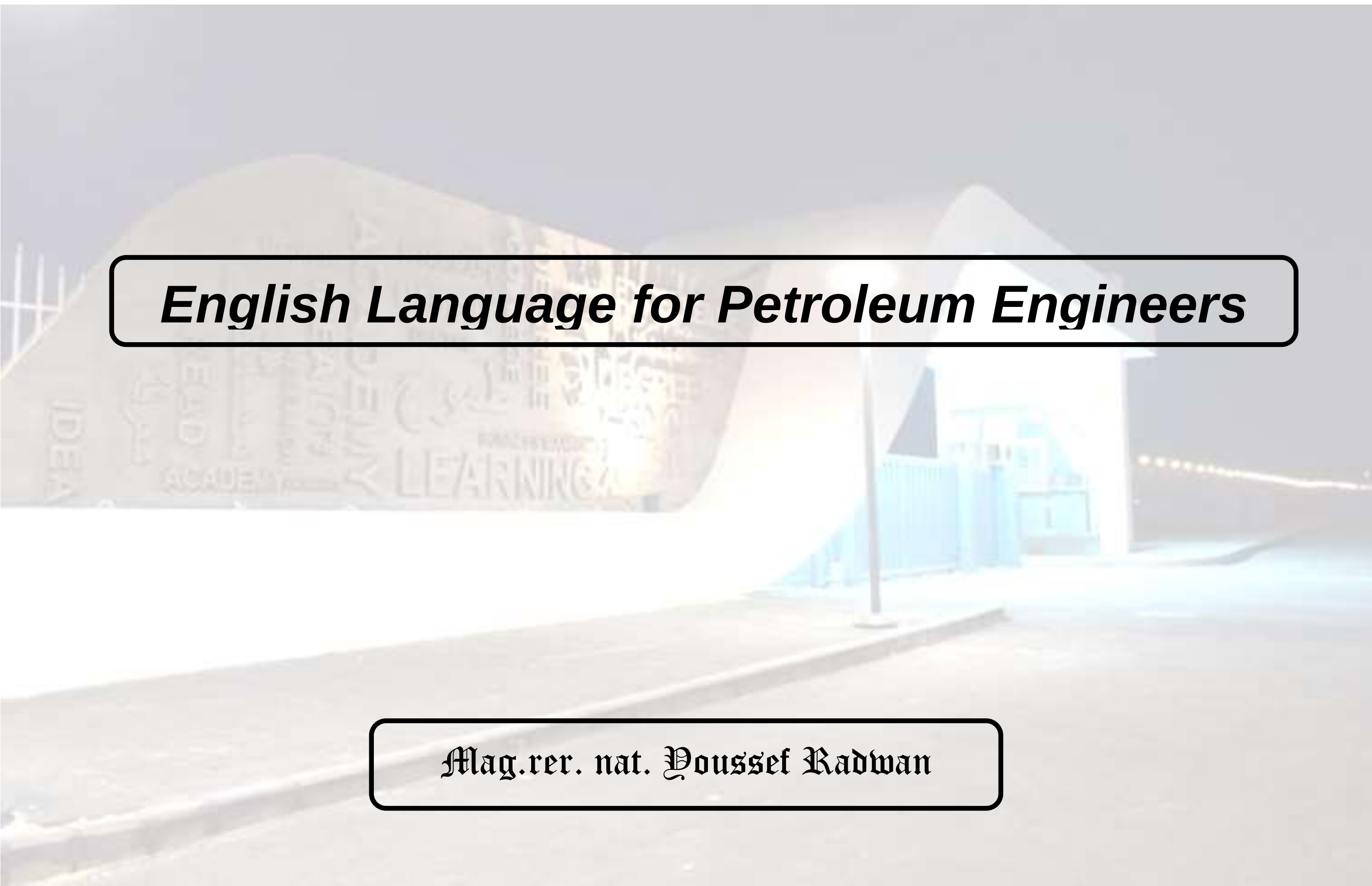
Syrian Private University

Faculty of Petroleum Engineering



English Language for Petroleum Engineers

Mag.rer. nat. Youssef Radwan

مرجع المقرر كتاب

Håvard Devold, Oil and gas production handbook , An introduction to oil and gas production, transport, refining and petrochemical industry
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Unit 1

Facilities and processes	مرافق وعمليات
Oil and gas industry facilities and systems are broadly defined, according to their use in the oil and gas industry production stream: Upstream Midstream Downstream	أعلى النهر ، منبع مُنْتَصَفُ الجَرَيان أسفل النهر، مصب
First: Upstream	
Typically refers to all facilities for production and stabilization of oil and gas. The reservoir and drilling community often uses upstream for the wellhead, well, completion and reservoir only, and downstream of the wellhead as production or processing. Exploration and upstream/production together is referred to as E&P.	إجْمالاً؛ نموذجيا مرافق تَرْكِيز إزالة الغازات المذابة الخزان مجموعة أعلى النهر منبع مصدر فوهة البئر
1 History	
Oil has been used for lighting purposes for many thousands of years. In areas where oil is found in shallow reservoirs, seeps of crude oil or gas may naturally develop, and some oil could simply be collected from seepage or tar ponds. Historically, we know the tales of eternal fires where oil and gas seeps ignited and burned. One example is the site where the famous oracle of Delphi was built around 1,000 B.C. Written sources from 500 B.C. describe how the Chinese used natural gas to boil water. *It was not until 1859 that "Colonel" Edwin Drake drilled the first successful oil well, with the sole purpose of finding oil. The Drake Well was located in the middle of quiet farm country in northwestern Pennsylvania, and sparked the international search for an industrial use for petroleum. These wells were shallow by modern standards, often less than 50 meters deep, but they produced large quantities of oil. The oil was collected in the wooden tank.* *There were different-sized barrels. At that time, barrel size had not been standardized, which made statements like "oil is selling at $5 per barrel" very confusing (today a barrel is 159*	إنَارَة خزان اِرْتِشاح ؛ تَسَرُّب جُمعت اِرْتِشاح ؛ تَسَرُّب برك قطران سَفْلَت أبدي أشعل ملاك الوحي إلى أن حل عام حفر بهدف وحيد العثور إقليم زراعي هادئ ضحلة عميق كميات خزان خشبي برميل مُوَحّد مُرْبِك فرط الإنتاج تجنب بئر الامبراطورية أنجز

liters). But even in those days, overproduction was something to be avoided. When the "Empire well" was completed in September 1861, it produced 3,000 barrels per day, flooding the market, and the price of oil plummeted to 10 cents a barrel. In some ways, we see the same effect today. When new shale gas fields in the US are constrained by the capacity of the existing oil and gas pipeline network, it results in low prices at the production site. Soon, oil had replaced most other fuels for motorized transport. The automobile industry developed at the end of the 19th century, and quickly adopted oil as fuel. Gasoline engines were essential for designing successful aircraft. Ships driven by oil could move up to twice as fast as their coal-powered counterparts, a vital military advantage. Gas was burned off or left in the ground. Despite attempts at gas transportation as far back as 1821, it was not until after World War II that welding techniques, pipe rolling, and metallurgical advances allowed for the construction of reliable long distance pipelines, creating a natural gas industry boom. At the same time, the petrochemical industry with its new plastic materials quickly increased production. Even now, gas production is gaining market share as liquefied natural gas (LNG) provides an economical way of transporting gas from even the remotest sites.	أنتج أغرق يهبط تأثير حَجَز استيعاب شبكة الأنابيب أسعار منخفضة موقع الإنتاج سرعان حل محل وقود تبنت أساسية تصميم طائرات ناجحة مقادة مشغّل بالفحم حيوي يحرق يترك محاولات نقل إلى مابعد الحرب العالمية الثانية لحام تقدم تعديني سمح خلق أوجد ازدهار يكسب حصة السوق غاز مسال اقتصادي أبعد الأماكن

Unit 2

2 Exploration	
Exploration includes prospecting, seismic and drilling activities that take place before the development of a field is finally decided. In the past, surface features such as tar seeps or gas pockmarks provided initial clues to the location of shallow hydrocarbon deposits. Today, a series of surveys, starting with broad geological mapping through increasingly advanced methods such as passive seismic, reflective seismic, magnetic and gravity surveys give data to	قسمات مظاهر بثرة قدمت مؤشرات أولية سلسلة مسوحات وضع خرائط بتزايد متقدمة سيزمي منفعل انعكاسي جاذبية مُتَطَوّر تحديد صخور حاملة إحْتِمَالات

sophisticated analysis tools that identify potential hydrocarbon bearing rock as "prospects".
An offshore well typically costs $30 million, with most falling in the $10 -$100 million range. Rig leases are typically $200,000 - $700,000 per day.
The average US onshore well costs about $4 million, as many have much lower production capacity. Smaller companies exploring marginal onshore fields may drill a shallow well for as little as $100,000.
This means that oil companies spend much time on analysis models of good exploration data, and will only drill when models give a good indication of source rock and probability of finding oil or gas. The first wells in a region are called wildcats because little may be known about potential dangers, such as the down-hole pressures that will be encountered, and therefore require particular care and attention to safety equipment.
If a find (strike, penetration) is made, additional reservoir characterization such as production testing, appraisal wells, etc., are needed to determine the size and production capacity of the reservoir in order to justify a development decision.

The Role of Geoscientists
The majority of geoscientists employed in the search for oil and gas fall into one of three sub-specialties. Although there can be much overlap, these three sub-specialties are as follows: geologists (understanding the rocks), geophysicists (interpreting the subsurface structure or configuration through seismic, gravity, etc.) and geochemists (understanding the subsurface fluids, like petroleum).
Geoscientists are employed by oil exploration and production companies because of their expertise in applying earth science to predict subsurface conditions and processes at work in sedimentary basins that form the "hydrocarbon "habitat" for oil and gas deposits.
In their role of assessing uncertainty, geoscientists must have the ability to work in multi-disciplinary teams that collectively bring together a variety of expertise, including geophysics, petrophysics, drilling, reservoir engineering, production engineering, facilities operations, environmental analysis, economics, accounting, legal, commercial, and negotiations. It is critical that the multidisciplinary team

عرض البحر نموذجياً
معظمها يقع في مجال
عقود إيجار مُعَدَّات
طاقة إنتاجية
هامشي
يمضي
نماذج التحليل
إشَارَة دليل
صخر المصدر
احتمالية
قطط متوحشة
أخطار محتملة
ضغوط أسفل البئر
تصادف
عناية
انتباه أدوات السلامة
عُثر على اكتشاف
تحديد خصائص
اختبار الإنتاج تّقييم
تقدير
يبرر قرار التطوير

دور علماء الأرض
غالبية عاملون في البحث
يقعون تخصصات فرعية
تراكب
يفسرون
بنية تحت سطحية
شَكْل
موائع

خبرة تطبيق
تنبؤ
ظروف عمليات فاعلة
أحواض الترسيب
مَوْطِن
تقييم شَكّ
متعدّدة الاختصاصات
بشكل جماعي
عمليات المرافق تحليل بيئي
اقتصاد محاسبة قانونية
تجارية مفاوضات دَقِيق
يقرر
قيمة

decides the value of information that they either have or need, and members of the team must learn quickly from each other and from past experience. As stated earlier, mistakes in the exploration business can be costly in terms of money, environmental impact, and human safety. Typically, every well that is drilled undergoes an extensive study afterwards, called a “post-well appraisal”, to learn as much as possible about successes and failures. The information learned from the appraisal is often applied to future projects.	

Unit 3

3. Reservoir	
The oil and gas bearing structure is typically porous rock, such as sandstone or washed out limestone. The sand may have been laid down as desert sand dunes or seafloor. Oil and gas deposits form as organic materials (tiny plants and animals) deposited in earlier geological periods, are transformed by high temperature and pressure into hydrocarbons. *For an oil reservoir to form, porous rock needs to be covered by a nonporous layer such as salt, shale, chalk or mud rock that prevent the hydrocarbons from leaking out of the structure. As rock structures become folded and raised as a result of tectonic movements, the hydrocarbons migrate out of the deposits and upward in porous rock and collect in crests under the non-permeable rock, with gas at the top and oil and fossil water at the bottom.* *Salt is a thick fluid, and if deposited under the reservoir, it will flow up in heavier rock over millions of years. This process creates salt domes with a similar reservoir-forming effect. These are common e.g. in the Middle East.* *This extraordinary process is ongoing. However, an oil reservoir matures in the sense that an immature formation may not yet have allowed the hydrocarbons to form and collect. A young reservoir generally has heavy crude, less than 20 API, and is often Cretaceous in origin (65-145 million years ago).* *Most light crude reservoirs tend to be Jurassic or Triassic (145- 205/205-250 million years ago), and gas reservoirs*	مسامية نموذجياً مغسول شاحب توضّع قاع البحر دقيقة تحولت لتتشكل تغطى يمنع ارتشاح تسرب بنية تطوى وترفع تهاجر توضعات تتجمع في قمم مائع ثخين توضّع قبب ملحية تأثير مشكّل لخزان شائع استثنائية جارية، مستمرة ينضج غير ناضجة فجة يتراكم خام معهد البترول الأمريكي نهوض حت تحطم يرشح للخارج تاركاً

where the organic molecules are further broken down are often Permian or Carboniferous in origin (250-290/290-350 million years ago). These are often exposed at the surface and can be strip-mined, but must be separated from the sand with hot water, steam and diluents, and further processed with cracking and reforming in a refinery to improve fuel yield. The oil and gas is pressurized in the pores of the absorbent formation rock. When a well is drilled into the reservoir structure, the hydrostatic formation pressure drives the hydrocarbons out of the rock and up into the well. When the well flows, gas, oil and water are extracted, and the levels shift as the reservoir is depleted. The challenge is to plan drilling so that reservoir utilization can be maximized.	مركبات طيارة تتبخر ضحلة مشبعة بالبيتومين تضغط مسام ممتصة يجبر يتدفق يستخلص تنزاح بستنفد تحدي استغلال انتفاع

Unit 4

4 Drilling	
Even at the beginning of the 21st century, the petroleum industry is yet to overcome some major problems it faces in the operations. A major focus is on the drilling practices. This makes it difficult for the industry to get the results they require within the shortest possible time. Hence a lot of time is put into drilling, sometimes weeks or even months, just a single well. " Edwin Drake drilled the first well, for the purpose of petroleum production, in 1859 in Venango County, near Titusville in Pennsylvania”. Although, some claims of prior art do exist, (e.g. Germany in 1857 and Canada in 1858), Drake's well at Titusville is still registered as the first to be copied. He and his crew drilled in the manner of salt well drillers but used a steam engine to power the drill and a piping to prevent borehole collapse, allowing for the drill to penetrate further into the ground. This gave a progress of three feet (1m) per day. However, they hit their first production depth of 69.5 feet (21m) drilling from spring to August 27. Since then, a variety of drilling mechanisms has been developed and modified to sink a borehole into the ground. Each has its own advantages and disadvantages, in terms of depth to which it can drill, the type	كانت ما زال عليها أن تتجاوز تواجه ممارسة تتطلب في أقصر زمن ممكن يكرس يصرف يخصص مزاعم فن سابق موجود يستنسخ فريق طاقم العمل اسلوب طريقة مد أنابيب يمنع انهيار يسمح يخترق الى حد أبعد تقدم يضرب مجموعة يتطور يحفر محاسن مساوئ نمط عينة مستردة

of sample returned, the cost involved and penetration rate achieved. *A radical change occurred at the turn of the 20th century. The introduction of the rotary drilling that displaced the then very popular cable tool drilling as a standard method for reaching oil and gas "traps" down through the formation. Limitations such as; downtime due to dull bits, lack of precise vertical or horizontal wells, formation fluid leakage during drilling and waste created by drilling mud still persist with this state-of-the-art basic mechanical method.* *In addition, drilling for petroleum and gas get increasingly difficult by the day. Nowadays, we are required to drill as far as 25000 feet (7620m), most times, in deep stormy waters in order to get a satisfying volume. Hence the need for a more efficient drilling technique still remains a constant goal.* *Although, laser drilling experiments dates back to the 1960s, it is only recently that experts started looking towards applying it to petroleum and gas drilling. "In 1997, the Gas Technology Institute (GTI) initiated a two-year study exploring the feasibility of adopting high-powered military lasers for a evolutionary application in the oil and gas exploration and production." The experiment shows that laser drilling stands a viable option to improve drilling technologies, especially in offshore operations.* *Downtimes created by dull bits are drastically reduced as bits are replaced with laser heads that have no contact with the rock and also waste created by drilling mud is eliminated. It seals the wall of the well bore as it bores by creating a ceramic sheath. This eliminates the cost of employing steel wall casing, as influx/out-fluxes of fluids in and out of the well is eliminated and hence, problem of formation collapse is drastically reduced. In addition, it penetrates over 100 times faster than conventional rotary methods.*	كلفة مُتَضَمّنة معدل الاختراق المنجز جَذْرِيّ منعطف إدخال حل محل شائع حفر بالسلك معياري نموذجي مصيدة قيود محدودية وقت ضائع رأس حفر متآكل افتقار نفايات طين الحفر انتفاع استخدام إضافة إلى بازدياد في الوقت الراهن عميقة عاصفة مُرْضٍ حاجة كفؤ مازالت ثابت تجارب يرجع تاريخها مؤخراً إسْتُهِلّ سبر جَدْوَى تبنّي عالي القدرة ثورية تطبيق يمثل قابل للتطبيق خيار تحسين وقت ضائع ناتج رأس حفر متآكل بشدّة تستبدل بلا تماس أزيلت يسد يحفر إيجاد غلاف يلغي يحذف إكساء فولاذي للجدران انبثاق يحذف انهيار بشدّة يخترق أسرع تقليدية
4.1 Drilling Technique	
A successful well drilling, whether onshore or offshore, must be able to provide: *1- a means of fracturing and penetrating through rock formations to reach petroleum and gas,* *2- a means of excavating the rock cuttings off the bore hole,* *3- a means of preventing the walls of the bore hole from collapsing or caving in, especially when drilling through unconsolidated formations,*	سواء أكان بر عرض البحر أَدَاة وسيلة طريقة تكسير اختراق استخلاص فتات صخري منع انهيار تكهف غير متماسكة قطر

4- The diameter of the well must be large enough to permit lowering tools down the hole and permit application of newer drilling techniques.	لتسمح إنزال معدات تطبيق
Cable Tool Drilling Technique Although the rotary drilling technique is used more frequently today, the cable-tool is still used in some cases nevertheless.	أكثر تواتراً إلا أن
The cable tool is not a drill in the common sense, because it is not power rotated. It operates much like a seesaw with a powered walking beam mounted on a derrick.	عارضة متحركة مركّبة منصة حفارة آلية
Penetration is achieved by repeatedly lifting and dropping heavy iron string and a variety of drill bits on the borehole. A chiseling effect of the drill bits on the rock crushes consolidated rock into small fragments. "The length of cable is adjusted so that on the down stroke, the tools stretch the line as the bit hits the bottom of the hole, striking with a sharp blow and immediately retracting.	اختراق بتكرار رفع إسقاط نحت بالإزميل يحطم متماسكة يضبط ضربة تمط السلك يضرب قاع البئر بضربة حادة فوراً يرتد
The drilling process has to be stopped at intervals to get rock cutting off the bore hole and water is added either by the driller or flows in from the formation to do this. The water mixes with the crushed rock particles and turns it into slurry that settles at the bottom of the bore hole. At a point where the slurry accumulates to a quantity that begins to reduce the penetration to an unaccepted level, drilling is stopped and the slurry is removed by a bailer. The bit is reinstalled into the hole and drilling continues after each stage of removing slurry.	فواصل حفار ينساب وحل يستقر يتراكم يقلل اختراق غير مقبول دَلْو يعاد تركيبها
Advantages of Cable Tool Drilling	مزايا محاسن الحفر بالدق
Cable tool drilling has the following advantages:	
1- A relatively cheaper drilling method. The capital cost of a new cable tool rig and maintenance expenditure are relatively cheaper than that of a rotary drilling rig of similar capacities.	أرخص نسبياً نفقات صيانة طاقة مشابهة
2- Efficient use of personnel. Cable-tool rigs are often operated by one or two persons.	استخدام كفؤ للعمِال
3- Suitable for water poor areas and remote settings. This is due to the fact that the cable tool drilling requires little amount of water and identifies each water bearing formation penetrated in addition to its low fuel consumption and reliability.	مناسبة مناطق فقيرة بالمياه تحدد حاملة للماء مخترقة استهلاك منخفض من الوقود وثوقية
4- Qualitative and quantitative data; including good flow estimates, temperature, water chemistry measurement and static water level, can be obtained while drilling.	كيفية كمّية المستوى الستاتيكي للماء يحصل على
Disadvantages of Cable Tool Drilling:	مساوئ

Cable tool drilling has the following disadvantages: *1- Directional drilling is impossible as this method is limited to vertical holes.* *2- Depth and penetrating rates are very low, especially through hard rock formations.* *3- In unconsolidated formations, casing must be driven as drilling progresses. Collapsing or caving in of the formation is almost inevitable without immediate casing.* *4- Blowout preventers are not easily adapted.* *5- Productivity measured in hole produced per day is low compared to rotary drilling on similar formation.* *6- Lack of experienced personnel. With more abundant rotary drilling rigs today, a cable-tool driller with a wide range of experience is hard to find.*	مستحيل مقتصرة معدلات العمق والاختراق غير متماسكة يدخل مع تقدم الحفر تَقْرِيباً لا يمكن تفاديها مانع الانفجار تكيف انتاجية مقيسة افتقار عمال مهرة وفيرة طيف خبرة واسع صعب إيجاده

Unit 5

4.2 Rotary Drilling Technique	
It was at the turn of the 20th century (approximately 100 years ago) that saw to the birth of the rotary drilling as a standard method of reaching oil and gas formations. It was about this time that this basic mechanical method served as an option and phased out the cable tool drilling method. Since its birth, major improvements have occurred but in the last couple of decades, the method of drilling has not changed at all. *The American Oil & Gas Historical Society (2006) summarized the basic difference between the rotary and the cable-tool drilling technique. "Instead of the repetitive lift and drop of heavy cable-tool bits, the rotary drilling introduced the hollow drill stem which enables rock debris to be washed out of the bore hole with re-circulated mud while the rotating drill bit cuts deeper." They added that the rotary drilling fluid (drilling mud), that is used to circulate out the chipped rock, washes the bore hole clean and makes the drilling exercise more efficient.* *The drilling mud equally helps the well against bursting forth unexpectedly. This is so because the mud controls the pressure difference between itself in the bore hole and that fluid in the formation.* ***Laser Technology in Petroleum Drilling***	ولادة للوصول خدم خيار يزيل بالتدريج يحدث زوج عقد (10 سنوات) تاريخي جمعية يلخص اختلاف أساسي بدلاً متكرر أجوف يمكن جرف إلى الخارج يعيد تدوير يحفر للأعمق يضيف صخر متشظي ينظف إجراءات الحفر أكثر كفاءة أيْضاً انفجار مستمر مفاجئ يتحكم يضبط فرق الضغط منجز إلى االآن

The work accomplished so far on laser drilling has resulted in some positive indications (Mustafiz, Bjorndalen, and Islam. 2004). They added that although experiments on laser drilling were conducted between 1960s and 1970s, it is only very recently that the application of laser technology is directed to drilling petroleum wells. However, a suggestion in 1990 had it that application of laser technology in petroleum drilling is not feasible, but this was because the experiments conducted then, in this regard, were made with low powered lasers (less than 1 kiloWatt). However, current experiments have proved it otherwise.

Graves & O'Brien (1998) highlighted some very significant importance laser drilling would have over conventional rotary drilling method. <u>These include:</u>

1. *Drilling over 100 times faster.*
2. *Cutting off downtime due to dull bits.*
3. *Drilling more precise vertical and horizontal wells.*
4. *Eliminating formation fluid leakage during drilling.*
5. *Eliminating wastes created by drilling mud and rock cuttings.*
6. *Cost effectiveness by decreasing current drilling times.*

They added however, that a combination of laser and rotary drilling is not out of thought, as this would result in an increase in bit life. Other possibilities with the advancement of laser technology include; development of down hole drilling machine, laser-assisted drill bits, laser-perforation tools, and sidetrack and directional laser drilling devices. Hence, the thought of applying laser technology being a viable option for enhancing the petroleum drilling phase.

Rotary drilling, usually applied to make deep wells, is the most common well boring method used today by both water and geothermal well drilling. Although the idea of using a rotary drill bit to make holes is not new, it is only in the early 1900 ‟s that a standard method of applying this technique found its way into making petroleum and gas wells for production in commercial quantity. It still remains the most effective method of well drilling in petroleum and gas industries today.

Much like a common hand held drill; the fundamental principle behind this technique is the use of a sharp, rotating drill bit with an applied force to drill down through the earth

ينتج عنه مؤشرات
تجارب
مجراة
مؤخراً
موجه غير أن
مقترح
مجدي
آنذاك
بهذا الصدد منخفض الطاقة
يثبت خلاف ذلك
أهمية بارِزة جدية للغاية

1. حفر أسرع بأكثر من مئة مرة
2. اختصار الوقت الضائع بسبب رؤوس الحفر المتآكلة
3. حفر أكثر دقة لآبار شاقولية وأفقية
4. تفادي ارتشاح مائع التشكيلة خلال الحفر
5. تفادي نفايات ناتجة عن طين الحفر والفتات الصخري
6. فعالية التكلفة نتيجة خفض أزمنة الحفر الحالية

دمج توحيد
ليست خارج الحسبان
احتمالية
تقدم
تطوير آلة
معزز بالليزر تثقيب
مَسَارٌ جانِبِيٌّ موجه
معدات
خيار قابل للتطبيق لتحسين
طور مرحلة
حفر
حارة فكرة
طريقها
كمية تجارية بقيت الأكثر
تأثيراً

شبيه جداً مثقب يدوي شائع
المبدأ الأساسي
حاد دوار
قوة مطبقة
قشرة الأرض

crust. Following constant technological advancements, the actual mechanics of today's rotary rigs is quite complicated. Today's rotary drilling rig consists of multiple engines that can be split into five components: *1- The prime mover – that supplies power* *2- The hoisting equipment – that raises and lowers the drill strings (drill pipe)* *3- The rotating equipment – that rotates (turns) the drill strings and the drill bit.* *4- The circulating equipment – that pumps drilling mud down the hole.* *5- The blowout preventer (BOP).* *Today's rotary drilling rig consists of multiple engines that can be split into five components:* *1. The Prime Movers: – that supplies power* *They are the power house of the entire rig, in that they provide the energy needed to power the entire equipment in the rig. Steam engines used to be popular with the early rigs but today's rigs make more use of gas or diesel engines.* *2. Hoisting Equipment: that raises and lowers the drill strings (drill pipe).* *It consists of tools used to raise and lower whatever other equipment that in and out of the well. It is composed of the draw works (pulleys), drilling lines, crown block, travelling block and the hook. The derrick is the most visible part of the hoisting equipment and it serves as support for the cables (drilling lines), draw works as well as to hold the monkey board in place.* *3. The Rotating Equipment: that rotates (turns) the drill strings and the drill bit.* *It consists of components that receives power from the prime mover and transfers it down to the drill bit for it to crush or drill ahead.* *4. The Circulating System: that pumps drilling mud down the hole.* *It is a continuous circulation of drilling fluid (mud) down through the well throughout the drilling process.* *5. Blowout Preventers (BOP):* *It is the term used for a situation where the control of formation fluid flow in the well is lost. Adequate prevention systems need to be in place as its occurrence is always*	فعلية معقدة كليّاً متعددة تنفصل محرك رئيس تمد أداة الرفع ترفع وتخفض أداة الدوران أداة التدوير تضخ طين الحفر مانع الانفجار متعددة تنفصل محركات رئيسة تمد محطة توليد طاقة كامل تمد الطاقة المطلوبة تشغل محركات بخارية شائعة الحفارات أولى أداة الرفع ترفع وتخفض بكرات سحب أسلاك حفر بكرة القمة خطاف دعامة منصة التعليق أداة الدوران تستلم تحوّل للأسفل تتابع الحفر أداة التدوير طين الحفر عبر مانع الانفجار يفقد مناسب حدوث

catastrophic, often leading to losses of lives, property and environment.	كارثي يقود خسائر في الأرواح الممتلكات والبيئة

Unit 6

4.3 Production	
Today, oil and gas is produced in almost every part of the world, from the small 100 barrels-a-day private wells to the large bore 4,000 barrels-a-day wells; in shallow 20 meter deep reservoirs to 3,000 meter deep wells in more than 2,000 meters of water; in $100,000 onshore wells and $10 billion offshore developments. Despite this range, many parts of the process are quite similar in principle.	ينتج خاصة ضحل تطويرات
4.3.1 Onshore production	
Onshore production is economically viable from a few dozen barrels of oil a day and upward. Oil and gas is produced from several million wells worldwide. In particular, a gas gathering network can become very large, with production from thousands of wells, several hundred kilometers/miles apart, feeding through a gathering network into a processing plant. A typical picture shows a well, equipped with a sucker rod pump (donkey pump) often associated with onshore oil production. However, as we shall see later, there are many other ways of extracting oil from a non free-flowing well. For the smallest reservoirs, oil is simply collected in a holding tank and picked up at regular intervals by tanker truck or railcar to be processed at a refinery. *Onshore wells in oil-rich areas are also high capacity wells producing thousands of barrels per day, connected to a 1,000,000 barrel or more per day GOSP (Gas Oil Separation Plant) Product is sent from the plant by pipeline or tankers. The production may come from many different license owners, so metering of individual well-streams into the gathering network are important tasks.* *Unconventional plays target very heavy crude and tar sands that became economically extractable with higher prices and new technology. Heavy crude may need heating and diluents to be extracted. Tar sands have lost their volatile compounds and can be extracted with steam. It must be further processed to separate bitumen from the sand. Since*	تقليدية مِضَخَّةِ قضيب ماص (مِضَخَّةِ الحصان) غالباً مترافقة انسياب مقيد مجمعة احتجاز تنقل وتجمع شاحنة الصهريج عربات سكك حديد مصفاة غنية بالنفط طاقة مصنع فصل الغاز عن النفط خط أنابيب صهاريج امتياز مالكو قياس الاستهلاك تدفقات الآبار مهام لاتقليدية طرائق اقتصادياً قابل للاستخلاص أسعار أعلى تسخين مخففات طيارة مركبات بخار

about 2007, drilling technology and fracturing of the reservoir have allowed shale gas and liquids to be produced in increasing volumes. This allows the US in particular to reduce dependence on hydrocarbon imports. Canada, China, Argentina, Russia, Mexico and Australia also rank among the top unconventional plays. These unconventional reserves may contain more 2-3 times the hydrocarbons found in conventional reservoirs.	بيتومين تسمح حجوم اعتماد استيرادات احتل مرتبة طرائق احتياطات
4.3.2 Offshore production	
A whole range of different structures is used offshore, depending on size and water depth. In the last few years, we have seen pure sea bottom installations with multiphase piping to shore, and no offshore topside structure at all. Replacing outlying wellhead towers, deviation drilling is used to reach different parts of the reservoir from a few wellhead cluster locations. Some of the common offshore structures are: *1. <u>Shallow water complex</u>, which is characterized by several independent platforms with different parts of the process and utilities linked with gangway bridges. Individual platforms include wellhead riser, processing, accommodations and power generation platforms. (This picture shows the BP Valhall complex.) Typically found in water depths up to 100 meters.* *<u>2. Gravity base</u> consists of enormous concrete fixed structures placed on the bottom, typically with oil storage cells in a "skirt" that rests on the sea bottom. The large deck receives all parts of the process and utilities in large modules. Large fields at 100 to 500 meters of water depth were typical in the 1980s and 1990s. The concrete was poured at an onshore location, with enough air in the storage cells to keep the structure floating until tow-out and lowering onto the seabed. The picture shows the world's largest GBS platform, Troll A, during construction.*	مجال بنى تركيبات أجهزة متعدد المراحل مد أنابيب الجانب الاعلى يحل محل بعيد أبراج رأس الحفر انحراف تجمع مواقع مجمّع المياه الضحلة تتميّز مستقلة منصة مرافق خدمات أنابيب مرتبطة جسور ممرات منفردة رافعة رأس الحفر مَسْكَن قاعدة ثابتة بالجاذبية ضخمة بيتون متموضعة على قاع خلايا تخزين الأطراف يتلقى وحدة الدخل والخرج نمطيّة يسكب يعوم جر وتنزيل قاع البحر

Unit 7

3. <u>Compliant towers</u> are much like fixed platforms. They consist of a narrow tower, attached to a foundation on the seafloor and extending up to the platform. This tower is	أبراج سهلة الانقياد مطاوع مَرْبُوط أساس مُمْتَدّ

flexible, as opposed to the relatively rigid legs of a fixed platform. Flexibility allows it to operate in much deeper water, as it can absorb much of the pressure exerted by the wind and sea. Compliant towers are used between 500 and 1,000 meters of water depth.	مرن عكس صلب يمتص ممارس
*4. <u>4. Floating production,</u> where all topside systems are located on a floating structure with dry or subsea wells. Some floaters are: *FPSO: Floating Production, Storage and Offloading. Their main advantage is that they are a standalone structure that does not need external infrastructure such as pipelines or storage. Crude oil is offloaded to a shuttle tanker at regular intervals, from days to weeks, depending on production and storage capacity. FPSOs currently produce from around 10,000 to 200,000 barrels per day. An FPSO is typically a tanker type hull or barge, often converted from an existing crude oil tanker (VLCC or ULCC). Due to the increasing sea depth for new fields, they dominate new offshore field development at more than 100 meters water depth.*	إنتاج طافٍ الأجزاء العليا إنتاج وتخزين وتفريغ عائم قائم بذاته بنية تحتية النفط الخام ناقلة مكوكية فواصل منتظمة هَيْكَل مَرْكَب محول يهيمن
The wellheads or subsea risers from the sea bottom are located on a central or bow-mounted turret, so that the ship can rotate freely to point into wind, waves or current. The turret has wire rope and chain connections to several anchors (position mooring - POSMOOR), or it can be dynamically positioned using thrusters (dynamic positioning–DYNPOS). Most installations use subsea wells. The main process is placed on the deck, while the hull is used for storage and offloading to a shuttle tanker. It may also be used for the transportation of pipelines. FPSOs with additional processing and systems, such as drilling and production and stranded gas LNG production are planned. A variation of the FPSO is the Sevan Marine design. This uses a circular hull which shows the same profile to wind, waves and current, regardless of direction. It shares many of the characteristics of the ship-shaped FPSO, such as high storage capacity and deck load, but does not rotate and therefore does not need a rotating turret.	مركز تبادل محور برج مركب على قوس وصلات مراسي مَرْسىً دافعة ظهر هيكل تفريغ معالجة دائري مظهر جانبي بغض النظر خصائص لها شكل سفينة
<u>Tension Leg Platform</u> (TLP) consists of a structure held in place by vertical tendons connected to the sea floor by pile-secured templates. The structure is held in a fixed position by tensioned tendons, which provide for use of the TLP in a broad water depth range up to about 2,000m.	منصة ساق التوتر أوتار قوالب مكفولة بأوتاد أوتار مشدودة متوترة

The tendons are constructed as hollow high tensile strength steel pipes that carry the spare buoyancy of the structure and ensure limited vertical motion. *<u>Semi-submersible platforms</u> have a similar design but without taut mooring. This permits more lateral and vertical motion and is generally used with flexible risers and subsea wells. Similarly, Seastar platforms are miniature floating tension leg platforms, much like the semisubmersible type, with tensioned tendons.*	قوة مقاومة الشد طَفْو منصات نصف مغمورة مرسى مشدود مصغر
*<u>SPAR</u> (**Single Point Anchor) Reservoir”** consists of a single tall floating cylindrical hull, supporting a fixed deck. The cylinder does not, however, extend all the way to the seabed. Rather, it is tethered to the bottom by a series of cables and lines. The large cylinder serves to stabilize the platform in the water, and allows for movement to absorb the force of potential hurricanes.* *SPARs can be quite large and are used for water depths from 300 up to 3,000 meters. SPAR is not an acronym, and is named for its resemblance to a ship's spar. SPARs can support dry completion wells, but are more often used with subsea wells.* *Subsea production systems are wells located on the sea floor, as opposed to the surface. As in a floating production system, the petroleum is extracted at the seabed, and is then “tied-back” to a pre-existing production platform or even an onshore facility, limited by horizontal distance or "offset.” The well is drilled by a movable rig and the extracted oil and natural gas is transported by undersea pipeline and riser to a processing facility. This allows one strategically placed production platform to service many wells over a reasonably large area. Subsea systems are typically used at depths of 500 meters or more and do not have the ability to drill, only to extract and transport.* *Drilling and completion is performed from a surface rig. Horizontal offsets of up to 250 kms/150 miles are currently possible. The aim of the industry is to allow fully autonomous subsea production facilities, with multiple wellpads, processing, and direct tie-back to shore.*	صاري السفينة اسطواني هَيْكَل يمتد مربوط تمتص أعاصير محتملة كلمة مركبة من أوائل حروف منظومات الإنتاج تحت البحري يستخلص تربط مُنْشَأة إزاحة بشكل معقول نموذجياً إكمال ذاتي مستقل تصميم معياري للبئر

Unit 8

4.4 Upstream process sections	
4.4.1 Wellheads	
The wellhead sits on top of the actual oil or gas well leading down to the reservoir. A wellhead may also be an injection well, used to inject water or gas back into the reservoir to maintain pressure and levels to maximize production. Once a natural gas or oil well is drilled and it has been verified that commercially viable quantities of natural gas are present for extraction, the well must be "completed" to allow petroleum or natural gas to flow out of the formation and up to the surface. *This process includes strengthening the well hole with casing, evaluating the pressure and temperature of the formation, and installing the proper equipment to ensure an efficient flow of natural gas from the well. The well flow is controlled with a choke.* *We differentiate between, dry completion (which is either onshore or on the deck of an offshore structure) and subsea completions below the surface. The wellhead structure, often called a Christmas tree, must allow for a number of operations relating to production and well workover. Well workover refers to various technologies for maintaining the well and improving its production capacity.*	بئر حقن ليحافظ يضاعف تحقق يكمل تقوية إكساء تقييم تركيب مناسب كفؤ صمام خانق نفرق الصيانة
4.4.2 Manifolds and gathering	
<u>Onshore</u>, the individual well streams are brought into the main production facilities over a network of gathering pipelines and manifold systems. The purpose of these pipelines is to allow setup of production "well sets" so that for a given production level, the best reservoir utilization well flow composition (gas, oil, water), etc., can be selected from the available wells. *For gas gathering systems, it is common to meter the individual gathering lines into the manifold as shown in this picture. For multiphase flows (combination of gas, oil and water), the high cost of multiphase flow meters often leads to the use of software flow rate estimators that use well test data to calculate actual flow.* *<u>Offshore</u>, the dry completion wells on the main field center feed directly into production manifolds, while outlying*	فردية تدفقات تجميع تركيب أنبوب متشعب ناسب مجموعات البئر استثمار تركيب التدفق برنامج مقيم معدل التدفق تغذي بعيدة متعددة الأطوار

wellhead towers and subsea installations feed via multiphase pipelines back to the production risers. Risers are a system that allows a pipeline to "rise" up to the topside structure. For floating structures, this involves a way to take up weight and movement. For heavy crude and in Arctic areas, diluents and heating may be needed to reduce viscosity and allow flow.	الرافعات الوزن الحركة قطبية تخفيض لزوجة
4.4.3 Separation	
Some wells have pure gas production which can be taken directly for gas treatment and/or compression. More often, the well produces a combination of gas, oil and water, with various contaminants that must be separated and processed. The production separators come in many forms and designs, with the classic variant being the gravity separator. Photo: JL Bryan Oilfield Equipment In gravity separation, the well flow is fed into a horizontal vessel. In gravity separation, the well flow is fed into a horizontal vessel. The retention period is typically five minutes, allowing gas to bubble out, water to settle at the bottom and oil to be taken out in the middle. The pressure is often reduced in several stages (high pressure separator, low pressure separator, etc.) to allow controlled separation of volatile components. A sudden pressure reduction might allow flash vaporization leading to instability and safety hazards.	صافي مباشرة معالجة ضغط تَوليفَة ملوثات تفصل فاصل أشكال تصاميم تقليدي الفاصل الجاذبي وِعَاء اِحْتِفاظٌ طرد فقاعات يهبط مسيطر عليه مفاجئ يسمح تَّبْخِيرُ سَّرِيعُ
4.4.4 Metering, storage and export	
Most plants do not allow local gas storage, but oil is often stored before loading on a vessel, such as a shuttle tanker taking oil to a larger tanker terminal, or direct to a crude carrier. Offshore production facilities without a direct pipeline connection generally rely on crude storage in the base or hull, allowing a shuttle tanker to offload about once a week. A larger production complex generally has an associated tank farm terminal allowing the storage of different grades of crude to take up changes in demand, delays in transport, etc. *Metering stations allow operators to monitor and manage the natural gas and oil exported from the production installation. These employ specialized meters to measure the natural gas or oil as it flows through the pipeline, without impeding its movement. This metered volume represents a transfer of ownership from a producer to a customer (or another division within the company), and is called custody*	تخزين سفينة ناقلة نفط محطة أخيرة تعتمد تفرغ مجمع مُرْتَبِط يواكب الطلب تأخير **قياس** الاستهلاك يراقب يدير تستخدم إعَاقَة نقل ملكية قياس الاستهلاك حيازة النقل تنظيم فاتورة

transfer metering. It forms the basis for invoicing the sold product and also for production taxes and revenue sharing between partners. Accuracy requirements are often set by governmental authorities. *Typically, a metering installation consists of a number of meter runs so that one meter will not have to handle the full capacity range, and associated prover loops so that the meter accuracy can be tested and calibrated at regular intervals.*	المنتج المباع ضرائب الإنتاج تقاسم الإيرادات الشركاء متطلبات الدقة تحدد السلطات الحكومية عداد يتعامل كامل طيف الطاقة الإنتاجية حلقات معاير العدادات تختبر تعاير فوصل زمنية منتظمة
2.4.5 Utility systems	أنظمة المرافق
Utility systems are systems which do not handle the hydrocarbon process flow, but provide some service to the main process safety or residents. Depending on the location of the installation, many such functions may be available from nearby infrastructure, such as electricity. Many remote installations are fully self-sustaining and must generate their own power, water, etc.	تتعامل تؤمن سلامة عملية رئيسة مقيمون اعتماداً موقع وظائف المجاورة مستديم ذاتياً

Unit 9

Second: Midstream	منتصف الطريق
Broadly defined as gas treatment, LNG production and regasification plants, and oil and gas pipeline systems.	
1 Gas Plants	
Gas processing consists of separating the various hydrocarbons and fluids from the pure natural gas to produce what is known as "pipeline quality" dry natural gas. Major transportation pipelines usually impose restrictions on the makeup of natural gas that is allowed into the pipeline. Before the natural gas can be transported it must be purified. Whatever the source of the natural gas, once separated from crude oil (if present) it commonly exists in mixtures with other hydrocarbons, principally ethane, propane, butane and pentanes. In addition, raw natural gas contains water vapor, hydrogen sulfide (H_2S), carbon dioxide, helium, nitrogen and other compounds. Associated Hydrocarbons, known as "natural gas liquids" (NGL), are used as raw materials for oil refineries or petrochemical plants and as sources of energy.	ضغط ملوثات تفصل فاصل أشكال تصاميم تقليدي الفاصل الجاذبي
2 Gas compression	

Gas from a pure natural gas wellhead might have sufficient pressure to feed directly into a pipeline transport system. Gas from separators has generally lost so much pressure that it must be recompressed to be transported. Turbine driven compressors gain their energy by using a small proportion of the natural gas that they compress. The turbine itself serves to operate a centrifugal compressor, which contains a type of fan that compresses and pumps the natural gas through the pipeline. Some compressor stations are operated by using an electric motor to turn the centrifugal compressor. *This type of compression does not require the use of any natural gas from the pipe; however, it does require a reliable source of electricity nearby. The compression includes a large section of associated equipment such as scrubbers (to remove liquid droplets) and heat exchangers, lube oil treatment, etc.*	فواصل يعاد ضغطه عَنَفَة تحصل ضاغط نابذ أجهزة غسل الغاز قطرات السائل مبادلات حرارية معالجة زَيْتُ التَشْحِيمِ
3 Pipelines	
Pipelines can measure anywhere from 6 to 48 inches (15-120 cm) in diameter. In order to ensure their efficient and safe operation, operators routinely inspect their pipelines for corrosion and defects. This is done with sophisticated pieces of equipment known as "pigs." Pigs are intelligent robotic devices that are propelled down pipelines to evaluate the interior of the pipe. Pigs can test pipe thickness, roundness, check for signs of corrosion, detect minute leaks, and any other defect along the interior of the pipeline that may either restrict the flow of gas, or pose a potential safety risk for the operation of the pipeline. Sending a pig down a pipeline is fittingly known as "pigging." *The export facility must contain equipment to safely insert and retrieve pigs from the pipeline as well as depressurization, referred to as <u>pig launchers</u> and <u>pig receivers</u>. Loading on tankers involves loading systems, ranging from tanker jetties to sophisticated single point mooring and loading systems that allow the tanker to dock and load the product, even in bad weather.*	يبلغ مقاس قطره يضمن كفؤ يفَحّص تآكل أعطال متطور خنازير أدوات روبوتية ذكية يحشر يقدر الجزء الداخلي ثخانة استدارة إشارات تسرب طفيف يحد من يمثل خطر محتمل على السلامة بما يتناسب مع الاسم خنزرة منشآة التصدير بسلام يدخل استعادة إزالة الضغط قاذفات مستقبلات الخنازير أرصفة الموانئ إرساء بنقطة واحدة يفرّغ يحمّل
4 LNG liquefaction and regasification facilities	
Natural gas that is mainly methane cannot be compressed to liquid state at normal ambient temperature. Except for special uses such as *compressed natural gas (CNG), the only practical solution to*	محيطة غاز طبيعي مضغوط يستهلك معزول حاملات

long distance gas transportation when a pipeline is not available or economical is to produce LNG at -162 °C. This requires one or more cooling stages. Cooling work consumes 6-10% of the energy to be transported. Special insulated tank LNG carriers are required for transportation, and at the receiving end, a regasification terminal heats the LNG to vaporization for pipeline distribution.	تبخير

Unit 10

Third: Downstream	
1 Refining	
Where oil and condensates are processed into marketable products with defined specifications such as gasoline, diesel or feedstock for the petrochemical industry. Refinery offsites such as tank storage and distribution terminals are included in this segment, or may be part of a separate distributions operation. *Refining aims to provide a defined range of products according to agreed specifications. Simple refineries use a distillation column to separate crude into fractions, and the relative quantities are directly dependent on the crude used. Therefore, it is necessary to obtain a range of crudes that can be blended to a suitable feedstock to produce the required quantity and quality of end products.* *During World War II, the demand for synthetic materials to replace costly and sometimes less efficient products caused the petrochemical industry to develop into a major player in modern economy. Before then, it was a tentative, experimental sector, starting with basic materials:* *<u>1. Synthetic rubbers in </u>the 1900s . 2. <u>Bakelite</u>, the first petrochemical-derived, 3. Plastic, in 1907, 4. First petrochemical <u>solvents</u> in the 1920s, 5. P<u>olystyrene</u> in the 1930s And it then moved to an incredible variety of areas: Household goods (kitchen appliances, textiles, furniture), Medicine (heart pacemakers, transfusion bags), Leisure (running shoes, computers...), Highly specialized fields like archaeology and crime detection.* *With increasing consumption and ever-increasing conventional and unconventional resources, the challenge becomes not one of availability, but of sustainable use of*	مواصفات متفق عليها عمود تقطير قطفات بترول تابع يمزج مادة أولية صناعية تركيبية تحل محل كفؤة بدائية مطاط صناعي بكاليت مذيبات مدهش لا تُصَدَّقُ بضائع منزلية منظم ضربات القلب أكياس نقل الدم وقت فراغ متخصصة جداً علم الآثار كشف الجريمة استهلاك متزايد باستمرار تحدي وفرة مستدام تأثيرات بيئية تأثيرات المناخ نجاح اقتصادي

fossil fuels in the face of rising environmental impacts, that range from local pollution to global climate effects. *The economic success of a modern refinery depends on its ability to accept almost any available crude. With a variety of processes such as cracking, reforming, additives and blending, it can provide product in quantity and quality to meet market demand at premium prices. The refinery operations often include product distribution terminals for dispensing product to bulk customers such as airports, gasoline stations, ports and industries.*	تقبل مجموعة عمليات تحطيم تهذيب كيماوى إضافات مزج طلب مُمْتازة محطات توزيع انتاج نهائية لتصريف زبائن الجملة
2 Petrochemical	
These products are chemical products where the main feedstock is hydrocarbons. Examples are plastics, fertilizer and a wide range of industrial chemicals. *Chemicals derived from petroleum or natural gas – petrochemicals are an essential part of today's chemical industry. Petrochemical plants produce thousands of chemical compounds. The main feedstock is natural gas, condensates (NGL) and other refinery byproducts such as naphtha, gasoil, and benzene. Petrochemical plants are divided into three main primary product groups according to their feedstock and primary petrochemical product:* *<u>Olefins</u> include ethylene, propylene, and butadiene. These are the main sources of plastics (polyethylene, polyester, PVC), industrial chemicals and synthetic rubber.* *<u>Aromatics</u> include benzene, toluene, and xylenes, which also are a source of plastics (polyurethane, polystyrene, acrylates, nylon), as well as synthetic detergents and dyes.* *<u>Synthesis gas (syngas)</u> is formed by steam reforming between methane and steam to create a mixture of carbon monoxide and hydrogen. It is used to make ammonia, e.g., for fertilizer urea, and methanol as a solvent and chemical intermediary. Syngas is also feedstock for other processes such as the Fischer–Tropsch process that produces synthetic diesel.*	مشتقة أساسي مادة أولية متكثفات يقسم منظفات أصبغة سماد يوريا وَسِيط ديزل صنعي

Unit 11

3 Unconventional and conventional resources and environmental effects	

As demand increases, prices soar and new conventional resources become economically viable. At the same time, production of oil and gas from unconventional sources becomes more attractive. These unconventional sources include very heavy crudes, oil sands, oil shale, gas and synthetic crude from coal, coal bed methane, methane hydrates and biofuels. At the same time, improved oil recovery (IOR) can improve the percentage of the existing reservoirs that can be economically extracted.
The crude must be upgraded in a processing plant to make lighter SynCrude with a higher yield of high value fuels. Typical SynCrude has an API of 26-30.
The diluents are recycled by separating them out and piping them back to the wellhead site. The crude undergoes several stages of hydrocracking and coking to form lighter hydrocarbons and remove coke. It is often rich in sulfur (sour crude), which must be removed.

<u>1- Extra heavy crude</u>
Very heavy crude are hydrocarbons with an API grade of about 15 or below. The most extreme heavy crude currently extracted is Venezuelan 8 API crude. If the reservoir temperature is high enough, the crude will flow from the reservoir. In other areas, such as Canada, the reservoir temperature is lower and steam injection must be used to stimulate flow from the formation. When reaching the surface, the crude must be mixed with diluents (often LPGs) to allow it to flow in pipelines.
<u>2- Tar sands</u>
Tar sands can often be strip-mined. Typically, two tons of tar sand will yield one barrel of oil. Typical tar sand contains sand grains with a water envelope, covered by a bitumen film that may contain 70% oil. Various fine particles can be suspended in the water and bitumen. This type of tar sand, and the resulting slurry is piped to the extraction plant where it is agitated and the oil skimmed from the top.
Provided that the water chemistry is appropriate (the water is adjusted with chemical additives), it allows bitumen to separate from sand and clay. The combination of hot water and agitation releases bitumen from the oil sand, and allows small air bubbles to attach to the bitumen droplets.
The bitumen froth floats to the top of separation vessels, and is further treated to remove residual water and fine solids. It

الطلب يزداد
يحلّق
قابل للتطبيق
جذابا أكثر
خام صناعي
وقود حيوي
استرجاع استرداد محسن
الطلب يزداد
يحلّق
قابل للتطبيق
جذابا أكثر
خام صناعي وقود حيوي
استرجاع استرداد محسن
يرقي يحسن خام صنعي
مردودية مخففات يعيد تدوير
يرسل بالأنابيب
يخضع تكسير هدروجيني
تحويل الفحم إلى كوك
كبريت (خام حمضي) يزيل

للغاية
حقن بخار
يحفّز

رمال اسفلتية
يستخرج كقطاعات أو أشرطة
غلاف غشاء
معلّق
وحل يرسل بالأنابيب
تَرَجْرَجَ
مَقْشُوْد

شريطة أن
مناسبة
مضافات
فقاعات
يلتصِقَ
قطرات
زبد يطفو

can then be transported and processed the same way as extra heavy crude. It is estimated that around 80% of tar sands are too far below the surface for current open-cast mining techniques. *Techniques are being developed to extract the oil below the surface. This requires a massive injection of steam into a deposit, thus liberating the bitumen underground, and channeling it to extraction points where it can be liquefied before reaching the surface. The tar sands of Canada (Alberta) and Venezuela are estimated at 250 billion barrels, equivalent to the total reserves of Saudi Arabia.* <u>*3- Oil Shale*</u> *Most oil shales are fine-grained sedimentary rocks containing relatively large amounts of organic matter, from which significant amounts of shale oil and combustible gas can be extracted by destructive distillation. Significant shale "plays" have been discovered in the last decade, such as the Marcellus in the northern US and Canada, Eagle Ford on the US east coast and Bakken in south Texas.* *Oil shale differs from coal in that organic matter in shales has a higher atomic hydrogen to carbon ratio. Coal also has an organic to inorganic matter ratio of more than 4, while oil shales have a higher content of sedimentary rock. Sources estimate the world reserves of oil shales at more than 2.5 trillion barrels.* *Oil shales are thought to form when algae and sediment deposit in lakes, lagoons and swamps where an anaerobic (oxygen-free) environment prevents the breakdown of organic matter, thus allowing it to accumulate in thick layers. These layers were later covered with overlying rock, to be baked under high temperature and pressure.* *However, the heat and pressure were lower than in oil and gas reservoirs. Shale can be strip-mined and processed with distillation. Extraction with fracturing and heating is still relatively unproven. Companies are experimenting with direct electrical heating rather than steam injection. Extraction cost is currently around $25-30 per barrel.* <u>*4- Shale gas and coal bed methane*</u> *Oil shales are also becoming an important source of shale gas, and some analysts expect that this source of natural gas can supply half of the gas consumption in the US and Canada by 2020. Shales normally do not have the required matrix permeability for the gas to be produced, and in the*	اوعية أكثر متبقي منجم مفتوح تعدين حقن ضخم يحرر إرسالها بأقنية تُسال ناعمة الحبة تحوي نسبياً معتبرة قابللة للاحتراق للاشتعال تقطير إتلافي تخريبي طرائق يكتشف يختلف نسبة يعتقد أنّه يتشكّل أشنة لاغونة مستنقع لاهوائي تمنع تحلل تفسخ تطبخ يستخرج أشرطة تَقْطِير غير مؤكّد محللون يتوقع يزود أمية نفاذية

past, gas could be produced only from source rock with significant natural fracturing. The natural gas comes from decomposition of shale oil. *and is held in natural fractures, some in pore spaces, and some adsorbed onto organic material. Recently, there have been strong advances in extraction technology, which uses a combination of horizontal wells and hydraulic fracturing in a way that maintains fracturing and flow of gas much better than before. Even so, production typically requires a high number of wells with limited lifetimes, so continuous drilling of new wells is required to maintain output. Methane is a potent greenhouse gas, and emissions from leaking capped wells and fractures is a potential problem due to the large number of wells.* *This form of production is different from oil shale gas, which is produced by pyrolysis (heating and hydrocarbon decomposition) of mined oil shale.* *Coal deposits also contain large amounts of methane, referred to as coal bed methane. The methane is absorbed in the coal matrix and requires extraction techniques similar to shale gas. Often the coal bed is flooded, so after well completion and fracturing, the coal seam (layer of coal) must be dewatered. A common solution is to extract water through the well tubing. Generally, the water needs to be pumped out and therefore control is needed to prevent the gas from entering the water in the tubing (the well becomes gassy). This reduces the pressure and allows methane to desorb from the matrix and be produced through the casing.* *5- Methane hydrates* *Methane hydrates are the most recent form of unconventional natural gas to be discovered and researched. These formations are made up of a lattice of frozen water, which forms a sort of cage around molecules of methane. Hydrates were first discovered in permafrost regions of the Arctic and have been found in most of the deep water continental shelves tested. The methane originates from organic decay. At the sea bottom, under high pressure and low temperatures, the hydrate is heavier than water and cannot escape. Research has revealed that this form of methane may be much more plentiful than first expected. Estimates range anywhere from 180 to over 5800 trillion scm. The US Geological Survey estimates that methane hydrates may contain more organic carbon than all the world's coal, oil,*	تفكك كسور طبيعية فراغات المسام مممتزة مؤخراً دمج تكسير هيدروليكي إجْمالاً زمن خرج فعّال بيت زجاجي انبثاقات تسرب مغطّاة محتملة شكل تحوّل حراريّ ميثان طبقة الفحم ممتز مغْمُور يجَفَّف يَنْزِعُ الماء حل تبطين يضخ منها ينزح يقلل يلفظ الغاز الممتص إكساء يدرس شبكة متجمدة شكل قفص جزيئات جمد سرمدي القطب رف مدروس ينشأ تحلل عضوي يهرب يكشف أغزر متوقع تقديرات تتراوح في أيّ مكان متر مكعب قياسي حداثة

and conventional natural gas – combined. However, research into methane hydrates is still in its infancy.	

Unit 12

4 Units

Some common units used in the oil and gas industry are listed here as a representative selection of US and metric units, since both are used in different parts of the oil industry. The non-standard factors differ slightly between different sources.

API	American Petroleum Institute crude grade	API = (141.5 / Specific gravity) – 131.5 Spec gravity = 141.5/(API + 131.5) kg/l
Bl	Barrel (of oil)	1 Bl = 42 Gallons 1 Bl = 159 liters 1 Bl equiv. to 5487 scf = 147 scm gas
Bpd	Barrel per day	1 Bpd ≈ 50 tons/tons per year
BTU	British thermal unit	1 BTU = 0.293 Wh = 1,055 kJ
Cal	Calorie	1 Cal = 4,187 J (Joules)
MMscf	Million standard cubic feet	1 MMscf = 23.8 TOE ≈ 174 barrels
psi	Pounds per square inch	1 psi = 6.9 kPa = 0.069 atm
Scf	Standard cubic feet (of gas) defined by energy, not a normalized volume	1 scf = 1000 BTU = 252 kcal = 293 Wh = 1,055 MJ ≈ 0.0268 scm
Scm	Standard cubic meter (of gas, also Ncm) Defined by energy content	1 Scm = 39 MJ = 10.8 kWh 1 Scm ≈ 37.33 Scf (not a volume conv.) 1 Scm ≈ 1.122 kg
TOE	Tons oil equivalent Range 6.6 - 8 barrels at API range 8 - 52	1 TOE = 1000 kg = 1 Ton (metric) oil 1 TOE = 1 Tone oil (US) 1 TOE ≈ 7.33 Barrels (at 33 API) 1 TOE ≈ 42.9 GJ =11,9 MWh 1 TOE ≈ 40.6 MMBTU 1 TOE ≈ 1.51 ton of coal 1 TOE ≈ 0.79 ton LNG 1 TOE ≈ 1,125 Scm = 42,000 Scf
kWh	Kilowatt hour = 1000 joules * 3600 S	1 kWh = 3.6 MJ = 860 kcal = 3,413 BTU

Product specific gravity, API grades

Product	Liters Per Ton (metric)	API Grade	Specific Gravity (kg/m3)	Barrels per Ton At 60°F
LPG	1835	10	1000	6.29
Jet A-1	1254	18	934	6.73
Gasoline premium/super	1353	25	904	6.98
Gasoline regular	1418	30	876	7.19
Kerosene	1273	33	860	7.33
Gas oil	1177	36	845	7.46
Diesel fuel	1159	39	830	7.60
Fuel oil 80 CST	1065	42	816	7.73
Fuel oil 180 CST	1050	50	780	8.06
Fuel oil 230 CST	1047			
Fuel oil 280 CST	1044			
Bitumen	979			

CO2 Emissions from burning of coal and hydrocarbons

Product	Average Carbon No	CO_2 kg per kg	CO_2 kg Per kWh	Other unit
Methane	1	2,75	0,178	1,92 kg CO_2 / scm
Gasoline	8	3,09	0,241	2,28 kg CO_2 / liter
Diesel	12	3,11	0,249	2,68 kg CO_2 / liter
Fuel oil	25	3,12	0,268	3,97 kg CO_2 / liter
Coal	1	3,67	0,325	

5 Glossary of terms and acronyms

ABS	Acrylonitrile-butadiene-styrene
AC	Alternating current
AGA	American Gas Association
AO	Asset optimization
API	American Petroleum Institute
BPA	Bisphenol A
BTX	Benzene, toluene and xylenes
CAPEX	Capital Expenses (Invested capital)
CCR	Central control room
CDU	Crude Oil Distillation Unit
CMMS	Computerized maintenance management system
CMS	Condition monitoring systems
CNG	Compressed natural gas
CPF	Central processing facility
CSP	Collector and separation platform
DC	Direct current
DEA	Diethanolamine
DEGBE	Diethylene glycol butyl ether
DEGBEA	Diethylene glycol butyl ether acetate
DETA	Diethylenetriamine
DPGEE	Dipropylene glycol ethyl ether.
DPGME	Dipropylene glycol methyl ether.
DYNPOS	Dynamic positioning (of rigs and ships)
E&P	Exploration and production
EDTA	Ethylenediamine tetraacetic acid
EG	Ethylene glycol
EGBE	Ethylene glycol butyl ether
EGBEA	Ethylene glycol butyl ether acetate
EO	Ethylene oxide
EOR	Enhanced oil recovery (new technology, cf IOR)
EPA	Propylene glycol ethyl ether acetate
EPS	Expanded polystyrene
ESD	Emergency shutdown system
ESP	Electric submerged pump
ETBE	Ethyl-tertiary-butyl-ether

F&G	Fire & gas system
FCC	Fluid catalytic cracking
FGS	Field gathering station
FPSO	Floating production storage and offloading
F-T	Fischer–Tropsch process
GB(S)	Gravity base structure
GE	Glycol ether
GOR	Gas oil ratio from the well
GOSP	Gas oil separation plant
GRP	Glass reinforced plastics
GTL	Gas to liquids
GTP	Gas treatment platform
HAZID	Hazard identification study
HAZOP	Hazard and operability study
HDPE	High-density polyethylene
HFC	Hydrofluorocarbons
HDS	Hydrodesulfurization (unit)
HIPPS	High integrity pressure (or pipeline) protection system
HP	High pressure
HPU	Hydraulic power unit (topside utility for subsea)
HVAC	Heat ventilation and air conditioning
IMS	Information management system
IO	Integrated operations
IOR	Improved oil recovery (using proven technology)
IPA	Isopropyl acetate
IR	Infrared
ISO	International Standards Organization
K-Mass Flow	Coriolis type sass flow meter
LDPE	Low-density polyethylene
LLDPE	Linear low-density polyethylene
LNG	Liquid natural gas (e.g., methane)
LP	Low pressure
LPG	Liquid petroleum gas
LPG	Liquefied petroleum gas (e.g., propane)
LVOC	Large volume organic chemicals
MCC	Motor control center
MEA	Monoethanolamine

MEG	Monoethylene glycol
MEK	Methyl ethyl ketone
MMA	Methyl methacrylate
MP	Propylene glycol methyl ether
MPA	Propylene glycol methyl ether acetate
MPG / USP	Pharmaceutical grade monopropylene glycol
MSDS	Material Safety Data Sheet (international: SDS)
MTBE	Methyl-tert-butyl-ether
MTBF	Mean time between failure
NAO	Normal alpha olefins or n-olefins (See alpha olefins)
NBR	Nitrile-butadiene rubber
NGL	Natural gas liquids
NGL	Natural gas liquids, condensates (see also, LPG)
OPEX	Operational expenses
PCP	Progressive cavity pump
PD-Meter	Positive displacement meter
PES	Unsaturated polyester resins
PET	Polyethylene terephthalate
PFD	Probability of failure on demand
PG	Propylene glycol
PGEE	Propylene glycol ethyl ether
PGEEA	Propylene glycol ethyl ether acetate
PGME	Propylene glycol methyl ether
PGMEA	Propylene glycol methyl ether acetate
PGP	Power generation platform
PID	Proportional integral derivate control algorithm
PIMS	Production information management system
PMMA	Polymethyl methacrylate
PO	Propylene oxide
PoC	Pump of controller (for artificial lift)
POM	Polyoxymethylene
POSMOOR	Position mooring for a floating facility
PSD	Process shutdown system
PVC	Polyvinyl chloride
ROV	Remote operated vehicle (for subsea workover)

RRF	Risk reduction factor
RTU	Remote terminal unit
SAN	Styrene-acrylonitrile
SAS	Safety and automation system
SBR	Styrene-butadiene rubber
SCADA	Supervisory control and data acquisition
SIF	Safety instrumented function
SIL	Safety integrity level (per IEC 61508)
SIRC	
SIS	Safety instrumented system
TAED	Tetraacetylethylenediamine
TAME	Tertiary-amyl-methyl-ether
TBA	Tertiary-butyl-alcohol
TDI	Toluene di-isocyanate
TEA	Triethanolamine
TEPA	Tetraethylenepentamine
TIP	Tie-in platform
TLP	Tension leg platform
UMS	Unmanned machinery space class (marine = E0)
uPES, UPR, USPE	Unsaturated polyester resins
URF	Umbilicals, risers and flowlines
UV	Ultraviolet
VAM	Vinyl acetate monomer
VCM	Vinyl chloride monomer
VDU	Vacuum distillation unit
VOC	Volatile organic compound
WHP	Well head platform
XPS	Extruded polystyrene