



**Ministry of Higher Education and Scientific
Research Al-Mustaqbal University College**

**Department of Chemical Engineering and
petroleum Industrials**

Properties of crude oil

2nd Stage

Lecturer: Dr. Duaa Alwarid


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Classification of Crude Oil

Appreciable property differences appear between crude oil as a result of the variable ratios of the crude oil components. For are refiner dealing with crudes of different origins, a simple criterion maybe established to group crudes with similar characteristics.

Crude oil scan be arbitrarily classified into three or four groups depending on the relative ratio of the hydrocarbon classes that predominates in the mixture.

The following describes three types of crudes:

1. Paraffinic—the ratio of paraffinic hydrocarbons is high compared to aromatics and naphthenes.
 2. Naphthenic—the ratios of naphthenic and aromatic hydrocarbons are relatively higher than in paraffinic crudes.
 3. Asphaltic—contain relatively a large amount of polynuclear aromatics, a high asphaltene content, and relatively less paraffins than paraffinic crudes.
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Classification of Crude Oil

A division according to the chemical composition of the 250-300°C (480-570F) fraction has also been suggested.

Paraffin wax refers to a mixture of alkanes that falls within the $20 \leq n \leq 40$ range; they are found in the solid state at room temperature and begin to enter the liquid phase past approximately 37 °C.

Table 3.1. Classification by Chemical Composition (Adapted from Speight, 1999)

Composition of 250–300°C (480–570°F) fraction					Crude Oil Classification
Paraffinic %	Naphthenic %	Aromatic %	Wax %	Asphalt %	
>46, <61	>22, <32	>12, <25	<10	<6	Paraffinic
>42, <45	>38, <39	>16, <20	<6	<6	Paraffinic-naphthenic
>15, <26	>61, <76	>8, <13	0	<6	Naphthenic
>27, <35	>36, <47	>26, <33	<1	<10	Paraffinic-naphthenic-aromatic
<8	>57, <78	>20, <25	<0.5	<20	Aromatic

Difficulties arise in using such a classification in that in the fractions boiling above 200°C (390°F) the molecules can no longer be placed in one group because most of them are of a typically mixed nature.

Purely naphthenic or aromatic molecules occur very seldom; cyclic compounds generally contain paraffinic side chains and often even aromatic and naphthenic rings side by side.

Classification of Crude Oil

The petroleum industry generally classifies crude oil by the:

1. Geographic location:

The geographic location is important because it affects transportation costs to the refinery.

It is always referred to the geographical location of an crude oil to identify it, such as West Texas intermediate, Brent, Oman

2. API gravity:

The American Petroleum Institute Gravity (API gravity), is a measure of how heavy or light a petroleum liquid is compared to water.

$$API\ gravity = \frac{141.5}{Sp.gr} - 131.5$$

Petroleum is lighter than water and floats: API gravity > 10

Petroleum is heavier than water and sinks: API gravity < 10

According to API, crude oil can be classified to:

- Light Crude Oil > 31
- Mixed Based 22-31
- Heavy crude < 22

Light crude oil is more desirable than heavy oil since it produces more yield of gasoline and diesel fuel. It is usually rich in low-boiling points constituents.

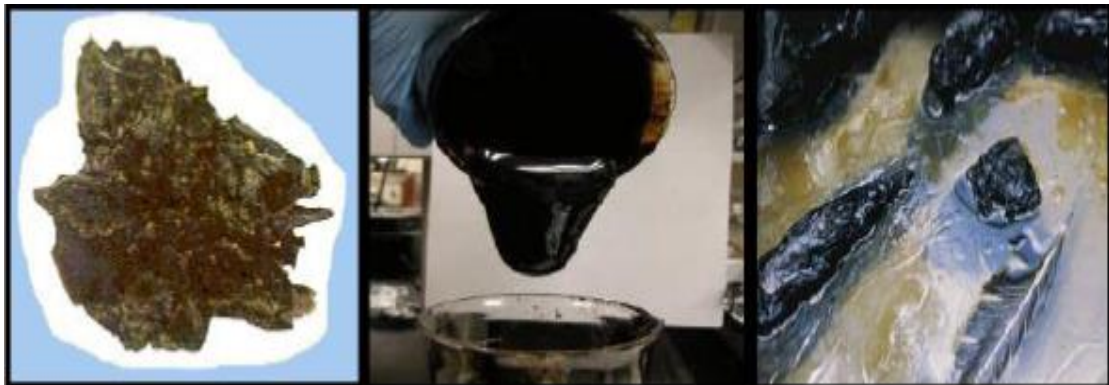
Light crude oil has low viscosity due to the presence of high proportion of light hydrocarbon fractions.

Furthermore light crude oil flows freely at room temperature and contains low waxy content

The most famous light crude oil is West Texas Intermediate with 39.6° API (827 kg/m³), Brent Crude 38.06° API (835 kg/m³) and Dubai Crude 31° API (871kg/m³),

Heavy oil is a complex mixture that does not flow easily.

Heavy oil is asphaltic and contains asphalts and resins. It is heavy and viscous due to the high ratio of aromatic and naphthenic to paraffin and high amount of nitrogen, sulfur, oxygen and heavy metals.



Measuring crude oil

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:

$$\text{Barrels of crude oil per metric ton} = 1 \div \left[\frac{141.5}{\text{API gravity} + 131.5} \times 0.159 \right]$$

The standard barrel (bbl) of crude oil or other petroleum product is 42 Us Gallons (34.9734 imp gal; 158.9873 L).

In other industries , fish barrels, beer barrel are used which is equivalent to 40 US gallons, while in petroleum industry 42 US gallon is used as a standard to get abbreviation of **bbl**.

3. Sulfur Content:

Crude oil may referred as sweet and sour crude oils.

Sweet crude oil contains relatively little sulfur amount (< 0.5 wt%) while sour crude oil contains considerable amounts of sulfur.

Sweet oils commands a higher price than sour oil because it has fewer environmental problems and requires less refining to meet standard sulfur content in fuels.

Within any given crude oil, sulfur concentration tends to increase gradually with increasing carbon number.

Most sour crudes have sulfur levels in the range of 1.0–2.0 wt%, but some have sulfur levels > 4 wt%.

Why West Texas Intermediate (WTI) is cheaper than Brent?

Both are the two major benchmarks for oil prices. However they are light sweet crude oils, but WTI is generally sweeter and lighter.

WTI supplied to American Midwest while Brent supplied to Europa. There is a glut in the amount of crude oil going to refineries in the Midwest due to an increased supply from Canada and North Dakota's Bakken Shale. This makes the WTI cheaper than the Brent.

4. Classification of crude oil by Correlation Index (CI):

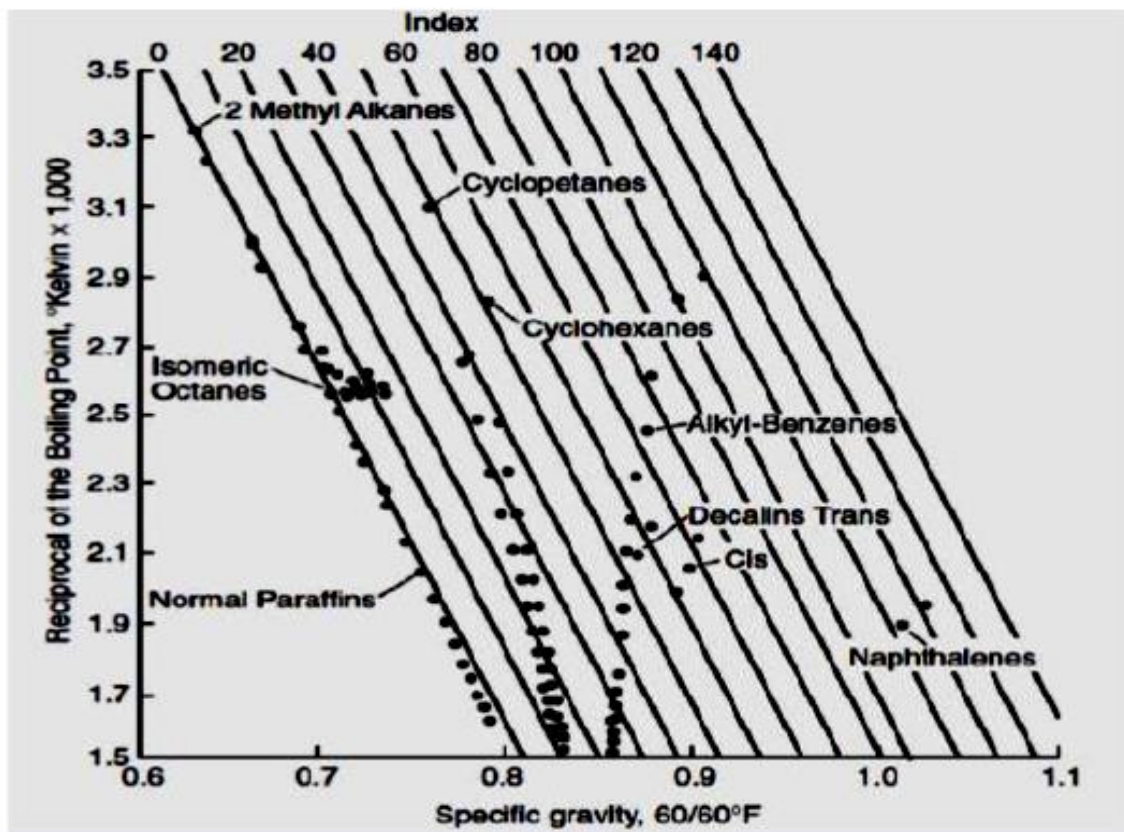
A correlation index is a useful criterion for indicating the crude class or type. The following relationship between the mid-boiling point in Kelvin degrees ($^{\circ}\text{K}$) and the specific gravity of a crude oil or a fraction yields the correlation index (Bureau of Mines Correlation index).

$$\text{BMCI} = 48,640 / K + (473.6d - 456.8)$$

K = mid-boiling point in Kelvin degrees (Mid-boiling point is the temperature at which 50 vol % of the crude is distilled.)

d = specific gravity at 60/60 $^{\circ}\text{F}$

The correlation index is based on the plot of specific gravity versus the reciprocal of the boiling point in degrees Kelvin.



For pure hydrocarbons, the line described by the constants of the individual members of the normal paraffin series is given a value of $CI = 0$.

Parallel line passing through the point for the values of benzene is given as $CI = 100$

Values for the index between 0 and 15 indicate a predominance of paraffinic hydrocarbons in the fraction.

A value from 15 to 50 indicates predominance of either naphthenes or mixtures of paraffins, naphthenes, and aromatics.

An index value above 50 indicates a predominance of aromatic species.