



Al-Mustaqbal University

College of Engineering and Engineering Technologies

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Name of the substance: Chemicals from petroleum

Lecture number: Second

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Storage and transportation of petroleum products :

Natural gas is considered one of the most difficult petroleum derivatives to store because liquefying the gas requires the use of high pressures or very low temperatures. Perhaps one of the most successful methods for natural gas is to create reservoirs. It has a similar nature to underground natural gas reservoirs .



The most important types of compounds found in crude oil are the following- :

- 1- **Paraffinic hydrocarbons** : These compounds have a general formula, C_nH_{2n+2} , and their chains are either linear, known as paraffins, or branched, which are known as isoparaffins. These compounds may be gaseous, liquid, or solid (waxy substances), depending on the chemical composition and molecular weight .

- 2- **Naphthenic hydrocarbon** : These compounds have the general formula C_nH_{2n} , which are saturated cyclic hydrocarbons consisting of five to seven carbon atoms .
- 3- **Aromatic hydrocarbons** : which have the general formula C_nH_{2n} . It has hexagonal structures
- 4- **Multiring: hydrocarbons.**: These compounds are in the form of: Polycyclic aromatic compounds or compounds.
- 5- **Olfenic hydrocarbons:** These compounds have the general formula nH_{2n} and can be either single or double-bonded. Due to the effectiveness of this class of compounds It is found in crude oil in small concentrations and its percentage can be increased by thermal solution processes.
- 6- **Sulfur compounds:** Sulfur is found in crude oil in free or combined form and in proportions that may reach 6%. The familiar sulfur compounds in crude oil are hydrogen sulfide, thiophenes, mercaptans, sulfides, and others. Oils that contain less than 0.5% of sulfur compounds are called low-sulfur oils, which are a very desirable type. Because the sulfur compounds are relatively heavy, oils containing low-sulfur compounds are known as High sulfur compounds in heavy oils.
- 7- **Oxygen compounds** : Oxygen is found in crude oil in the form of compounds such as alcohols, phenols, resins, and organic acids. A high.

Classification of petroleum

Crude oil is classified by refineries according to its base as follows:

- A- **Paraffinic-based crude oil:** This type is usually rich in waxes and lubricating oils and contains small amounts of naphthenate and asphalt, and the percentage is Oxygen, sulfur and nitrogen compounds in it are also few.

- B- **Asphalt base crudes:** This type contains a percentage of: High in bitumen, asphalt and heavy fuel oils.
- C- **Mixed base crude oil :** Characteristics of this type of crude oil Intermediate between those of paraffinic oil and asphalt-based oil. D- **Aromatic base crudes:** This type of petroleum contains It contains relatively large amounts of aromatic compounds with low molecular weights, naphthenes, and small amounts of Asphalt and lubricants.

Petroleum exploration

Many advanced devices and modern techniques are used in geological surveys to explore oil wells The most important are two types:

- 1- **Lateral measuring devices.** This method is considered one of the primary surveying methods and is based on the principle that gravity is slightly less when there are rock clusters near the surface of the Earth, as gravity increases when... Convex peaks, as for salt clusters, lead to less gravity because the density of salt is less than the density of rocks.
- 2- **Seismic survey method:** This method is conducted by opening a small hole and then generating sound waves by means of a small explosion in the seismic hole. The sound waves are monitored using audio headphones placed at different dimensions and directions. From the seismic source, the arrival time of the echo is recorded and it is studied Seismic maps can determine the locations of crude oil pools.



Drilling of petroleum well

There are two methods for drilling transmission wells:

1- *Impact type* This method involves a chisel driller attached to a steel wire moving up and down, so that the drilled parts are removed using basket-like equipment. This method is currently undesirable due to the waste of large quantities of oil that flow heavily when the drilling reaches the oil reservoir due to the effect of pressure. Internal procedure for amputation.

2- *Rotary drilling method* It is one of the preferred methods at the present time, which consists of connecting the excavator to the drive axis with the help of a drilling tower. The advantages of the rotary drilling method over the rotary drilling method are the following:

A- Its hydrostatic pressure prevents sudden flow of oil from the well

B- Its importance is in transporting the crushed rocks abroad. Thus, the drilling process continues until the oil depot is found. The rig is connected through thick pipes that reach the outside and are used for feeding and unloading. After the completion of drilling the well, complementary operations are carried out, such as lining the well with a concrete layer to prevent the well from collapsing, and the well is connected to equipment. Proper pumping and withdrawing

Evaluation of petroleum and its products

Due to the difference in petroleum components in chemical composition and because it is a mixture of different compounds, its physical properties such as color, specific gravity, viscosity, etc., and its professional properties such as the degree of ignition, flash point, etc. change accordingly. Therefore, crude oil and its derivatives are subjected to very important evaluation tests in order to deal with it or its derivatives during the filtering or Transportation or storage, or in order to determine the chemical processes to be used with crude oil to transform it into useful derivatives according to the uses assigned to it.

1. Density and Specific Gravity (API)

Density is defined as the mass of a unit volume at certain conditions of pressure and temperature and is measured in grams per cm^3 . The term specific gravity is used more widely, which is defined as the ratio of the weight of a specific volume of a substance to the weight of the same volume of water, provided that they are measured at the same temperature .



It is worth noting that the price of petroleum depends on the specific gravity, as light oils are characterized by higher prices than heavy oils because the former contain higher percentages of derivatives required in the markets, such as gasoline hydrocarbons. On the other hand, oils with light colors or colorless are characterized by higher grades of API. The medium oils are green in color, while the heavy oils are characterized by deeper colors, such as black

API Gravity Formulas:

The formula to calculate API gravity from specific gravity (SG) is:

$$\text{API gravity} = \frac{141.5}{\text{SG}} - 131.5$$

Conversely, the specific gravity of petroleum liquids can be derived from their API gravity value as

$$\text{SG at } 60^{\circ}\text{F} = \frac{141.5}{\text{API gravity} + 131.5}$$

Thus, a heavy oil with a specific gravity of 1.0 (i.e., with the same density as pure water at 60 °F) has an API gravity of:

$$\frac{141.5}{1.0} - 131.5 = 10.0^{\circ}\text{ API}$$

Using API gravity to calculate barrels of crude oil per metric ton :

In the oil industry, quantities of crude oil are often measured in metric tons. One can calculate the approximate number of barrels per metric ton for a given crude oil based on its API gravity:

$$\text{barrels of crude oil per metric ton} = \frac{\text{API gravity} + 131.5}{141.5 \times 0.159}$$

For example, a metric ton of West Texas Intermediate (39.6° API) has a volume of about 7.6 barrels.

2- viscosity

The viscosity of a liquid is defined as the resistance that layers of a liquid exhibit to others as it passes through a capillary tube at a certain temperature and pressure. Viscosity is an important physical property for many petroleum products, especially oils and lubricants. Its appointment is considered essential for crude oil before derivatives can be made It includes solidification and chemical processes

The viscosity of crude oil depends greatly on its content of gases dissolved in it and its temperature. When both the gaseous content and temperature increase, the viscosity decreases. The temperature of the ground layers varies according to their depth from the surface of the Earth, and the rate of this variation varies from one location to another, but in general this change is by an amount 6 per 30 metres. Due to the change in viscosity with temperature, this means that the viscosity of oil in rocky reservoirs below the surface of the earth increases as the depth of the well increases. Knowing this information about the raw points is very important to facilitate the process of extracting oil.



3- Flash point

It is the lowest temperature at which the vapor of a petroleum derivative burns when exposed to a flame. This characteristic is considered one of the very important characteristics in terms of choosing the most appropriate conditions in terms of safety for storing, transporting and using various petroleum derivatives. Several types of flash point measuring devices are used depending on the volatility of the petroleum derivative to be tested. For

example, it is used with kerosene and other solvents that have a flash point of less than 85 C. Closed-gap devices follow the international testing method ASTM D56. For fuel oils and similar derivatives, the Pensky Martens method is used. Closed gap according to ASTM 93 method. As for lubricating oils and similar derivatives that have flash points higher than 85 C, the method is used. 3534 Cleveland open cup, according to ASTM D92 9 4.

4- Pour point

The spill point is used to determine the concentration of paraffinic or aromatic substances in crude oil, and whenever it is This high degree had a large percentage of paraffin wax .

5- Burning point

It represents the lowest temperature at which volatile vapor from a petroleum derivative in an open vessel continues to burn. When ignited by a flame source placed near the surface of the liquid .

6- Cetane number and Cetane index

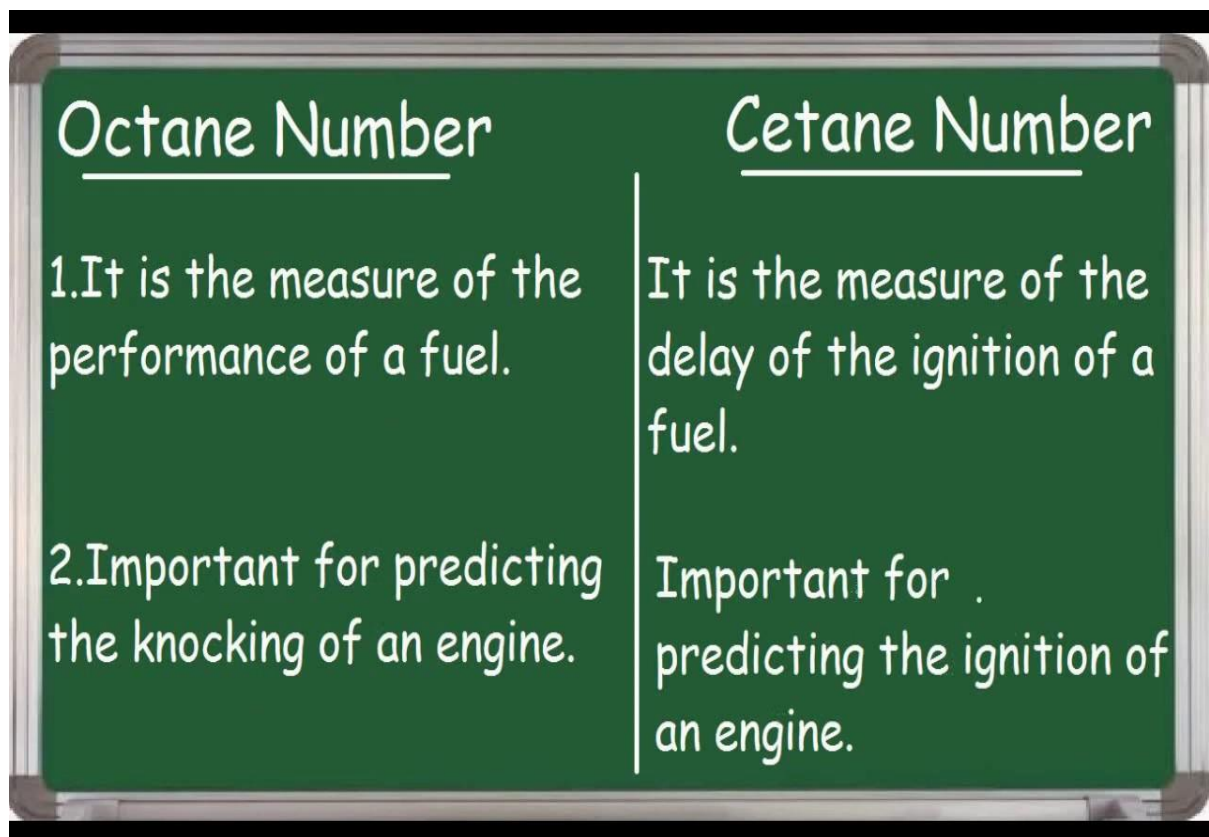
Cetane number is a term used to express the combustion quality of diesel fuel. This number represents the volumetric percentage of cetane (Cheba) that must be mixed with alpha-methylnaphthalene in a standard fuel to give the same combustion efficiency as the fuel under examination. This number is measured under standard conditions and according to the ASTM D613 test method. As for the cetane factor, it means the arithmetic factor by which the cetane number can be calculated from other characteristics.

This examination is considered one of the standard methods used in many oil refineries to ensure that the petroleum derivative is free of sulfur compounds such as mercaptans, especially for some derivative solvents. Oil and jet fuel from fuel. This examination is conducted using a mixture of lead oxide and sodium hydroxide, which is in the form of basic sodium lead (Alkaline sodium plumbite). This solution is used in some operations Desalination,

where odor-causing impurities such as mercaptans are converted into less odorous disulfide derivatives And to remove free sulfur .

7- *Octane number*

A special characteristic of gasoline, which is the characteristic of early combustion or what is known as the anti-cracking property In internal combustion engines The octane number is an indicator of the crackles that may occur in a car engine during combustion



<u>Octane Number</u>	<u>Cetane Number</u>
1.It is the measure of the performance of a fuel.	It is the measure of the delay of the ignition of a fuel.
2.Important for predicting the knocking of an engine.	Important for predicting the ignition of an engine.

Primary crude oil treatment

Crude oil contains a number of inorganic impurities that must be identified and removed before filtering operations are carried out due to their negative effects. For example, the presence of table salt and other chlorides in high proportions may interact with the water

under the surface. Suspended materials, sand impurities, and clay deposits are removed by leaving the crude oil in tanks known as stagnation tanks, where it is separated from the crude oil. As for salts, they are removed in a way known as desalting 7 of 42
Desalting: where salts are removed in two ways

1- ***Chemical desalting method:*** This method is done by adding water to the crude oil heated to a temperature ranging between 95-150 degrees Celsius at a rate ranging between 6-15% under an appropriate pressure sufficient to prevent its evaporation. Then the mixture is emulsified, thus the salt moves to the aqueous phase. This is followed by the process of evaporating the emulsion with the help of some chemical additives, so that the salt-saturated water phase separates to get rid of it .

2- ***Electrical desalting method:*** This method includes adding 4-10% of water, emulsified under pressure at a temperature ranging between 70-150 degrees Celsius. Then the mixture is emulsified by adding an Emulsifying agent. Then the emulsified mixture is passed into a high-voltage electrostatic field, and the effective field causes it to aggregate. Salt impurities in the aqueous phase. At the same time, the applied field affects the aqueous phase to agglomerate and thus it can be separated. As for the salt-free oil, it flows to distillation units .