread of representation which … ( make) the application of the term "world language" a reality.

f. There …. (be) many different reasons why people …. (study) foreign languages, English in particular.

g. Learning foreign languages … (open) up opportunities and careers that didn't even exits some years ago.

## UNIT 2. THE PETROLIUM INDUSTRY

### Task 1. Read and translate the text.

The **petroleum industry** includes the global processes of exploration, extraction, refining, transporting (often by oil tankers and pipelines), and marketing petroleum products. The largest volume products of the industry are fuel oil and gasoline (petrol). Petroleum (oil) is also the raw material for many chemical products, including pharmaceuticals, solvents, fertilizers, pesticides, and plastics. The industry is usually divided into three major components: upstream, midstream and

downstream. Midstream operations are usually included in the downstream category.

Petroleum is vital to many industries, and is of importance to the maintenance of industrial civilization in its current configuration, and thus is a critical concern for many nations. Oil accounts for a large percentage of the world's energy consumption, ranging from a low of 32% for Europe and Asia, to a high of 53% for the Middle East.

Other geographic regions' consumption patterns are as follows: South and Central America (44%), Africa (41%), and North America (40%). The world consumes 30 billion barrels (4.8 $km^3$) of oil per year, with developed nations being the largest consumers. The United States consumed 25% of the oil produced in 2007. The production, distribution, refining, and retailing of petroleum taken as a whole represents the world's largest industry in terms of dollar value.

Governments such as the United States government provide a heavy public subsidy to petroleum companies, with major tax breaks at virtually every stage of oil exploration and extraction, including the costs of oil field leases and drilling equipment.

**Task 2. Answer the questions**

1. What does petroleum industry include?
2. What chemical products are mentioned in the text?
3. What three major components is this industry divided into?
4. What do governments provide to petroleum companies?

**Task 3. Put the verbs into the correct form (Present Simple)**

1. The **petroleum industry** ……..(include) the global processes of exploration, extraction, refining, transporting (often by oil tankers and pipelines), and marketing petroleum products.
2. Petroleum (oil) ……..(be) also the raw material for many chemical products, including pharmaceuticals, solvents, fertilizers, pesticides, and plastics.
3. Other geographic regions' consumption patterns ……(be) as follows: South and Central America (44%), Africa (41%), and North America (40%).
4. The world……..( consume) 30 billion barrels (4.8 $km^3$) of oil per year, with developed nations being the largest consumers.
5. The production, distribution, refining, and retailing of petroleum taken as a whole …….(represent) the world's largest industry in terms of dollar value.
6. Governments such as the United States government ……..(provide) a heavy public subsidy to petroleum companies

## UNIT 3. NATURAL HISTORY

### Task 1. Read and translate the text

Natural oil spring in Korňa, Slovakia.

Petroleum is a naturally occurring liquid found in rock formations. It consists of a complex mixture of hydrocarbons of various molecular weights, plus other organic compounds. It is generally accepted that oil is formed mostly from the carbon rich remains of ancient plankton after exposure to heat and pressure in the Earth's crust over hundreds of millions of years. Over time, the decayed residue was covered by layers of mud and silt, sinking further down into the Earth's crust and preserved there between hot and pressured layers, gradually transforming into oil reservoirs.

### Task 2. Answer the questions

1. What does petroleum consist of?
2. What was the decayed residue covered by?
3. What was the decayed residue preserved between?

### Task 3. Match the left column with the right one

| | |
|---|---|
| rock | compounds |
| complex | plankton |
| organic | formations |
| ancient | reservoirs |
| decayed | layers |
| hot and pressured | residue |
| oil | mixture |

**Task 4. Read and translate the text**

**Early history**

Petroleum in an unrefined state has been utilized by humans for over 5000 years. Oil in general has been used since early human history to keep fires ablaze and in warfare.

Its importance to the world economy evolved slowly, with whale oil used for lighting in the 19th century and wood and coal used for heating and cooking well into the 20th century. The Industrial Revolution generated an increasing need for energy which was met mainly by coal, and with other sources including whale oil. However, when it was discovered that kerosene could be extracted from crude oil and used as a lighting and heating fuel, petroleum was in great demand, and by the early twentieth century had become the most valuable commodity traded on world markets.

**Task 5. Answer the questions**

1. How long has petroleum been utilized?
2. What has petroleum been used for?
3. What oil was used for lighting in the 19th century?
4. What did the Industrial Revolution generate?

**Task 6. Put the verbs into the correct form (Passive or Active )**

1. Petroleum in an unrefined state …….( utilize) by humans for over 5000 years.
2. Oil in general …….( use) since early human history to keep fires ablaze and in warfare.
3. The importance of petroleum to the world economy.....( evolve) slowly.
4. The Industrial Revolution …….(generate) an increasing need for energy which …….( meet) mainly by coal, and with other sources including whale oil.
5. When …….(discover) that kerosene …….(can extract) from crude oil and …….(use) as a lighting and heating fuel, petroleum was in great demand, and by the early twentieth century had become the most valuable commodity traded on world markets.

## UNIT 4. MODERN HISTORY

### Task 1. Read and translate the text

Oil wells in Boryslav

Imperial Russia produced 3,500 tons of oil in 1825 and doubled its output by midcentury. After oil drilling began in what is now Azerbaijan in 1846 in Baku, two large pipelines were built in the Russian Empire: the 833 km long pipeline to transport oil from the Caspian to the Black Sea port of Batum (Baku-Batum pipeline), completed in 1906, and the 162 km long pipeline to carry oil from Chechnya to the Caspian. Batum was renamed to Batumi in 1936.

At the turn of the 20th century, Imperial Russia's output of oil, almost entirely from the Apsheron Peninsula, accounted for half of the world's production and dominated international markets. Nearly 200 small refineries operated in the suburbs of Baku by 1884. As a side effect of these early developments, the Apsheron Peninsula emerged as the world's "oldest legacy of oil pollution and environmental negligence." In 1846, Baku the first ever well drilled with percussion tools to a depth of 21 meters for oil exploration. In 1878, Ludvig Nobel and his Branobel company "revolutionized oil transport" by commissioning the first oil tanker and launching it on the Caspian Sea.

The first modern oil refineries were built by Ignacy Łukasiewicz near Jasło (then in the dependent Kingdom of Galicia and Lodomeria in Central European Galicia), Poland in 1854–56. These were initially small as demand for refined fuel was limited. The refined products were used in artificial asphalt, machine oil and lubricants, in addition to Łukasiewicz's kerosene lamp. As kerosene lamps gained popularity, the refining industry grew in the area.

The first commercial oil well in Canada became operational in 1858 at Oil Springs, Ontario (then Canada West). Businessman James Miller Williams dug several wells between 1855 and 1858 before discovering a rich reserve of oil four metres below ground. Williams extracted 1.5 million litres of crude oil by 1860, refining much of it into kerosene lamp oil. Some historians challenge Canada’s claim to North America’s first oil field, arguing that Pennsylvania’s famous Drake Well was the continent’s first. But there is evidence to support Williams, not least of

which is that the Drake well did not come into production until August 28, 1859. The controversial point might be that Williams found oil above bedrock while Edwin Drake's well located oil within a bedrock reservoir. The discovery at Oil Springs touched off an oil boom which brought hundreds of speculators and workers to the area. Canada's first gusher (flowing well) erupted on January 16, 1862, when local oil man John Shaw struck oil at 158 feet (48 m). For a week the oil gushed unchecked at levels reported as high as 3,000 barrels per day.

The first modern oil drilling in the United States began in West Virginia and Pennsylvania in the 1850s. Edwin Drake's 1859 well near Titusville, Pennsylvania, is typically considered the first true modern oil well, and touched off a major boom. In the first quarter of the 20th century, the United States overtook Russia as the world's largest oil producer. By the 1920s, oil fields had been established in many countries including Canada, Poland, Sweden, Ukraine, the United States, Peru and Venezuela.

The first successful oil tanker, the *Zoroaster*, was built in 1878 in Sweden, designed by Ludvig Nobel. It operated from Baku to Astrakhan. A number of new tanker designs were developed in the 1880s.

In the early 1930s the Texas Company developed the first mobile steel barges for drilling in the brackish coastal areas of the Gulf of Mexico. In 1937 Pure Oil Company (now part of Chevron Corporation) and its partner Superior Oil Company (now part of ExxonMobil Corporation) used a fixed platform to develop a field in 14 feet (4.3 m) of water, one mile (1.6 km) offshore of Calcasieu Parish, Louisiana. In early 1947 Superior Oil erected a drilling/production oil platform in 20 ft (6.1 m) of water some 18 miles off Vermilion Parish, Louisiana. It was Kerr-McGee Oil Industries (now Anadarko Petroleum Corporation), as operator for partners Phillips Petroleum (ConocoPhillips) and Stanolind Oil & Gas (BP), that completed its historic Ship Shoal Block 32 well in November 1947, months before Superior actually drilled a discovery from their Vermilion platform farther offshore. In any case, that made Kerr-McGee's Gulf of Mexico well, Kermac No. 16, the first oil discovery drilled out of sight of land. Forty-four Gulf of Mexico exploratory wells discovered 11 oil and natural gas fields by the end of 1949. During World War II (1939-1945) - control of oil supply from Baku and Middle East played a huge role in the events of the war and the ultimate victory of the allies. Cutting off the oil supply considerably weakened Japan in the latter part of the war. After World War II ended, the countries of the Middle East took the lead in oil production from the United States. Important developments since World War II include deep-water drilling, the introduction of the Drillship, and the growth of a global shipping network for petroleum relying upon oil tankers and pipelines. In 1949, first offshore oil drilling at Oil Rocks (Neft Dashlari) in the Caspian Sea off Azerbaijan eventually resulted in a city built on pylons. In the 1960s and 1970s, multi-governmental organizations of oil–producing nations OPEC and OAPEC played a major role in setting petroleum prices and policy. Oil spills and their

cleanup have become an issue of increasing political, environmental, and economic importance.

**Task 2. Answer the questions**

1. How much oil did Imperial Russia produce in 1825?
2. What were the lengths of the two first pipelines built by the Russian Empire?
3. When was the first commercial oil well in Canada became operational?
4. What was the name of the world's "oldest legacy of oil pollution and environmental negligence?
5. What can you say about James Miller Williams and Edwin Drake?
6. What was the name of the first successful oil tanker?
7. Who developed the first mobile steel barges for drilling in the brackish coastal areas of the Gulf of Mexico?
8. What countries took the leading role in oil production after the World War II ended?

**Task 3. What does these dates refer to?**

1825, 1846, 1936, 1846, 1884, 1878, 1858, 1860, 1859, 1862, 1878, 1937, 1947

**Task 4. What does these numbers refer to?**

3500, 833, 162, 200, 21, 1500000, 48, 3000, 14, 20, 32

**Task 5.Put the verbs into the correct form (Passive or Active )**

1. Imperial Russia ……(produce) 3,500 tons of oil in 1825 and doubled its output by mid-century.
2. After oil drilling …….(begin) in what is now Azerbaijan in 1846 in Baku, two large pipelines …….( build) in the Russian Empire.
3. . Batum …….( rename) to Batumi in 1936.
4. . Nearly 200 small refineries ……(operate) in the suburbs of Baku by 1884.
5. The first modern oil refineries ……( build) by Ignacy Łukasiewicz near Jasło.
6. These were initially small as demand for refined fuel ……..( limit).
7. The refined products …….( use) in artificial asphalt, machine oil and lubricants, in addition to Łukasiewicz's kerosene lamp.
8. As kerosene lamps ……..(gain) popularity, the refining industry ……(grow) in the area.
9. The controversial point might be that Williams ……..(find) oil above bedrock while Edwin Drake's well ……(locate) oil within a bedrock reservoir.

10. Edwin Drake's 1859 well …….. (typically consider) the first true modern oil well.

11. The discovery at Oil Springs ……..(touch) off an oil boom which ……..(bring) hundreds of speculators and workers to the area.

12. By the 1920s, oil fields ……..( establish) in many countries including Canada, Poland, Sweden, Ukraine, the United States, Peru and Venezuela.

13. In the early 1930s the Texas Company …….(develop) the first mobile steel barges for drilling in the brackish coastal areas of the Gulf of Mexico.

14. After World War II ……(end), the countries of the Middle East …….(take) the lead in oil production from the United States.

15. Important developments since World War II ……..(include) deep-water drilling, the introduction of the Drillship, and the growth of a global shipping network for petroleum relying upon oil tankers and pipelines.

## UNIT 5. PETROLIUM INDUSTRY STRUCTURE

### Task 1. Read and translate the text

**Industry structure**

NIS refinery in Pančevo, Serbia

The American Petroleum Institute divides the petroleum industry into five sectors:

- upstream (exploration, development and production of crude oil or natural gas)
- downstream (oil tankers, refiners, retailers and consumers)
- pipeline
- marine
- service and supply

**Pre-reading question:** What top 10 largest world oil companies do you know?

### Upstream

Oil companies used to be classified by sales as *"supermajors"* (BP, Chevron, ExxonMobil, ConocoPhillips, Shell, Eni and Total S.A.), *"majors",* and

*"independents" or "jobbers"*. In recent years however, National Oil Companies (NOC, as opposed to IOC, International Oil Companies) have come to control the rights over the largest oil reserves; by this measure the top ten companies all are NOC. The following table shows the ten largest national oil companies ranked by reserves and by production in 2012.

Top 10 largest world oil companies by reserves and production

| Rank | Company (Reserves) | Worldwide Liquids Reserves ($10^9$ bbl) | Worldwide Natural Gas Reserves ($10^{12}$ ft$^3$) | Total Reserves in Oil Equivalent Barrels ($10^9$ bbl) | Company (Production) | Output (Millions bbl/day)[1] |
|---|---|---|---|---|---|---|
| 1 | Saudi Aramco | 260 | 254 | 303 | Saudi Aramco | 12.5 |
| 2 | NIOC | 138 | 948 | 300 | NIOC | 6.4 |
| 3 | Qatar Petroleum | 15 | 905 | 170 | ExxonMobil | 5.3 |
| 4 | INOC | 116 | 120 | 134 | PetroChina | 4.4 |
| 5 | PDVSA | 99 | 171 | 129 | BP | 4.1 |
| 6 | ADNOC | 92 | 199 | 126 | Royal Dutch Shell | 3.9 |
| 7 | Pemex | 102 | 56 | 111 | Pemex | 3.6 |
| 8 | NNPC | 36 | 184 | 68 | Chevron | 3.5 |
| 9 | NOC | 41 | 50 | 50 | Kuwait Petroleum Corporation | 3.2 |
| 10 | Sonatrach | 12 | 159 | 39 | ADNOC | 2.9 |

**^1 : Total energy output, including natural gas (converted to bbl of oil) for companies producing both.**

Most upstream work in the oil field or on an oil well is contracted out to drilling contractors and oil field service companies.

Aside from the NOCs which dominate the Upstream sector, there are many international companies that have a market share. For example:[23]

- BG Group
- BHP Billiton
- ConocoPhillips
- Chevron

- Eni
- ExxonMobil
- OMV
- Hess Ltd
- Marathon Oil
- Total
- Tullow Oil
- First Texas Energy Corp

**Read and translate the text. Choose from the list (A-E) the heading which best summerise each art (1-5) of the text.**

**A Processing/refining**

**B Technological applications**

**C Gathering**

**D Transportation**

**E Storage**

**Midstream**

Midstream operations are sometimes classified within the downstream sector, but these operations compose a separate and discrete sector of the petroleum industry. Midstream operations and processes include the following:

- **1…….:** The gathering process employs narrow, low-pressure pipelines to connect oil- and gas-producing wells to larger, long-haul pipelines or processing facilities.
- **2…….:** Processing and refining operations turn crude oil and gas into marketable products. In the case of crude oil, these products include heating oil, gasoline for use in vehicles, jet fuel, and diesel oil. Oil refining processes include distillation, vacuum distillation, catalytic reforming, catalytic cracking, alkylation, isomerization and hydrotreating. Natural gas processing includes compression; glycol dehydration; amine treating; separating the product into pipeline-quality natural gas and a stream of mixed natural gas liquids; and fractionation, which separates the stream of mixed natural gas liquids into its components. The fractionation process yields ethane, propane, butane, isobutane, and natural gasoline.
- **3……..:** Oil and gas are transported to processing facilities, and from there to end users, by pipeline, tanker/barge, truck, and rail. Pipelines are the most economical transportation method and are most suited to movement across longer distances, for example, across continents. Tankers and barges are also employed for long-distance, often international transport. Rail and

truck can also be used for longer distances but are most cost-effective for shorter routes.

- **4……..:** Midstream service providers provide storage facilities at terminals throughout the oil and gas distribution systems. These facilities are most often located near refining and processing facilities and are connected to pipeline systems to facilitate shipment when product demand must be met. While petroleum products are held in storage tanks, natural gas tends to be stored in underground facilities, such as salt dome caverns and depleted reservoirs.
- **5……..:** Midstream service providers apply technological solutions to improve efficiency during midstream processes. Technology can be used during compression of fuels to ease flow through pipelines; to better detect leaks in pipelines; and to automate communications for better pipeline and equipment monitoring.

**Task 2. Answer the questions**

1. What does the gathering process employ?
2. What do processing and refining operations include?
3. How are oil and gas transported?
4. What kind of transport can be used for transportation?
5. Where are oil and gas stored?

**Task 3. Match the left column with the right one**

| | |
|---|---|
| narrow, low-pressure | distillation |
| oil- and gas-producing | natural gas |
| vacuum | pipelines |
| pipeline-quality | wells |
| the most economical | providers |
| Midstream service | transportation method |
| technological | in pipelines |
| to better detect leaks | caverns |
| salt dome | solutions |

## UNIT 6. ENVIRONMENTAL IMPACT AND FUTURE SHORTAGES

### Task 1. Read and translate the text

Some petroleum industry operations have been responsible for water pollution through by-products of refining and oil spills. The industry is the largest industrial source of emissions of volatile organic compounds (VOCs), a group of chemicals that contribute to the formation of ground-level ozone (smog).

The combustion of fossil fuels produces greenhouse gases and other air pollutants as by-products. Pollutants include nitrogen oxides, sulphur dioxide, volatile organic compounds and heavy metals.

As petroleum is a non-renewable natural resource the industry is faced with an inevitable eventual depletion of the world's oil supply. The BP Statistical Review of World Energy 2007 listed the reserve/production ratio for proven resources worldwide. The study placed the ratio of proven reserves to production in the Middle East at 79.5 years, Latin America at 41.2 years and North America at 12 years. A simplistic interpretation of the ratio has led to many false predictions of immanent "running out of oil" since the early years of the oil industry in the 1800s. This has been especially true in the United States, where the ratio of proved reserves-to-production has been between 8 years and 17 years since 1920. Many have mistakenly interpreted the result as the number of years before the oil supply is exhausted. Such analyses do not take into account future reserves growth.[1]

The Hubbert peak theory, which introduced the concept of peak oil, questions the sustainability of oil production. It suggests that after a peak in oil production rates, a period of oil depletion will ensue. Since virtually all economic sectors rely heavily on petroleum, peak oil could lead to a partial or complete failure of markets.

According to research by IBIS World, biofuels (primarily ethanol, but also biodiesel) will continue to supplement petroleum. However output levels are low, and these fuels will not displace local oil production. More than 90% of the ethanol used in the US is blended with gasoline to produce a 10% ethanol mix, lifting the oxygen content of the fuel.

Researchers have discovered that the petrochemical industry can produce ground-level ozone pollution at higher amounts in winter than in summer.

### Task 2. Answer the questions

1. What environmental problems does some petroleum industry cause?
2. What pollutants are mentioned in the text?
3. What does the Hubbert peak theory suggest ?

4. When can that the petrochemical industry produce higher amount of ground-level ozone pollution?

**Task 3. Put the verbs into the correct form (Present Simple and Present Perfect)**

1. Some petroleum industry operations ……..(be responsible for) water pollution through by-products of refining and oil spills.
2. The combustion of fossil fuels ……..(produce) greenhouse gases and other air pollutants as by-products.
3. Pollutants ……(include) nitrogen oxides, sulphur dioxide, volatile organic compounds and heavy metals.
4. A simplistic interpretation of the ratio…….( lead) to many false predictions of immanent "running out of oil" since the early years of the oil industry in the 1800s.
5. This …….(be) especially true in the United States, where the ratio of proved reserves-to-production has been between 8 years and 17 years since 1920.
6. . Many ……( mistakenly interprete) the result as the number of years before the oil supply is exhausted.
7. Such analyses ……(not take) into account future reserves growth.
8. Researchers ……..(discover) that the petrochemical industry can produce ground-level ozone pollution at higher amounts in winter than in summer.

**Task 4. Read and translate the text**

**Safety and environmental concerns**

Fire-extinguishing operations after the Texas City refinery explosion.

The refining process releases a number of different chemicals into the atmosphere and a notable odor normally accompanies the presence of a refinery. Aside from air pollution impacts there are also wastewater concerns,[3] risks of industrial accidents such as fire and explosion, and noise health effects due to industrial noise.

Many governments worldwide have mandated restrictions on contaminants that refineries release, and most refineries have installed the equipment needed to comply with the requirements of the pertinent environmental protection regulatory agencies. In the United States, there is strong pressure to prevent the development of new refineries, and no major refinery has been built in the country since Marathon's Garyville, Louisiana facility in 1976. However, many existing refineries have been expanded during that time. Environmental restrictions and pressure to prevent construction of new refineries may have also contributed to rising fuel prices in the United States. Additionally, many refineries (more than 100 since the 1980s) have closed due to obsolescence and/or merger activity within the industry itself.

Environmental and safety concerns mean that oil refineries are sometimes located some distance away from major urban areas. Nevertheless, there are many instances where refinery operations are close to populated areas and pose health risks. In California's Contra Costa County and Solano County, a shoreline necklace of refineries, built in the early 20th century before this area was populated, and associated chemical plants are adjacent to urban areas in Richmond, Martinez, Pacheco, Concord, Pittsburg, Vallejo and Benicia, with occasional accidental events that require "shelter in place" orders to the adjacent populations.

**Task 5. Answer the questions**

1. Why can the refining process be dangerous for people?
2. Why are oil refineries sometimes located away from major urban areas?
3. What can you say about California's Contra Costa County and Solano County in terms of environmental safety?

**Task 6. Match the left column with the right one**

| | |
|---|---|
| The refining | restrictions |
| air pollution | new refineries |
| mandated | restrictions |
| the development of | concerns |
| Environmental | urban areas |
| Environmental and safety | impacts |
| adjacent to | process |
| occasional accidental | risks |
| pose health | events |

## UNIT 7. HISTORY OF OIL WELLS.

### Task 1. Read and translate the text

### Text 1

Bottom Part of an Oil Drilling Derrick in Brazoria County, Texas (Harry Walker Photograph, 1940)

An **oil well** is a boring in the Earth that is designed to bring petroleum oil hydrocarbons to the surface. Usually some natural gas is produced along with the oil. A well that is designed to produce mainly or only gas may be termed a **gas well.**

The earliest known oil wells were drilled in China in 347 CE. These wells had depths of up to about 240 metres (790 ft) and were drilled using bits attached to bamboo poles.[1] The oil was burned to evaporate brine and produce salt. By the 10th century, extensive bamboo pipelines connected oil wells with salt springs. The ancient records of China and Japan are said to contain many allusions to the use of natural gas for lighting and heating. Petroleum was known as *burning water* in Japan in the 7th century.

According to Kasem Ajram, petroleum was distilled by the Persian alchemist Muhammad ibn Zakarīya Rāzi (Rhazes) in the 9th century, producing chemicals such as kerosene in the alembic (*al-ambiq*), and which was mainly used for kerosene lamps. Arab and Persian chemists also distilled crude oil in order to produce flammable products for military purposes. Through Islamic Spain, distillation became available in Western Europe by the 12th century.

Some sources claim that from the 9th century, oil fields were exploited in the area around modern Baku, Azerbaijan, to produce naphtha for the petroleum industry. These fields were described by Marco Polo in the 13th century, who described the output of those oil wells as hundreds of shiploads. When Marco Polo in 1264 visited the Azerbaijani city of Baku, on the shores of the Caspian Sea, he saw oil being collected from seeps. He wrote that "on the confines toward Geirgine there is a fountain from which oil springs in great abundance, in as much as a hundred shiploads might be taken from it at one time."

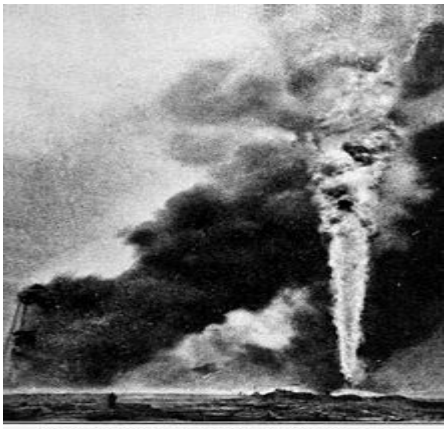
**Task 2. Answer the questions**

1. What is an oil well?
2. What can you say about the earliest known oil wells?
3. How was petroleum used in the 9th century?
4. What did Marco Polo describe?

**Task 3.Put the verbs into the correct form (Present or Past Simple, Passive or Active )**

1. An **oil well** is a boring in the Earth that ……(design) to bring petroleum oil hydrocarbons to the surface.
2. Usually some natural gas ……..( produce) along with the oil.
3. The earliest known oil wells ……..( drill) in China in 347 CE.
4. These wells ……..(have) depths of up to about 240 metres (790 ft) and were drilled using bits attached to bamboo poles.
5. The oil ……..( burn) to evaporate brine and produce salt.
6. By the 10th century, extensive bamboo pipelines ……..(connect) oil wells with salt springs.
7. The ancient records of China and Japan ……( say) to contain many allusions to the use of natural gas for lighting and heating.
8. Petroleum …….( know) as *burning water* in Japan in the 7th century.
9. According to Kasem Ajram, petroleum ……..( distill) by the Persian alchemist Muhammad ibn Zakarīya Rāzi (Rhazes) in the 9th century.
10. Arab and Persian chemists also ……..(distill) crude oil in order to produce flammable products for military purposes.
11. Through Islamic Spain, distillation …….( become) available in Western Europe by the 12th century.
12. These fields ……..( describe) by Marco Polo in the 13th century, who ……(describe) the output of those oil wells as hundreds of shiploads.
13. When Marco Polo in 1264 …….(visit) the Azerbaijani city of Baku, on the shores of the Caspian Sea, he ……(see) oil being collected from seeps.

**Task 4. Read and translate the text 2**



1904 oil well fire at Bibi-Eibat

In North America, the first commercial oil well entered operation in Oil Springs, Ontario in 1858, while the first offshore oil well was drilled in 1896 at the Summerland Oil Field on the California Coast.

The earliest oil wells in modern times were drilled percussively, by repeatedly raising and dropping a cable tool into the earth. In the 20th century, cable tools were largely replaced with rotary drilling, which could drill boreholes to much greater depths and in less time. The record-depth Kola Borehole used non-rotary mud motor drilling to achieve a depth of over 12,000 metres (39,000 ft).

Until the 1970s, most oil wells were vertical, although lithological and mechanical imperfections cause most wells to deviate at least slightly from true vertical. However, modern directional drilling technologies allow for strongly deviated wells which can, given sufficient depth and with the proper tools, actually become horizontal. This is of great value as the reservoir rocks which contain hydrocarbons are usually horizontal, or sub-horizontal; a horizontal wellbore placed in a production zone has more surface area in the production zone than a vertical well, resulting in a higher production rate. The use of deviated and horizontal drilling has also made it possible to reach reservoirs several kilometers or miles away from the drilling location (extended reach drilling), allowing for the production of hydrocarbons located below locations that are either difficult to place a drilling rig on, environmentally sensitive, or populated.

**Task 5. Answer the questions**

1. When did the first commercial oil well enter operation in North America?
2. How were the earliest oil wells in modern times drilled?
3. What were most oil wells until the 1970s?
4. Why are modern directional drilling horizontal?

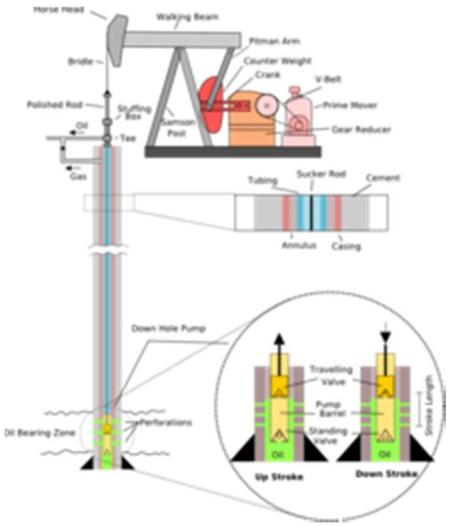
**Task 6.Put the verbs into the correct form (Present or Past Simple, Passive or Active Voice)**

1. In North America, the first commercial oil well ……..(enter) operation in Oil Springs, Ontario in 1858, while the first offshore oil well …….. (drill) in 1896 at the Summerland Oil Field on the California Coast.
2. In the 20th century, cable tools …….( largely replace) with rotary drilling.
3. The record-depth Kola Borehole …….(use) non-rotary mud motor drilling to achieve a depth of over 12,000 metres (39,000 ft).
4. Until the 1970s, most oil wells ……..(be) vertical, although lithological and mechanical imperfections……..( cause) most wells to deviate at least slightly from true vertical.
5. However, modern directional drilling technologies ……..(allow) for strongly deviated wells which can, given sufficient depth and with the proper tools, actually……( become) horizontal.
6. Reservoir rocks which contain hydrocarbons ……(be) usually horizontal, or sub-horizontal.

## UNIT 8. LIFE OF A WELL. DRILLING.

**Task 1. Read and translate the text**

### Life of a well. Drilling.




A schematic of a typical oil well being produced by a pumpjack, which is used to produce the remaining recoverable oil after natural pressure is no longer sufficient to raise oil to the surface.

The well is created by drilling a hole 12 cm to 1 meter (5 in to 40 in) in diameter into the earth with a drilling rig that rotates a drill string with a bit attached. After the hole is drilled, sections of steel pipe (casing), slightly smaller in diameter than the borehole, are placed in the hole. Cement may be placed between the outside of the casing and the borehole known as the annulus. The casing provides structural

integrity to the newly drilled wellbore, in addition to isolating potentially dangerous high pressure zones from each other and from the surface.

With these zones safely isolated and the formation protected by the casing, the well can be drilled deeper (into potentially more-unstable and violent formations) with a smaller bit, and also cased with a smaller size casing. Modern wells often have two to five sets of subsequently smaller hole sizes drilled inside one another, each cemented with casing.

**Task 2. Answer the questions**

1. Can you describe a typical oil well?
2. How deep are the wells drilled?
3. Why can the wells be drilled deeper?
4. How many sets of subsequently smaller hole sizes do modern wells have?

**Task 3. Put the appropriate preposition.**

1. A schematic ……a typical oil well being produced…….. a pumpjack, which is used to produce the remaining recoverable oil ……. natural pressure is no longer sufficient to raise oil ……. the surface.
2. The well is created …….. drilling a hole 12 cm ….. 1 meter (5 in to 40 in) in diameter …… the earth ……. a drilling rig that rotates a drill string ……. a bit attached.
3. After the hole is drilled, sections ……. steel pipe (casing), slightly smaller …….. diameter than the borehole, are placed …….. the hole.
4. Cement may be placed …… the outside ……. the casing and the borehole known as the annulus.
5. The casing provides structural integrity ……. the newly drilled wellbore, in addition to isolating potentially dangerous high pressure zones ……. each other and ……. the surface.
6. …… these zones safely isolated and the formation protected ……. the casing, the well can be drilled deeper (into potentially more-unstable and violent formations) ……. a smaller bit, and also cased …… a smaller size casing.
7. Modern wells often have two …….. five sets ……. subsequently smaller hole sizes drilled …….. one another, each cemented …… casing.

## UNIT 9. HOW TO DRILL THE WELL

### Task 1. Read and translate the text

Well Casing

- The drill bit, aided by the weight of thick walled pipes called "drill collars" above it, cuts into the rock. There are different types of drill bit; some cause the rock to disintegrate by compressive failure, while others shear slices off the rock as the bit turns.
- Drilling fluid, a.k.a. "mud", is pumped down the inside of the drill pipe and exits at the drill bit. The principal components of drilling fluid are usually water and clay, but it also typically contains a complex mixture of fluids, solids and chemicals that must be carefully tailored to provide the correct physical and chemical characteristics required to safely drill the well. Particular functions of the drilling mud include cooling the bit, lifting rock cuttings to the surface, preventing destabilisation of the rock in the wellbore walls and overcoming the pressure of fluids inside the rock so that these fluids do not enter the wellbore. Some oil wells are drilled with air or foam as the drilling fluid.

Mud log in process, a common way to study the lithology when drilling oil wells

- The generated rock "cuttings" are swept up by the drilling fluid as it circulates back to surface outside the drill pipe. The fluid then goes through "shakers" which strain the cuttings from the good fluid which is returned to the pit. Watching for abnormalities in the returning cuttings and monitoring pit volume or rate of returning fluid are imperative to catch "kicks" early. A "kick" is when the formation pressure at the depth of the bit is more than the hydrostatic head of the mud above, which if not controlled temporarily by closing the blowout preventers and ultimately by increasing the density of

the drilling fluid would allow formation fluids and mud to come up through the annulus uncontrollably.

- The pipe or drill string to which the bit is attached is gradually lengthened as the well gets deeper by screwing in additional 9 m (30 ft) sections or "joints" of pipe under the kelly or top drive at the surface. This process is called making a connection, or "tripping". Joints can be combined for more efficient tripping when pulling out of the hole by creating stands of multiple joints. A conventional triple, for example, would pull pipe out of the hole three joints at a time and stack them in the derrick. Many modern rigs, called "super singles", trip pipe one at a time, laying it out on racks as they go.

This process is all facilitated by a drilling rig which contains all necessary equipment to circulate the drilling fluid, hoist and turn the pipe, control downhole, remove cuttings from the drilling fluid, and generate on-site power for these operations.

**Task 2. Answer the questions**

1. What is "drill collars"?
2. What are the principal components of drilling fluid?
3. What do particular functions of the drilling mud include?
4. What is the function of "shakers"?
5. What is a "kick"?
6. What is "tripping"?

**Task 3. Put the verbs into the correct form (Present Simple)**

1. There ……..(be) different types of drill bit.
2. The principal components of drilling fluid …….(be) usually water and clay, but it also typically ……(contain) a complex mixture of fluids, solids and chemicals that must be carefully tailored to provide the correct physical and chemical characteristics required to safely drill the well.
3. Particular functions of the drilling mud ……..(include) cooling the bit, lifting rock cuttings to the surface, preventing destabilisation of the rock in the wellbore walls and overcoming the pressure of fluids inside the rock so that these fluids …….( not enter) the wellbore.
4. The generated rock "cuttings" are swept up by the drilling fluid as it ……(circulate) back to surface outside the drill pipe.
5. The fluid then……..( go) through "shakers" which strain the cuttings from the good fluid which is returned to the pit.
6. Many modern rigs, called "super singles",……..( trip) pipe one at a time, laying it out on racks as they ……..(go).

## UNIT 10. TYPES OF WELLS

### Task 1. Read and translate the text

A natural gas well in the southeast Lost Hills Field, California, US.

Fossil-fuel wells come in many varieties. By produced fluid, there can be wells that produce oil, wells that produce oil *and* natural gas, or wells that *only* produce natural gas. Natural gas is almost always a byproduct of producing oil, since the small, light gas carbon chains come out of solution as they undergo pressure reduction from the reservoir to the surface, similar to uncapping a bottle of soda pop where the carbon dioxide effervesces. Unwanted natural gas can be a disposal problem at the well site. If there is not a market for natural gas near the wellhead it is virtually valueless since it must be piped to the end user. Until recently, such unwanted gas was burned off at the wellsite, but due to environmental concerns this practice is becoming less common. Often, unwanted (or 'stranded' gas without a market) gas is pumped back into the reservoir with an 'injection' well for disposal or repressurizing the producing formation. Another solution is to export the natural gas as a liquid. Gas to liquid, (GTL) is a developing technology that converts stranded natural gas into synthetic gasoline, diesel or jet fuel through the Fischer-Tropsch process developed in World War II Germany. Such fuels can be transported through conventional pipelines and tankers to users. Proponents claim GTL fuels burn cleaner than comparable petroleum fuels. Most major international oil companies are in advanced development stages of GTL production, e.g. the 140,000 bbl/d (22,000 $m^3$/d) Pearl GTL plant in Qatar, scheduled to come online in 2011. In locations such as the United States with a high natural gas demand, pipelines are constructed to take the gas from the wellsite to the end consumer.

Raising the derrick

Another obvious way to classify oil wells is by land or offshore wells. There is very little difference in the well itself. An offshore well targets a reservoir that happens to be underneath an ocean. Due to logistics, drilling an offshore well is far more costly than an onshore well. By far the most common type is the onshore well. These wells dot the Southern and Central Great Plains, Southwestern United States, and are the most common wells in the Middle East.

*Another way to classify oil wells is by their purpose in contributing to the development of a resource.* They can be characterized as:

- *wildcat wells* are drilled where little or no known geological information is available. The site may have been selected because of wells drilled some distance from the proposed location but on a terrain that appeared similar to the proposed site.
- *exploration wells* are drilled purely for exploratory (information gathering) purposes in a new area, the site selection is usually based on seismic data, satellite surveys etc. Details gathered in this well includes the presence of Hydrocarbon in the drilled location, the amount of fluid present and the depth at which oil or/and gas occurs.
- *appraisal wells* are used to assess characteristics (such as flow rate, reserve quantity) of a proven hydrocarbon accumulation. The purpose of this well is to reduce uncertainty about the characteristics and properties of the hydrocarbon present in the field.
- *production wells* are drilled primarily for producing oil or gas, once the producing structure and characteristics are determined.
- *development wells* are wells drilled for the production of oil or gas already proven by appraisal drilling to be suitable for exploitation.
- *Abandoned well* are wells permanently plugged in the drilling phase for technical reasons.

Oil extraction in Boryslav in 1909

At a producing well site, active wells may be further categorised as:

- *oil producers* producing predominantly liquid hydrocarbons, but mostly with some associated gas.
- *gas producers* producing almost entirely gaseous hydrocarbons.
- *water injectors* injecting water into the formation to maintain reservoir pressure, or simply to dispose of water produced with the hydrocarbons

because even after treatment, it would be too oily and too saline to be considered clean for dumping overboard offshore, let alone into a fresh water resource in the case of onshore wells. Water injection into the producing zone frequently has an element of reservoir management; however, often produced water disposal is into shallower zones safely beneath any fresh water zones.

- *aquifer producers* intentionally producing water for re-injection to manage pressure. If possible this water will come from the reservoir itself. Using aquifer produced water rather than water from other sources is to preclude chemical incompatibility that might lead to reservoir-plugging precipitates. These wells will generally be needed only if produced water from the oil or gas producers is insufficient for reservoir management purposes.
- *gas injectors* injecting gas into the reservoir often as a means of disposal or sequestering for later production, but also to maintain reservoir pressure.

**Task 2. Answer the questions**

1. What types of wells by produced fluid do you know?
2. What is the classification of oil wells by land or offshore wells?
3. What is the classification of oil wells by their purpose in contributing to the development of a resource?
4. At a producing well site how may active wells be further categorized?

**Task 3. Put the appropriate preposition.**

1. Another way to classify oil wells is …….. their purpose ……. contributing ……. the development …… a resource.

2. Water injection …… the producing zone frequently has an element …… reservoir management; however, often produced water disposal is ……. shallower zones safely …….. any fresh water zones.

3. Using aquifer produced water rather than water …… other sources is to preclude chemical incompatibility that might lead …… reservoir-plugging precipitates.

4. These wells will generally be needed only if produced water ……. the oil or gas producers is insufficient …….. reservoir management purposes.

5. Gas injectors inject gas into the reservoir often as a means …… disposal or sequestering …….. later production, but also to maintain reservoir pressure.

## UNIT 11. COMPLETION

### Task 1. Read and translate the text

Modern drilling rig in Argentina

After drilling and casing the well, it must be 'completed'. Completion is the process in which the well is enabled to produce oil or gas.

In a cased-hole completion, small holes called perforations are made in the portion of the casing which passed through the production zone, to provide a path for the oil to flow from the surrounding rock into the production tubing. In open hole completion, often 'sand screens' or a 'gravel pack' is installed in the last drilled, uncased reservoir section. These maintain structural integrity of the wellbore in the absence of casing, while still allowing flow from the reservoir into the wellbore. Screens also control the migration of formation sands into production tubulars and surface equipment, which can cause washouts and other problems, particularly from unconsolidated sand formations of offshore fields.

After a flow path is made, acids and fracturing fluids may be pumped into the well to fracture, clean, or otherwise prepare and stimulate the reservoir rock to optimally produce hydrocarbons into the wellbore. Finally, the area above the reservoir section of the well is packed off inside the casing, and connected to the surface via a smaller diameter pipe called tubing. This arrangement provides a redundant barrier to leaks of hydrocarbons as well as allowing damaged sections to be replaced. Also, the smaller cross-sectional area of the tubing produces reservoir fluids at an increased velocity in order to minimize liquid fallback that would create additional back pressure, and shields the casing from corrosive well fluids.

In many wells, the natural pressure of the subsurface reservoir is high enough for the oil or gas to flow to the surface. However, this is not always the case, especially in depleted fields where the pressures have been lowered by other producing wells, or in low permeability oil reservoirs. Installing a smaller diameter tubing may be enough to help the production, but artificial lift methods may also be needed. Common solutions include downhole pumps, gas lift, or surface pump jacks. Many new systems in the last ten years have been introduced for well completion. Multiple packer systems with frac ports or port collars in an all in one system have cut completion costs and improved production, especially in the case

of horizontal wells. These new systems allow casings to run into the lateral zone with proper packer/frac port placement for optimal hydrocarbon recovery.

**Task 2. Answer the questions**

1. What is a completion in terms of oil and gas industry?
2. What are perforations?
3. Why are 'sand screens' or a 'gravel pack' installed in open hole completion?
4. Why is the area above the reservoir section of the well packed off inside the casing, and connected to the surface via tubing?
5. Why may installing a smaller diameter tubing be needed to help the production?

**Task 3.Put the verbs into the appropriate form(Passive or Active)**

1. Completion …….(be) the process in which the well ……(enable) to produce oil or gas.

2. In a cased-hole completion, small holes called perforations …… (make) in the portion of the casing which ……..(pass) through the production zone, to provide a path for the oil to flow from the surrounding rock into the production tubing.

3. Screens also ……..(control) the migration of formation sands into production tubulars and surface equipment.

4. After a flow path is made, acids and fracturing fluids……..(may pump) into the well to fracture, clean, or otherwise …….(prepare) and (stimulate) the reservoir rock to optimally produce hydrocarbons into the wellbore.

5.This arrangement …….(provide) a redundant barrier to leaks of hydrocarbons as well as allowing damaged sections …….(replace).

6.. However, this ……(be) not always the case, especially in depleted fields where the pressures …….(lower) by other producing wells, or in low permeability oil reservoirs.

7.. Many new systems in the last ten years ……(introduce) for well completion.

## UNIT 12. PRODUCTION

**Task 1. Read and translate the text**

The production stage is the most important stage of a well's life; when the oil and gas are produced. By this time, the oil rigs and workover rigs used to drill and complete the well have moved off the wellbore, and the top is usually outfitted with a collection of valves called a Christmas tree or production tree. These valves regulate pressures, control flows, and allow access to the wellbore in case further completion work is needed. From the outlet valve of the production tree, the flow

can be connected to a distribution network of pipelines and tanks to supply the product to refineries, natural gas compressor stations, or oil export terminals.

As long as the pressure in the reservoir remains high enough, the production tree is all that is required to produce the well. If the pressure depletes and it is considered economically viable, an artificial lift method mentioned in the completions section can be employed.

Workovers are often necessary in older wells, which may need smaller diameter tubing, scale or paraffin removal, acid matrix jobs, or completing new zones of interest in a shallower reservoir. Such remedial work can be performed using workover rigs – also known as *pulling units*, *completion rigs* or "service rigs" – to pull and replace tubing, or by the use of well intervention techniques utilizing coiled tubing. Depending on the type of lift system and wellhead a rod rig or flushby can be used to change a pump without pulling the tubing.

Enhanced recovery methods such as water flooding, steam flooding, or $CO_2$ flooding may be used to increase reservoir pressure and provide a "sweep" effect to push hydrocarbons out of the reservoir. Such methods require the use of injection wells (often chosen from old production wells in a carefully determined pattern), and are used when facing problems with reservoir pressure depletion, high oil viscosity, or can even be employed early in a field's life. In certain cases – depending on the reservoir's geomechanics – reservoir engineers may determine that ultimate recoverable oil may be increased by applying a waterflooding strategy early in the field's development rather than later. Such enhanced recovery techniques are often called "tertiary recovery".

**Task 2. Answer the questions**

1. What happens during the production stage?
2. What is a production tree?
3. What is the function of a production tree?
4. What can be used to change a pump without pulling the tubing?
5. What may be used to increase reservoir pressure?
6. What is the role of "tertiary recovery" technique?

**Task 1. Read and translate the text**

**Abandonment**

A well is said to reach an "economic limit" when its most efficient production rate does not cover the operating expenses, including taxes.[5]

When the economic limit is raised, the life of the well is shortened and proven oil reserves are lost. Conversely, when the economic limit is lowered, the life of the well is lengthened.

When the economic limit is reached, the well becomes a liability and is abandoned. In this process, tubing is removed from the well and sections of well bore are filled with concrete to isolate the flow path between gas and water zones from each other, as well as the surface. Completely filling the well bore with concrete is costly and unnecessary. The surface around the wellhead is then excavated, and the wellhead and casing are cut off, a cap is welded in place and then buried.

At the economic limit there often is still a significant amount of unrecoverable oil left in the reservoir. It might be tempting to defer physical abandonment for an extended period of time, hoping that the oil price will go up or that new supplemental recovery techniques will be perfected. In these cases, temporary plugs will be placed downhole and locks attached to the wellhead to prevent tampering. There are thousands of "abandoned" wells throughout North America, waiting to see what the market will do before permanent abandonment. Often, lease provisions and governmental regulations usually require quick abandonment; liability and tax concerns also may favor abandonment.

In theory an abandoned well can be reentered and restored to production (or converted to injection service for supplemental recovery or for downhole hydrocarbons storage), but reentry often proves to be difficult mechanically and not cost effective.

**Task 2. Answer the questions**

1. When does a well reach an "economic limit" ?
2. What happens to the well after its abandonment?
3. What cases are temporary plugs placed downhole and locks attached to the wellhead to prevent tampering in?
4. Is it profitable to reenter an abandoned well?

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**(англійська мова)**

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Комп'ютерне верстання *І. В. Волосожарова*

План 2016, поз. 501 М

Підп. до друку 01.02.2018. Формат 60х84/16
Друк на ризографі Ум. друк. арк. 1,5
Тираж 50 пр. Зам. №

Видавець і виготовлювач:
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ДК № 5328 від 11.04.2017.